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Television Viewing in Infancy and Child Cognition at 3 Years of Age in a US Cohort

Marie Evans Schmidt, PhD^a, Michael Rich, MD, MPH^a, Sheryl L. Rifas-Shiman, MPH^b, Emily Oken, MD, MPH^b, and Elsie M. Taveras, MD, MPH^b

^aCenter on Media and Child Health, Children's Hospital Boston, Harvard Medical School, Boston, Massachusetts

^bObesity Prevention Program, Department of Ambulatory Care and Prevention, Harvard Medical School and Harvard Pilgrim Health Care, Boston, Massachusetts

Abstract

Objective—To examine the extent to which infant television viewing is associated with language and visual motor skills at 3 years of age.

Measures—We studied 872 children who were participants in Project Viva, a prospective cohort. The design used was a longitudinal survey, and the setting was a multisite group practice in Massachusetts. At 6 months, 1 year, and 2 years, mothers reported the number of hours their children watched television in a 24-hour period, from which we derived a weighted average of daily television viewing. We used multivariable regression analyses to predict the independent associations of television viewing between birth and 2 years with Peabody Picture Vocabulary Test III and Wide-Range Assessment of Visual Motor Abilities scores at 3 years of age.

Results—Mean daily television viewing in infancy (birth to 2 years) was 1.2 (SD: 0.9) hours, less than has been found in other studies of this age group. Mean Peabody Picture Vocabulary Test III score at age 3 was 104.8 (SD: 14.2); mean standardized total Wide-Range Assessment of Visual Motor Abilities score at age 3 was 102.6 (SD: 11.2). After adjusting for maternal age, income, education, Peabody Picture Vocabulary Test III score, marital status, and parity, and child's age, gender, birth weight for gestational age, breastfeeding duration, race/ethnicity, primary language, and average daily sleep duration, we found that each additional hour of television viewing in infancy was not associated with Peabody Picture Vocabulary Test III or total standardized Wide-Range Assessment of Visual Motor Abilities scores at age 3.

Conclusion—Television viewing in infancy does not seem to be associated with language or visual motor skills at 3 years of age.

Keywords

television viewing; infancy; media; cognition

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Address correspondence to Elsie M. Taveras, MD, MPH, Harvard Medical School and Harvard Pilgrim Health Care, Department of Ambulatory Care and Prevention, Obesity Prevention Program, 133 Brookline Ave, 6th floor, Boston, MA 02215. elsie_taveras@harvardpilgrim.org.

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Since 1999, THE American Academy of Pediatrics has recommended no screen media for children <2 years of age.¹ Nevertheless, recent nationally representative data indicate that 68% of children <2 years of age use screen media on a typical day, and one quarter of these children have a television (TV) set in his or her bedroom.² Additional data suggest most US-born infants <2 years of age watch between 1 and 2 hours of TV daily.^{3–6} Given the large number of infants who are regularly exposed to TV, and the large number of parents who believe that it is good for their development, it is important to determine the effects of TV viewing on the developing cognition of young children.

Several small, experimental studies from the 1970s and 1980s found negative associations of infant TV viewing with subsequent cognitive and language development.^{7–9} An analysis of data from the National Longitudinal Survey of Youth-Child (NLSY) (1986) has shown that each 1 hour increase in TV viewing before the age of 3 years is associated with modest decreases in Peabody Individual Achievement Test reading recognition (– 0.31 points) and reading comprehension scores (–0.58) at age 6 years.¹⁰ Observational studies of language development suggest varied effects of infant TV and video viewing, depending largely on the content viewed. In 1 study, viewing specific programs between 6 and 30 months of age (eg, Dora the Explorer, Arthur) was associated with improved language skills at 30 months, whereas viewing other programs (eg, Sesame Street, Teletubbies) was associated with reduced language skills at 30 months.¹¹ A recent cross-sectional survey found a 17-point drop in MacArthur Bates Communicative Development Inventory (CDI) scores for each hour of infant viewing of baby DVD/videos between the ages of 8 and 16 months.¹² Finally, a recent systematic review found no controlled experimental trials of the effects of broadcast TV programs on children <3 years of age.¹³

