Real-World Usage of Educational Media Does Not Promote Parent–Child Cognitive Stimulation Activities

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ABSTRACT

OBJECTIVE: To determine whether educational media as actually used by low-income families promote parent–child cognitive stimulation activities.

METHODS: We performed secondary analysis of the control group of a longitudinal cohort of mother–infant dyads enrolled postpartum in an urban public hospital. Educational media exposure (via a 24-hour recall diary) and parent–child activities that may promote cognitive stimulation in the home (using StimQ) were assessed at 6, 14, 24, and 36 months.

RESULTS: Data from 149 mother–child dyads, 93.3% Latino, were analyzed. Mean (standard deviation) educational media exposure at 6, 14, 24, and 36 months was, respectively, 25 (40), 42 (58), 39 (49), and 39 (50) minutes per day. In multilevel model analyses, prior educational media exposure had small positive relationship with subsequent total StimQ scores ($\beta = 0.11$, $P = .03$) but was nonsignificant ($\beta = 0.08$, $P = .09$) after adjusting for confounders (child: age, gender, birth order, noneducational media exposure, language; mother: age, ethnicity, marital status, country of origin, language, depressive symptoms). Educational media did predict small increases in verbal interactions and toy provision (adjusted models, respectively: $\beta = 0.13$, $P = .02$; $\beta = 0.11$; $P = .03$). In contrast, more consistent relationships were seen for models of the relationship between prior StimQ (total, verbal interactions and teaching; adjusted models, respectively: $\beta = 0.20$, $P = .002$; $\beta = 0.15$, $P = .006$; $\beta = 0.20$, $P = .001$) and predicted subsequent educational media.

CONCLUSIONS: Educational media as used by this sample of low-income families does not promote cognitive stimulation activities important for early child development or activities such as reading and teaching.

KEYWORDS: children; cognitive stimulation; educational media

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WHAT'S NEW

Educational media as used by this sample of low-income families does not promote overall cognitive stimulation activities in the home important for early child development or activities such as reading and teaching.

STARTING FROM THE 1970s-era educational programs for school-aged children have been found to improve children's development and school readiness.[1–4] However, in infants and toddlers, the benefits of such programming have not been well established.[5] There are 2 mechanisms by which education media may be beneficial. One mechanism is through a direct impact on learning. Educational programming has been shown to facilitate learning early literacy skills (such as letters and numbers) in older children.[1] Another mechanism by which educational programming has been hypothesized to enhance development is through increased parent–child cognitive stimulation activities.[6,7] Laboratory studies suggest that media with educational-type content may potentiate the interaction during play.[6] Exposure to educational media may motivate the parent to do more teaching—for example, read more children's books or find activities that teach concepts related to constructs taught in the programming, such as labeling.[6] However, the degree to which this actually takes place in the real world is presently unknown. Understanding the extent to which such a relationship exists would help inform recommendations regarding educational media exposure in early childhood.

There are a number of gaps in prior studies assessing interrelationships between educational media and cognitive stimulation in early childhood. Experimental studies have

supported a causal relationship,[6,7] but these studies have been limited in that they have tested specially designed programs under laboratory conditions and therefore are not reflective of actual media usage. In contrast, observational studies of actual media usage have not supported a strong association between exposure to educational media and parent–child cognitive stimulation activities.[8,9] However, these have been limited by cross-sectional designs precluding analyses of possible directionality. The lack of evidence of causal relationships in the context of actual media usage is significant given claims of benefit.[10] Furthermore, the potential for complex relationships between educational media exposure and parent–child cognitive stimulation activities has been understudied. For example, while it is possible that educational programming leads to cognitive stimulation activities, it is also possible that parents who already engage in these activities also provide educational media for their children for further enrichment.[11] Finally, there has been limited study of these relationships for children in low-income families, who are at high risk for adverse child developmental outcomes due to reduced cognitive stimulation activities,[12,13] concomitant with greater levels of media exposure.[14]