There is also little to no evidence of any benefits of TV viewing for children <2 years of age,¹⁴ yet many parents believe TV helps their infants learn. In 1 recent survey, 29% of a large random sample ($n = 1009$) of parents indicated the most important reason their children <2 years of age watch TV or DVD/videos is that they are educational and “good for the child’s brain.”⁶ Almost 40% of parents of children <6 years of age, in a nationally representative survey, thought TV viewing “mostly helps” children’s learning.⁴

The cognitive effects of TV viewing in infancy remain uncertain. To our knowledge, there are no longitudinal studies that have examined the association of TV viewing in infancy with language or visual motor skills at 3 years of age. The purpose of this study was to examine the longitudinal association of TV viewing between birth and 2 years of age (herein referred to as “infancy”) with cognitive outcomes at 3 years of age. We hypothesized that each additional hour of TV viewing before the age of 2 years would be associated with lower Peabody Picture Vocabulary Test III (PPVT-III) and Wide-Range Assessment of Visual Motor Ability (WRAVMA) test scores at 3 years of age.

Methods

Population and Study Design

Study subjects were participants in Project Viva, a prospective cohort study of mothers and children. Details of recruitment and retention have previously been reported.¹⁵ Institutional review boards of participating institutions approved the study. All procedures were in accordance with the ethical standards for human experimentation established by the Declaration of Helsinki.

After obtaining informed consent, we performed in-person study visits with both mothers and children immediately after delivery and at 6 months and 3 years after delivery. We obtained demographic and health history information via interviews and self-administered questionnaires. Mothers also completed mailed questionnaires 1 and 2 years after delivery.

Of the 2128 women who gave birth to a singleton live infant, 1579 were eligible for the 3-year follow-up, and 1294 completed some part of the 3-year visit in person. We excluded 41 participants who were missing valid 3-year PPVT-III or WRAVMA data. Because our main exposure was a weighted average of infant TV viewing based on 3 time points (6 months, 1 year, 2 years), we excluded 367 participants who did not have data for all 3 time points. We also excluded 14 infants born before 34 weeks' gestation. In sum, data on TV viewing and child age 3-year cognitive results were available from 872 mother-child pairs.

Main Exposure: TV Viewing

In the 6-month and 1-year questionnaires, mothers were asked, "In the past week, how much time did your infant (child) watch TV or videos? By "watching," we mean the amount of time that the child is in a place where he/she can see a television that is on." Response options were in hours and minutes. In the 2-year questionnaire, mothers were asked, "In the past month, on average, about how many hours a day does your child spend sitting still watching TV/videos?" Response categories were: none, < 1 hour a day, 1 to 3 hours a day, 4 to 6 hours a day, 7 to 9 hours a day, and 10 hours a day. This measure of TV viewing, adapted from that used in the NLSY data,¹⁶ is linked in a dose-response manner with overweight among children¹⁷ and demonstrates considerable tracking with TV viewing over the infant and toddler years.¹⁸ Parental report, although overestimating children's TV viewing in comparison to both diaries and direct observation, seems to be well correlated with videotaped observation.¹⁹ Our study specifically examined TV viewing in infancy and its effects on cognition at 3 years of age. We did not measure infants' exposure to the Internet or computer games.

Main Outcomes: Child Cognitive Outcomes at Age 3

Trained research assistants administered the PPVT-III and WRAVMA to children at home or in a research office at 6 months and 3 years of age. The PPVT-III measures receptive vocabulary and is correlated with IQ, as measured by the Wechsler Intelligence Scale for Children ($r = .90$).²⁰ The WRAVMA is a standardized assessment of visual-motor abilities for children aged 3 to 17, and is moderately correlated with IQ ($r \sim .60$).²¹ Three tests make up the WRAVMA, comprising 3 different skill domains. They include a drawing test (visual

motor), a matching test (visual spatial), and a pegboard test (fine motor). Subtest scores can be reported individually, or in combination, as a total visual-motor integration composite.