To address these gaps, we analyzed the relationship between educational media exposure and cognitive stimulation activities utilizing data from a cohort of young children from low-income households followed from birth to 36 months. This data set contained multiple observations of educational media exposure and cognitive stimulation, and it therefore provided an opportunity to examine concurrent and predictive relationships between our 2 study variables, considering each in turn as an independent and dependent variable. To the extent that educational media exposure predicted subsequent cognitive stimulation, our study would support a mechanism by which educational programming might promote early child development. To the extent that cognitive stimulation activities predicted subsequent educational media exposure but not vice versa, our study would suggest that previously identified increases in cognitive stimulation activities found during experimental study of educational media may not accurately reflect the relationship between actual media usage and these activities in low-income families.

METHODS

STUDY DESIGN

We performed a secondary analysis of mother–infant dyads that had been enrolled onto the Bellevue Project for Early Language, Literacy and Education Success (BELLE Project), a randomized, longitudinal study assessing the role of primary care interventions in promoting child development.[15] Our primary study variables were educational media exposure and home cognitive stimulation, which were assessed at 6, 14, 24, and 36 months. We obtained written informed consent from parents before participation. Approval for the study was obtained from the New York University School of Medicine institutional review board and from Bellevue Hospital Center and the New York City Health and Hospitals Corporation.

STUDY POPULATION

Enrollment of consecutive eligible mother–infant dyads in the BELLE Project was performed in the postpartum unit of Bellevue Hospital Center, New York City, an urban public hospital serving a predominantly Latino and low-income population from November 2005 to October 2008. Consecutive mother–newborn dyads who planned to receive pediatric primary care at our institution and who met other criteria were enrolled. Inclusion criteria included full-term birth at 37 weeks or more, birth weight of 2500 g or more, singleton gestation, mother as primary caregiver, ability to maintain contact (working phone and intention to remain in geographic proximity), and primary language of English or Spanish. Exclusion criteria included significant complications requiring extended stay in the hospital after birth, transfer to a level II/III nursery, and potential adverse developmental consequences. One additional criterion for inclusion in this analysis was that the family had been assigned to the control arm of the BELLE trial because of previous findings that one of the parenting interventions under study (Video Interaction Project) reduced media exposure and enhanced parent–child interactions.[15,16]

STUDY VARIABLES AND ASSESSMENTS

EDUCATIONAL MEDIA EXPOSURE

We assessed electronic media exposure in the home at 6, 14, 24, and 36 months of age with a 24-hour recall diary based on an interview with the mother.[17] Mothers were asked to provide information about all electronic media (television, videos/DVDs, movies, and video games) to which the infant had been exposed on the most recent typical day, including name and duration (in minutes) of each program. All programs for which the infant was present and awake, from the infant's awakening in the morning until going to sleep for the night, were included in the definition of media exposure. This included programming that was watched by the child (in the foreground) or not attended to (in the background).

Program content was categorized as educational utilizing a previously developed system[9,17] based on industry rating systems and consumer media Web sites (TV Parental Guidelines,[18] TV Guide,[19] and the Motion Picture Association of America[20]). These programs consisted primarily of programming with educational content intended for children ages 2 to 6 years. Examples include *Sesame Street* and *Blue's Clues*. In addition, media marketed as infant directed and educational (eg, *Baby Einstein* and *Brainy Baby*) were also included. However, there was limited exposure to this type of programming.

HOME COGNITIVE STIMULATION

Parent–child activities that may promote cognitive stimulation in the home was assessed at 6, 14, 24, and 36 months of age with StimQ, which is conducted with a structured

interview with the child's mother.[21] StimQ is validated for use in low-socioeconomic-status populations in Spanish and English and correlates with the Home Observation for Measurement of the Environment inventory.[22] It has good internal consistency (Cronbach's $\alpha = 0.88$) and test–retest reliability (intraclass correlation coefficient = 0.93).

StimQ consists of 4 subscales, which are summed together for a total score. StimQ measures cognitive stimulation activities in the home and the verbal interactions taking place within those activities and during daily routines. The StimQ does not assess quality but quantifies high-quality interactions. Parental Verbal Responsivity (PVR) assesses parent–child verbal interactions such as talking while feeding and making sounds together. Parental Involvement in Developmental Advance (PIDA) assesses parent teaching activities such as naming body parts, stacking blocks, or basic arithmetic. Reading (READ) assesses the number and diversity of books read to the child, frequency of reading activities, and associated interactions. Finally, Availability of Learning Materials (ALM) assesses the degree to which the parent plays with the child using toys and other learning materials in the home. The infant version (StimQ-I) was used at 6 months, the toddler version (StimQ-T) at 14 and 24 months, and the preschool version (StimQ-P) at 36 months. In order to compare scores between age groups, we used *z* scores for analyses, calculated at each time point based on the mean and standard deviation for the sample. This enabled us to examine changes over time relative to other study subjects in the context of the constructs under study.

Control Variables

Sociodemographic data collected about the child included age, gender, and birth order. Additionally, child exposure to noneducational media was collected and categorized as described above for educational media. Noneducational young child–directed programs consisted of programming intended for children 2 to 6 years old without educational content (eg, *The Rugrats*). Because children who have more language may have more parent–child verbal interactions in the home, child language was included as a control variable. Child language was assessed at 14 and 24 months old using the Preschool Language Scale-4 (PLS-4)[23] and at 36 months using the Clinical Evaluation of Language Fundamentals—Preschool-2 (CELF-Preschool-2).[24]

Mother's information included age, ethnicity (self-identified), marital status, country of origin, education level, and language of interview. We also assessed for maternal depressive symptoms using the Patient Health Questionnaire-9 (PHQ-9)[25] at 6 and 14 months and the Center for Epidemiologic Studies Depression Scale (CES-D)[26] at 24 and 36 months.

Statistical Analysis

The analytic sample included all subjects who had observations available for at least one primary analysis. We performed a descriptive analysis of the sample with means, standard deviations, and frequencies of the study and control variables. Differences between the analytic sample and those not included in analysis were assessed with *t* and chi-square tests.

Before performing primary analyses, we first assessed whether there were overall associations between educational media exposure and cognitive stimulation by performing correlations between aggregated variables not accounting for either directionality or time. For these analyses, we performed Pearson correlations between StimQ (overall and subscales) and educational media exposure, each calculated as an average over the 6- to 36-month period, and including all families with at least 2 observations.

To address our primary study aims, we used multilevel models (MLM) with time-lagged study variables as our primary analytical method. Outcomes at 14, 24, and 36 months were predicted by observations at 6, 14, and 24 months, respectively. Analyses were performed in both directions, with: 1) home cognitive stimulation (StimQ) as the outcome and educational media exposure as the time-lagged predictor; and 2) educational media exposure as the outcome and home cognitive stimulation as the time-lagged predictor. We chose this approach because of its potential for providing support for causal relationships by demonstrating a chronological and directional relationship.[27] Separate analyses were performed for StimQ total score and each of the StimQ subscale scores. Each MLM was performed utilizing both a model adjusted solely by age (model 1), an adjusted model including the control variables child's age, gender, and birth order, exposure to noneducational media (minutes) and mother's age, ethnicity, marital status, country of origin, educational level, language of interview, and depressive symptoms (model 2). Last, an adjusted model including all control variables and child language (model 3) was performed. MLM coefficients were calculated as standardized βs. Because the distribution of media exposure was positively skewed, analyses of media exposure were performed using square-root transformations in order to better normalize the distribution of the residuals during modeling, a method that has been used previously for media data.[28] All tests were performed with commercially available software (STATA 12, StataCorp, College Station, Tex; and SPSS 22 IBM SPSS, Chicago, Ill).