Covariates

On questionnaires and interviews, mothers reported their age, education, household income, marital status, parity, TV viewing, children's race/ethnicity, and breastfeeding duration. Mothers completed the Edinburgh Postpartum Depression Scale (EPDS) when their child was 6 months of age. We obtained children's birth weights and delivery dates from medical charts. At 6 months, 1 year, and 2 years after birth, we also asked parents to report the number of hours their children slept in a usual 24-hour period on an average weekday and weekend day in the past month.

Statistical Analysis

Our main exposure was a weighted average of daily infant TV viewing between birth and 2 years of age. To calculate a weighted average of TV viewing from birth to 2 years, we created a sum that was weighted by the interval of time between the data collection of all 3 data points, and divided the sum by 2. In secondary analyses, we also separately examined infant TV viewing from birth to 6 months, 6 months to 1 year, and 1 to 2 years, with relation to PPVT-III and WRAVMA scores at 3 years of age.

We first examined the bivariate associations of infant TV viewing with other covariates and our main outcomes, which were PPVT-III and WRAVMA scores at age 3. We then used multiple linear regression models to assess the independent effects of TV viewing on PPVT-III and WRAVMA scores. In multivariable models, we included only those covariates that were of a priori interest or confounded associations of TV viewing with cognitive test scores. Model 1 was adjusted for child age and gender. Model 2 included maternal age, education, marital status, parity, PPVT-III score, and household income. In Model 3, we also adjusted for the child's birth weight for gestational age *z* score, breastfeeding duration, race/ethnicity, and English language use. Because average sleep duration could be a confounder of the relationship between infant TV viewing and PPVT-III and WRAVMA scores, in Model 4 we additionally adjusted for the child's average daily duration of sleep. We report regression estimates and 95% confidence limits (95% CLs) for the main predictor, TV viewing during infancy.

To assess effect modification by maternal education, we ran stratified models and tested multiplicative interaction terms in the final multivariable models. In the stratified analyses, we dichotomized maternal education into mothers who had graduated college versus mothers who had not graduated college. We performed data analyses with SAS 9.1 (SAS Institute, Inc, Cary, NC).

Results

On average, children watched 0.9 (SD: 1.2) hours of TV per day at 6 months of age, 1.2 (SD: 1.5) hours/day at 1 year of age, and 1.4 (SD: 1.1) hours/day at 2 years of age. The weighted average of daily TV viewing from birth to 2 years was 1.2 (SD: 0.9) hours. At 3

years of age, mean PPVT-III score was 104.8 (SD: 14.2), and mean standardized total WRAVMA score was 102.6 (SD: 11.2).

In bivariate analyses, children who lived in homes with lower household incomes and lower maternal educational attainment were more likely to watch more hours of TV per day (Table 1). In addition, black, Hispanic, and other nonwhite children were more likely than white children to watch more hours of TV per day (Table 1). Shorter duration of breastfeeding, less average sleep per day, and higher BMI at age 3 were also associated with more TV viewing in infancy (Table 1).

In multivariable analyses adjusted for the child's age and gender alone, average daily hours of TV viewing in infancy was associated with lower PPVT-III (-1.18 [95% CLs: -2.22 , -0.14]) and lower total standardized WRAVMA (-0.94 [95% CLs: -1.74 , -0.13]) scores at age 3 (Table 2). However, after additional adjustment for maternal age, income, education, marital status, parity, and maternal PPVT-III scores, the observed inverse relationship between TV viewing in infancy and cognitive scores at age 3 became null, suggesting that maternal characteristics had strong confounding effects on the observed relationship (Table 2), with maternal education and PPVT-III scores having the strongest effects. In fully adjusted models, each 1-hour increment in daily TV viewing from birth to 2 years was not significantly associated with PPVT-III (0.58 [95% CLs: -0.45 , 1.61]) or total standardized WRAVMA (-0.24 [95% CLs: -1.15 , 0.66]) scores at age 3.

We further examined whether the association between TV viewing and PPVT-III and WRAVMA scores varied by maternal education. In the multivariable models stratified by maternal education, we observed some differences but no significant interactions. For example, in final multivariable models, each additional hour of infant TV viewing was associated with a 0.88 increase in the PPVT-III score among children whose mothers who did not graduate college (95% CLs: -0.99 , 2.75) and was associated with a 0.19 increase in the PPVT-III score among children whose mothers who did graduate college (95% CLs: -1.09 , 1.47) (P for interaction term = .46).