Results

Study Sample

Enrollment for the BELLE Project has been described previously.[15] A total of 225 enrolled mother–infant dyads were assigned to the control arm of the study. The analytic sample consisted of 149 dyads (66.2%) with observations available for at least one primary analysis. Descriptive data are shown in Table 1. The majority of the sample mothers were Latino and born outside the United States, with education below the high school level. Mean educational media exposure was 25 minutes per day at 6 months

Table 1. Descriptive Data (n = 149)

Characteristic	Value
Mother	
Age, y, mean (SD)	28 (6.7)
High school graduate	56 (37.6)
Non-US born	131 (87.9)
Latino	139 (93.3)
Single	21 (14.1)
Interviewed in Spanish	131 (87.9)
Depressive symptoms at any assessment	57 (38.3)
Child	
Female gender	70 (47.0)
Firstborn	57 (38.3)

Data are presented as n (%) unless otherwise indicated.

and approximately 40 minutes per day at each of the subsequent assessments (Table 2). The majority of this exposure was media in the foreground that was programming watched by the child (eg, 23.5 watched out of 25.6 minutes at 6 months, 37.8 watched out of 38.8 minutes at 36 months). Mean noneducational media exposure was approximately 9 minutes per day at the 6-, 14-, and 24-month assessments and 15 minutes per day at the 36-month assessments. The analytic sample differed from those not included in the analysis (n = 76) by being more likely to be Hispanic/Latino ($P = .003$), non-US born ($P = .004$), Spanish interviewed ($P < .001$), and less likely to have completed high school ($P = .01$). Those not included in the analysis were excluded because of the lack of having 2 repeated observational measurements. However, there was no difference in maternal age, marital status, depressive symptoms, child's gender, or birth order.

StimQ and Educational Media Analyses

Pearson correlations were calculated between aggregated educational media exposure and aggregated StimQ (Table 3). In these analyses, StimQ and educational media exposure were found to be positively associated ($r = 0.29$; $P < .001$). StimQ subscales of PVR ($r = 0.26$; $P = .001$), Parental Involvement in Developmental Advancement ($r = 0.22$; $P = .008$), and READ ($r = 0.24$; $P = .003$) were also found to be positively correlated with educational media exposure. Availability of Learning Materials was the only subscale that was not associated with educational media ($P = .20$).

MLM analyses of educational media predicting StimQ and its subscales are shown in Table 4. Lagged educational media exposure significantly predicted StimQ in model 1 ($\beta = 0.11$; $P = .03$). This effect size was small and became nonsignificant after adjustment for control variables in model 2 ($\beta = 0.08$; $P = .10$) and for control variables and child's language in model 3 ($\beta = 0.08$; $P = .09$). Lagged educational media exposure predicted PVR (models 2 and 3; $\beta = 0.13$; $P = .02$) and ALM (models 2 and 3; $\beta = 0.11$; $P = .03$) after adjusting for covariates. However, PIDA and READ were not significantly predicted in any of these models.

MLM analyses of StimQ predicting educational media exposure are shown in Table 5. Lagged StimQ predicted educational media exposure in all models (models 2 and 3; $\beta = 0.20$; $P = .002$). Lagged PVR (models 2 and 3; $\beta = 0.15$; $P = .006$) and lagged PIDA (models 2 and 3; $\beta = 0.20$; $P = .001$) were also significant predictors of educational media exposure in both models. READ and ALM were significant predictors in model 1 analyses but became nonsignificant after full adjustments in models 2 and 3.

Table 2. Media Exposure by Age and Category (n = 149)

Age, mo	n (%)	Educational Exposure, min/d, Mean (SD)	Noneducational Media Exposure, min/d, Mean (SD)
6	134 (89.9)	25.6 (40.1)	8.7 (24.0)
14	111 (74.5)	41.8 (57.7)	9.3 (23.4)
24	144 (96.6)	39.4 (49.5)	9.1 (21.9)
36	147 (98.7)	38.8 (49.8)	15.2 (34.7)

Table 3. Pearson Correlation Coefficients of Mean Educational Media Exposure With Mean StimQ and Subscales (n = 148)

Scale	Correlation Coefficient	*P*
StimQ	0.29	<.001
PVR	0.26	.001
PIDA	0.22	.008
READ	0.24	.003
ALM	0.11	.20

ALM indicates Availability of Learning Materials; PIDA, Parental Involvement in Developmental Advance; PVR, Parental Verbal Responsivity; and READ, reading activities.