In secondary analyses, we examined the separate relationships of TV viewing as measured at ages 6 months, 1 year, and 2 years with 3-year PPVT-III and WRAVMA scores (Table 3). Separate multivariable analyses at 6 months, 1 year, and 2 years did not show any significant associations with PPVT-III or total standardized WRAVMA scores at age 3 (Table 3).

Discussion

In this prospective study of children followed from birth to 3 years of age, average daily TV viewing by infants between birth and 2 years of age was associated with lower language and visual motor skills at age 3 in unadjusted models. However, after adjustment for maternal, child, and household characteristics, this association disappeared. Contrary to parents' perceptions that TV viewing is beneficial to their children's brain development,^{4,6} we found no evidence of cognitive benefit from watching TV during the first 2 years of life. In our analyses, the effects of TV viewing during infancy on cognitive abilities at 3 years of age

seem to be confounded by shared sociodemographic and environmental determinants of both TV viewing and lower cognitive development scores.

To our knowledge, this is the first study to investigate longitudinal associations between infant TV viewing from birth to 2 years of age and both language and visual-motor skill test scores at 3 years of age. Our findings are consistent with a recent cross-sectional study that found no associations between infant (8-16 months) or toddler (17-24 months) TV/video viewing and contemporaneous CDI scores.¹² They also parallel studies that have found no association between duration of TV viewing by older children and adolescents (irrespective of content) and their academic achievement, when relevant characteristics of study participants, such as their IQ and socioeconomic status, were taken into account.²²

Our findings differ from those found by secondary analysis of data from a longitudinal cohort of children in the NLSY, in which investigators reported that TV and video viewing before the age of 3 was associated with lower Peabody Reading Achievement and Wechsler Memory for Digit Span scores at age 6.⁶ Differences in study design may account for our different results. First, our study measured outcomes at age 3, whereas the previous study measured outcomes at age 6. Our study measured TV viewing up to age 2, whereas the previous study measured TV viewing up to age 3. It is possible that the effects of TV on infants are not apparent until children are older than age 3 and more verbal, or that TV viewing before the age of 2 has a lesser impact on developing cognitive abilities than TV viewing as measured between 2 and 3 years of age. The previous study measured outcomes of reading skills and memory that may be affected by TV differently than vocabulary (PPVT-III) or visual motor skills (WRAVMA). Finally, the previous study recorded much higher levels of average TV viewing (2.2 hours/day for children <3 years of age) than our study (1.2 hours/day for children <2 years of age), so developing cognition may only be affected at higher exposures to TV than were reported in our study population.

Our study had several strengths. First, we collected prospective data on TV viewing from birth through 2 years of age. Second, our analysis included the ability to control for a large variety of sociodemographic and environmental predictors of cognitive outcomes. Finally, we obtained measures of both vocabulary and visual motor skills through the PPVT-III and WRAVMA tests. There have been very few studies of the effects of TV viewing in infancy on subsequent cognitive or language test performance. None to date have examined the effects of infant TV viewing on PPVT-III scores.

A limitation of this study is that we did not measure the content of the TV/video viewed by the infants. Although only a few studies have been conducted, there is emerging evidence that content is an important mediator of the effects of TV on infants. For example, 1 longitudinal study of children from 6 to 30 months age found the effects of TV viewing on language skills at 30 months depended on the specific programs viewed.¹¹ A cross-sectional study that found no association between general infant TV/video viewing and language skills found that viewing infant videos (eg, Baby Einstein, Brainy Baby) between 8 and 16 months of age was associated with significantly lower CDI scores.⁶ Finally, a recent analysis of longitudinal data from the Panel Survey of Income Dynamics found that viewing violent

TV/video content before the age of 3 doubled the likelihood of attention problems in childhood.²³

This study may have been limited by maternal characteristics and infant TV viewing among our study population. Despite the racial and ethnic diversity in our participant pool, the education and income levels of the mothers were relatively high, and only 16% of children in the sample watched TV in excess of 2 hours each day. With older children, research indicates that moderate TV viewing (1 to 10 hours per week) is positively associated with academic achievement, whereas heavier viewing (in excess of 10 hours per week) is negatively associated with achievement.²⁴ It is possible that the relatively low levels of infant TV viewing in our participant pool did not result in cognitive differences that might become measurable at higher levels of TV viewing. Finally, our TV viewing estimates were obtained through parental report. Although this has been found to be a valid measure of TV viewing,¹⁹ past research has indicated parental estimates, when compared with viewing diaries, yield overestimates of child TV viewing and smaller correlations with outcomes of interest.¹⁹ Because previous research has shown effects of TV viewing before age 3 on cognitive test scores at age 7,¹⁰ it remains unclear whether early TV viewing has effects on cognition that are not manifested until later in development.

Conclusions

In this prospective study, TV viewing between birth and 2 years of age was neither beneficial nor deleterious to child cognitive and language abilities at 3 years of age. Although unadjusted analyses showed lower cognitive abilities among those who had more hours of TV exposure during infancy, these differences disappeared when analyses were adjusted for maternal, child, and household characteristics.

The potential benefits of limiting exposure to TV in early childhood are multiple and include less exposure to violent media content,¹ improved diet quality,²⁵ lower risk of overweight and obesity,²⁶ lower risk of attention problems,²⁷ and improved sleep quality.²⁸ Although more research is needed, our findings suggest that the quantity of infant TV viewing is not associated with either poorer or better cognitive outcomes at age 3. At our present state of knowledge, pediatricians and parents will need to evaluate other health and developmental outcomes to determine the best strategies for TV viewing among infants and children.

References

1. American Academy of Pediatrics. Media education. *Pediatrics*. 1999; 104(2 pt 1):341–343. [PubMed: 10429023]
2. Rideout, VJ.; Vandewater, EA.; Wartella, EA. *Zero to Six: Electronic Media in the Lives of Infants, Toddlers and Preschoolers*. Menlo Park, CA: Henry J. Kaiser Family Foundation, Children's Digital Media Centers; 2003.
3. Vandewater EA, Rideout VJ, Wartella EA, Huang X, Lee JH, Shim M. Digital childhood: electronic media and technology use among infants, toddlers, and preschoolers. *Pediatrics*. 2007; 119(5) Available at: www.pediatrics.org/cgi/content/full/119/5/e1006.
4. Rideout, V.; Hamel, E. *The Media Family: Electronic Media in the Lives of Infants, Toddlers, Preschoolers, and Their Parents*. Menlo Park, CA: Henry J. Kaiser Family Foundation; 2006.