Discussion

This study showed that educational media as presently used by low-income families does not robustly promote changes in parent–child cognitive stimulation activities in the home that is important for early child development. Aggregate analysis revealed a concurrent association between educational media and cognitive stimulation during the infant and toddler period. However, MLM analyses showed that educational media exposure was associated with only small increases in cognitive stimulation, and only within limited domains. In contrast, somewhat larger associations were found between cognitive stimulation and subsequent educational media exposure, suggesting that the possibility that an underlying factor related to support for child development may be driving the association. Findings therefore do not support the idea that educational media promotes cognitive stimulation in the real world. This may have implications for policy makers interested in enhancing early child development by encouraging cognitive stimulating activities such as reading aloud and playing.

To our knowledge, this study is the first to longitudinally examine the relationship between educational media and the cognitive home environment across the early childhood period in high-risk infants and toddlers. Prior studies of this relationship, using observational and experimental methodologies, have shown mixed results or have had limitations

Table 4. StimQ and Subscales, as Predicted by Lagged Educational Media Exposure (n = 147)

	Model 1*			Model 2†			Model 3‡		
Scale	β (SE)	Obs	*P*	β (SE)	Obs	*P*	β (SE)	Obs	*P*
StimQ	0.11 (0.05)	302	.03	0.08 (0.05)	298	.10	0.08 (0.05)	292	.09
PVR	0.12 (0.06)	306	.03	0.13 (0.06)	302	.02	0.13 (0.05)	296	.02
PIDA	0.08 (0.06)	305	.15	0.07 (0.06)	301	.19	0.06 (0.06)	295	.24
READ	0.05 (0.05)	306	.39	0.00 (0.05)	302	.97	-0.00 (0.05)	296	.99
ALM	0.12 (0.05)	303	.02	0.11 (0.05)	299	.03	0.11 (0.05)	293	.03

β indicates standardized coefficient; ALM, Availability of Learning Materials; Obs, observations; PIDA, Parental Involvement in Developmental Advance; PVR, Parental Verbal Responsivity; READ, reading activities; and SE, standard error.

*Adjusted for child's age.

†Adjusted for child's age, gender, and birth order, exposure to noneducational media (minutes) and mother's age, ethnicity, marital status, country of origin, educational level, language of interview, and depressive symptoms.

‡Adjusted for all above confounders and child's language.

precluding firm conclusions. While observational studies have shown reduced cognitive stimulation in association with increased total exposure, many of these studies have either not specifically assessed exposure to educational media[29] or have not included multiple assessments over time.[8,9] A number of experimental studies have demonstrated clear reductions in parent–child interactions during both educational exposure and general television exposure.[30–32] Two experimental studies have indicated an enhancement in parent–child interaction during educational media exposure, with an increase in the number of new words per minute[7] and the quality of language[6]; however, both studies also found a decrease in the overall quantity of spoken words. Furthermore, both studies were conducted with programs specifically designed to increase parent–child interactions (eg, *Sesame Beginnings*), which may not be representative of the types of educational media watched at home. Thus, the methodologies utilized in experimental studies do not allow for the determination of whether real-world usage of educational media enhanced parent–child interactions over time. Our study therefore addresses an important gap in this body of research.

Although our results do not support a robust effect by educational media on cognitive stimulation, small but significant positive effects were observed on verbal responsivity and the availability of learning materials. The effects on PVR specifically are consistent with the 2 experimental studies that support an enhancement in parent–child verbal interactions with educational media exposure.[6,7] However, the literature lacks comparative study on parent–child teaching activities (PIDA), reading activities (READ), and the availability of learning materials (ALM). It is not entirely clear why educational media exposure would increase how effectively parents verbally respond to their child (PVR) but not necessarily increase the amount of parents teaching activities (PIDA) or reading activities (READ). The role of educational media is therefore likely to be complex with multiple possible mechanisms of effect on parent–child interactions and overall child development. Without further study, our results are small positive effects by educational media on cognitive stimulation in infants and toddlers, but only within limited domains. The latest American Academy of Pediatrics (AAP) guidelines regarding young children recommend avoid using digital media (except for video chatting) in children younger than 18 months.[33] The AAP suggests that if media is viewed, higher-quality educational media should be encouraged together with parent–child verbal interactions.