5. Pierrotsakos, SL.; Hanna, MM.; Self, JA.; Lewis, EN.; Brewer, CJ. Baby Einsteins everywhere: the amount and nature of television and video viewing of infants birth to 2 years; Presented at the International Conference for Infant Studies; May 8, 2004; Chicago, IL.
6. Zimmerman FJ, Christakis DA, Meltzoff AN. Television and DVD/video viewing in children under 2 years. *Arch Pediatr Adolesc Med.* 2007; 161(5):473–479. [PubMed: 17485624]
7. Carew JV. Experience and the development of intelligence in young children at home and in day care. *Monogr Soc Res Child Dev.* 1980; 45(6–7):1–115. [PubMed: 7219418]
8. Nelson K. Structure and strategy in learning to talk. *Monogr Soc Res Child Dev.* 1973; 38(149)
9. Gottfried, AW., editor. *Home Environment and Early Cognitive Development: Longitudinal Research.* Orlando, FL: Academic Press; 1984.
10. Zimmerman FJ, Christakis DA. Children's television viewing and cognitive outcomes: a longitudinal analysis of national data. *Arch Pediatr Adolesc Med.* 2005; 159(7):619–625. [PubMed: 15996993]
11. Linebarger DL, Walker D. Infants' and toddlers' television viewing and language outcomes. *Am Behav Sci.* 2005; 48(5):624–645.
12. Zimmerman FJ, Christakis DA, Meltzoff AN. Associations between media viewing and language development in children under age 2 years. *J Pediatr.* 2007; 151(4):364–368. [PubMed: 17889070]
13. Thakkar RR, Garrison MM, Christakis DA. A systematic review for the effects of television viewing by infants and preschoolers. *Pediatrics.* 2006; 118(5):2025–2031. [PubMed: 17079575]
14. Garrison, MM.; Christakis, DA. *A Teacher in the Living Room? Educational Media for Babies, Toddlers, and Preschoolers.* Menlo Park, CA: Henry J. Kaiser Family Foundation; 2005.
15. Gillman MW, Rich-Edwards JW, Rifas-Shiman SL, Lieberman ES, Kleinman KP, Lipshultz SE. Maternal age and other predictors of newborn blood pressure. *J Pediatr.* 2004; 144(2):240–245. [PubMed: 14760269]
16. Baker, PC.; Keck, CK.; Mott, FL.; Quinlan, SV. *NLYS Child Handbook, Revised Edition: A Guide to the 1986–1990 National Longitudinal Survey of Youth Child Data.* Columbus, OH: Center for Human Resource Research Ohio State University; 1993.
17. Gortmaker SL, Must A, Sobol AM, Peterson K, Colditz GA, Dietz WH. Television viewing as a cause of increasing obesity among children in the United States, 1986–1990. *Arch Pediatr Adolesc Med.* 1996; 150(4):356–362. [PubMed: 8634729]
18. Certain LK, Kahn RS. Prevalence, correlates, and trajectory of television viewing among infants and toddlers. *Pediatrics.* 2002; 109(4):634–642. [PubMed: 11927708]
19. Anderson DR, Field DE, Collins PA, Lorch EP, Nathan JG. Estimates of young children's time with television: a methodological comparison of parent reports with time-lapse video home observation. *Child Dev.* 1985; 56(5):1345–1357. [PubMed: 4053746]
20. Dunn, LM.; Dunn, LM. *Examiner's Manual for the Peabody Picture Vocabulary Test.* Circle Pines, MN: American Guidance Service; 1997.
21. Adams, W.; Sheslow, D. *Wide Range Assessment of Visual Motor Abilities.* Lutz, FL: Psychological Assessment Resources, Inc; 1995.
22. Schmidt ME, Vandewater EA. Media and attention, cognition, and school achievement. *Future Child.* 2008; 18(1):63–85. [PubMed: 21338006]
23. Zimmerman FJ, Christakis DA. Associations between content types of early media exposure and subsequent attentional problems. *Pediatrics.* 2007; 120(5):986–992. [PubMed: 17974735]
24. Williams PA, Haertel EH, Haertel GD, Walberg HJ. The impact of leisure time television on school learning: a research synthesis. *Am Educ Res J.* 1982; 19(1):19–50.
25. Miller SA, Taveras EM, Rifas-Shiman SL, Gillman MW. Association between television viewing and poor diet quality in young children. *Int J Pediatr Obes.* 2008; 3(3):168–176. [PubMed: 19086298]
26. Robinson TN. Reducing children's television viewing to prevent obesity: a randomized controlled trial. *JAMA.* 1999; 282(16):1561–1567. [PubMed: 10546696]
27. Christakis DA, Zimmerman FJ, DiGiuseppe DL, McCarthy CA. Early television exposure and subsequent attentional problems in children. *Pediatrics.* 2004; 113(4):708–713. [PubMed: 15060216]

28. Thompson DA, Christakis DA. The association of TV viewing and irregular sleep schedule among children less than 3 years of age. *Pediatrics*. 2005; 116(4):851–856. [PubMed: 16199693]

Abbreviations

TV	television
CDI	MacArthur Bates Communicative Development Inventory
PPVT-III	Peabody Picture Vocabulary Test III
WRAVMA	Wide-Range Assessment of Visual Motor Abilities
NLSY	National Longitudinal Survey of Youth-Child
EPDS	Edinburgh Postpartum Depression Scale
CL	confidence limit

What's Known on This Subject

TV viewing among older children has been found to have adverse effects on cognition.