In contrast, our study showed that parental cognitive stimulation is associated with subsequent increases in educational media exposure. One possible explanation is that parents observe advances in their child's development and attribute them to activities such as talking and

Table 5. Educational Media Exposure, as Predicted by Lagged StimQ and Subscales (n = 149)

	Model 1*			Model 2†			Model 3‡		
Outcome	β (SE)	Obs	*P*	β (SE)	Obs	*P*	β (SE)	Obs	*P*
Lagged StimQ	0.25 (0.06)	303	<.001	0.20 (0.06)	299	.001	0.20 (0.07)	293	.002
Lagged PVR	0.17 (0.06)	305	.003	0.15 (0.06)	301	.006	0.15 (0.06)	295	.006
Lagged PIDA	0.19 (0.06)	304	.001	0.20 (0.06)	300	.001	0.20 (0.06)	294	.001
Lagged READ	0.13 (0.06)	306	.04	0.07 (0.06)	302	.27	0.06 (0.06)	296	.333
Lagged ALM	0.12 (0.06)	305	.05	0.08 (0.06)	301	.18	0.07 (0.06)	295	.237

β indicates standardized coefficient; ALM, Availability of Learning Materials; Obs, observations; PIDA, Parental Involvement in Developmental Advance; PVR, Parental Verbal Responsivity; READ, reading activities; and SE, standard error.

*Adjusted for child's age.

†Adjusted for child's age, gender, and birth order, exposure to non-educational media (minutes) and mother's age, ethnicity, marital status, country of origin, educational level, language of interview, and depressive symptoms.

‡Adjusted for all above confounders and child's language.

teaching,[34] leading them to pursue additional opportunities to enhance development,[35] and the provision of materials related to the child's interests.[36] It is possible that provision of educational media could be taking place in a similar fashion. Empirically, parents are drawn to the potential educational benefits of media, as one study found that 75% of the top 100 selling baby DVDs make educational claims.[10] Therefore, it is possible that parental cognitive stimulation reinforces parental efforts to obtain developmentally stimulating material such as educational media.

Our study has a number of important limitations. First, we classified programming as educational with industry standards and consumer media Web sites, which are based on Federal Communications Commission regulations but are not related to any objective or scientific assessment of educational value. Furthermore, only some educational programming is specifically designed to enhance parent–child interactions, and such programming was not the focus of our study. Second, this study preceded the extensive use of new types of interactive media in the context of emerging digital platforms and applications, which has rapidly evolved over the past 5 years. While these findings apply to television and video programming that was watched in formats that included mobile devices such as tablets and smartphones, these results do not apply to interactive media such as games and apps. Third, media exposure data were collected with 24-hour diaries, which are subject to recall bias. Finally, we enrolled subjects from a low-income, predominantly Hispanic/Latino immigrant population. Children from Hispanic families are exposed to more television than white families, and exposure is higher in lower-income families and families with lower education levels.[37] Within Hispanic families, children with Spanish-speaking mothers watch less television compared to children with English-speaking mothers.[38] Therefore, our study may not be generalizable to populations with higher acculturation.

In summary, our study suggests that educational media as used by this sample of low-income families in their homes does not promote overall cognitive stimulation activities in the home. Although educational programs fostering cognitive stimulation activities have been developed on the basis of principles of child development, their impact may be lower than intended in the context of real-world utilization. These findings are especially concerning for children from low-income families because they participate in fewer cognitive stimulation activities in the home such as reading and are at higher risk for developmental delay.[12]

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