What This Study Adds

TV viewing in infancy does not seem to be associated with language or visual motor skills at age 3.

Table 1
Participant Characteristics According to TV Viewing Among 872 Mothers and Their Children in Project Viva

	Prevalence or Mean (SD) of Characteristic According to Hours of Average Daily TV Viewed From Birth to 2 Years					<i>p</i> ^a
	Overall (<i>N</i> = 872)	0 to <0.5 h (<i>n</i> = 203)	0.5 to <1 h (<i>n</i> = 185)	1 to <2 h (<i>n</i> = 346)	2 h (<i>n</i> = 138)	
Maternal characteristics						
Age, y	32.7 (4.8)	33.6 (4.6)	32.4 (4.8)	32.7 (4.8)	31.7 (4.8)	.003
Education, <i>n</i>						
High school	43 (4.9)	8 (3.9)	8 (4.3)	16 (4.6)	11 (8.0)	<.0001
Some college	163 (18.7)	20 (9.9)	31 (16.8)	70 (20.3)	42 (30.4)	
College graduate	331 (38.0)	57 (28.1)	74 (40.0)	145 (42.0)	55 (39.9)	
Graduate degree	334 (38.4)	118 (58.1)	72 (38.9)	114 (33.0)	30 (21.7)	
Household income, <i>n</i>						
< \$40 000	76 (8.7)	11 (5.4)	17 (9.2)	30 (8.7)	18 (13.0)	.01
\$40 000–\$69 999	168 (19.3)	29 (14.3)	29 (15.7)	72 (20.8)	38 (27.5)	
\$70 000	579 (66.4)	152 (74.9)	125 (67.6)	225 (65.0)	77 (55.8)	
Don't know/missing	49 (5.6)	11 (5.4)	14 (7.6)	19 (5.5)	5 (3.6)	
Marital status, <i>n</i>						
Married/cohabitating	828 (95.1)	197 (97.0)	175 (94.6)	330 (95.7)	126 (91.3)	.10
Single/divorced/widowed	43 (4.9)	6 (3.0)	10 (5.4)	15 (4.4)	12 (8.7)	
Parity, <i>n</i>						
0	425 (48.7)	92 (45.3)	93 (50.3)	176 (50.9)	64 (46.4)	.59
1	318 (36.5)	75 (37.0)	65 (35.1)	128 (37.0)	50 (36.2)	
2	129 (14.8)	36 (17.7)	27 (14.6)	42 (12.1)	24 (17.4)	
Depression at 6 mo, <i>n</i>						.31
EPDS score > 12	61 (7.5)	15 (7.7)	8 (4.6)	25 (7.7)	13 (10.3)	
EPDS score 12	758 (92.6)	181 (92.4)	166 (95.4)	298 (92.3)	113 (89.7)	
PPVT score	107.8 (14.5)	113.7 (14.4)	108.2 (12.9)	105.6 (15.0)	102.9 (12.7)	<.0001
Maternal postpartum TV viewing, hr/wk						
6 mo	11.4 (8.6)	6.5 (5.1)	9.9 (6.1)	12.1 (7.7)	19.1 (11.6)	<.0001
1 y	10.5 (8.8)	5.6 (5.5)	8.9 (5.7)	11.2 (8.2)	18.0 (11.8)	<.0001
2 y	10.3 (8.2)	5.8 (4.8)	9.0 (7.2)	10.8 (7.1)	17.2 (10.8)	<.0001

Prevalence or Mean (SD) of Characteristic According to Hours of Average Daily TV Viewed From Birth to 2 Years					
	Overall (N = 872)	0 to <0.5 h (n = 203)	0.5 to <1 h (n = 185)	1 to <2 h (n = 346)	2 h (n = 138)
Child characteristics					
Gender, n					
Boy	433 (49.7)	99 (48.8)	100 (54.1)	174 (50.3)	60 (43.5)
Girl	439 (50.3)	104 (51.2)	85 (46.0)	172 (49.7)	78 (56.5)
Race/ethnicity, n					
Black	80 (9.2)	6 (3.0)	17 (9.2)	32 (9.3)	25 (18.1)
Hispanic	21 (2.4)	5 (2.5)	6 (3.2)	8 (2.3)	2 (1.5)
Other	121 (13.9)	24 (11.8)	21 (11.4)	58 (16.8)	18 (13.0)
White	650 (74.5)	168 (82.8)	141 (76.2)	248 (71.7)	93 (67.4)
Birth weight for gestational age z score	0.25 (0.94)	0.29 (0.92)	0.21 (0.92)	0.23 (1.00)	0.29 (0.81)
BMI z score at age 3	0.45 (1.01)	0.20 (1.04)	0.40 (0.89)	0.58 (0.97)	0.58 (1.14)
Breastfeeding duration, mo	6.6 (4.5)	8.5 (4.1)	6.9 (4.4)	6.1 (4.6)	4.5 (4.3)
Average sleep from 6 mo to 2 y, hr/d	12.3 (1.1)	12.5 (1.1)	12.4 (1.1)	12.3 (1.1)	12.1 (1.2)
Primary language, n					
English	844 (96.8)	195 (96.1)	178 (96.2)	337 (97.4)	134 (97.1)
Other	28 (3.2)	8 (3.9)	7 (3.8)	9 (2.6)	4 (2.9)
Average child TV viewing from birth to 2 y, hr/d	1.2 (0.9)	0.3 (0.1)	0.7 (0.2)	1.4 (0.3)	2.8 (0.9)
PPVT-III score	104.8 (14.2)	106.2 (14.1)	103.1 (14.1)	105.7 (14.0)	102.6 (14.4)
Total WRAVMA ^b	102.6 (11.2)	103.4 (11.5)	103.1 (11.1)	102.1 (10.8)	102.2 (11.9)
Drawing	99.4 (11.1)	100.1 (12.0)	99.2 (9.8)	99.1 (10.6)	99.5 (12.7)
Pegboard	98.9 (10.9)	99.1 (11.3)	99.9 (11.6)	98.6 (10.3)	98.3 (10.7)
Matching	108.2 (13.2)	108.7 (12.8)	108.6 (13.3)	108.0 (13.1)	107.5 (13.7)

^a P values are from a χ^2 test for categorical characteristics and analysis of variance for continuous characteristics.

^b Total WRAVMA score is the sum of the drawing, matching, and pegboard subset scores, standardized to a mean and SD of 15.

Table 2
Adjusted Associations of Average TV Viewing From Birth to 2 Years of Age With Child Cognitive Outcomes at 3 Years of Age

Models	PPVT-III, Estimate (95% CLs)	Total WRAVMA, Estimate (95% CLs)
Model 1: age + gender	– 1.18 (– 2.22, – 0.14)	–0.94 (– 1.74, – 0.13)
Model 2: model 1 + maternal age, education, marital status, parity, PPVT-III score, and household income	0.56 (– 0.46, 1.58)	–0.33 (– 1.18, 0.52)
Model 3: model 2 + child birth weight for gestational age <i>z</i> score, breastfeeding duration, race/ethnicity, and English language	0.90 (– 0.09, 1.88)	–0.22 (– 1.08, 0.65)
Model 4: model 3 + average daily sleep duration from 6 mo to 2 y	0.58 (–0.45, 1.61)	–0.24 (–1.15, 0.66)

Table 3
Adjusted Associations^a of Infant TV Viewing at 6 Months, 1 Year, and 2 Years of Age and Cognitive Outcomes at 3 Years of Age

Models	PPVT-III, Estimate (95% CLs)	Total WRAVMA, Estimate (95% CLs)
6 mo	0.43 (−0.32, 1.18)	0.01 (−0.65, 0.66)
1 y	0.24 (−0.37, 0.85)	−0.02 (−0.55, 0.52)
2 y	0.59 (−0.28, 1.46)	−0.29 (−1.06, 0.48)

^a Models include the following variables: maternal age, education, marital status, parity, and PPVT-III score; household income; child birth weight for gestational age z score, breastfeeding duration, race/ethnicity, English language, and average daily sleep duration.