ARTICLE

Prospective Associations Between Early Childhood Television Exposure and Academic, Psychosocial, and Physical Well-being by Middle Childhood

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Objective: To estimate the influence of early childhood television exposure on fourth-grade academic, psychosocial, and lifestyle characteristics.

Design: Prospective longitudinal study.

Setting: Institut de la Statistique du Québec, Québec, Canada.

Participants: A total of 1314 (of 2120) children

Main Exposure: Parent-reported data on weekly hours of television exposure at 29 and 53 months of age. We conducted a series of ordinary least-squares regressions in which children's academic, psychosocial, and lifestyle characteristics are linearly regressed on early and preschool television exposure.

Outcome Measures: Parent and teacher reports of academic, psychosocial, and health behaviors and body mass index measurements (calculated as weight in kilograms divided by height in meters squared) at 10 years of age.

Results: Adjusting for preexisting individual and family factors, every additional hour of television exposure at 29 months corresponded to 7% and 6% unit decreases in classroom engagement (95% confidence interval [CI], –0.02 to –0.004) and math achievement (95% CI, –0.03 to 0.01), respectively; 10% unit increases in victimization by classmates (95% CI, 0.01 to 0.05); 13% unit decreases in time spent doing weekend physical activity (95% CI, 0.81 to 2.25); 9% unit decreases in activities involving physical effort (95% CI, –0.04 to 0.00); higher consumption scores for soft drinks and snacks by 9% and 10% (95% CI, 0.00 to 0.04 and 95% CI, 0.00 to 0.02), respectively; and 5% unit increases in body mass index (95% CI, 0.01 to 0.05). Preschool increments in exposure also made a unique contribution to developmental risk.

Conclusions: The long-term risks associated with higher levels of early exposure may chart developmental pathways toward unhealthy dispositions in adolescence. A population-level understanding of such risks remains essential for promoting child development.

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FOR THE PAST SEVERAL DECADES, television has become a ubiquitous fixture and preferred activity in most occidental family environments. Despite clear, age-specific recommendations from the American Academy of Pediatrics[1] that discourage any screen media exposure during infancy and less than 2 hours per day beyond 2 years of age, parents show poor factual knowledge and awareness of such existing guidelines.[2] One study found that almost half of 12- to 23-month-olds and 41% of 24- to 35-month-olds exceeded recommendations.[3]

The remarkable childhood intake of mass media has evoked interest in its potential impact, with most studies suggesting negative effects.[4,5] Common sense would suggest that television exposure replaces time that could be spent engaging in other developmentally enriching activities and tasks that foster cognitive, behavioral, and motor development. This idea has been empirically supported in adolescent populations.[6-11] Studies have also underscored exposure time as a risk factor for unhealthy lifestyle habits in school-age youth, predicting less than optimal physical activity, body weight, and[12] fruit and vegetable intake,[13] consumerism,[14] and tobacco and alcohol use.[15-17] Results regarding academic performance have been mixed, with more recent studies suggesting hazardous effects of overexposure.[4,18-20]

Television exposure almost invariably starts in early childhood.[3] Indeed, broadcasting has an educational orientation when targeting preschoolers, which might have some cognitive benefits. Nevertheless, preschool televiewing remains a cognitively passive activity at a time when key experiences for developing attention and

behavioral self-regulation are expected to occur.[21] Two studies have found long-term, albeit modest, associations between early childhood exposure and socioemotional difficulties at school entry and attention problems in first grade.[22,23] Another study also found negative effects on verbal and memory skills at ages 6 and 7 for each additional hour of average exposure before 3 years of age.[24] Interestingly, exposure between 3 and 5 years of age was linked to improvements in reading recognition. There were no effects on mathematics outcomes.

Past research has mainly focused on older children. The duration between television exposure and outcomes has been short-lived and sometimes even concurrent. Omitted variable bias has also been a challenge. Moreover, some of the observed effects could be attributable to earlier unmeasured exposure or preexisting conditions like difficult temperament, behavior problems, or family dysfunction. Evaluating the influence of television exposure in naturalistic settings offered by population-based studies with typically developing children can help verify its specific developmental risks by affording tighter control of potential confounding variables.

In the present study, we use the Quebec Longitudinal Study of Child Development to examine the influence of television exposure at 29 months and changes in exposure by 53 months on later academic, psychosocial, and lifestyle characteristics in the fourth grade. Measures comprise information from parents and teachers and direct child assessments. It is expected that more exposure and larger preschool increases will be associated with less optimal developmental outcomes.

METHODS

PARTICIPANTS

Coordinated by the Institut de la Statistique du Québec, the Quebec Longitudinal Study of Child Development originates from a randomly selected, stratified sample of 2837 infants born between 1997 and 1998 in Quebec, Canada (www.jesuisjeserai.stat.gouv.qc.ca/etude_an.htm). At the inception of the longitudinal component, 93 children were deemed ineligible and 172 were untraceable owing to incorrect coordinates. Of the 2572 remaining children, 14 were unreachable and 438 refused participation. Thus, for its early childhood phase, 2120 5-month-old infants (and their families) with parental consent were deemed eligible for follow-up at 17, 29, 41, and 53 months, representing 82% of the eligible target population. Of these, 39% were firstborn. For every school-age wave of the Quebec Longitudinal Study of Child Development, informed consent was obtained from parents, children, and teachers.

Participants were included in this institutional review board–approved study if they had complete parent reports on early childhood television viewing (n = 1314 of 2120 at 5 months). Follow-up occurred in the spring of the fourth grade (mean [SD] age, 121.83 [3.11] months).

MEASURES

Independent Variable

At both the 29- and 53-month follow-ups, parents were asked, "How much time per day does your child spend watching TV?" Scores reflect the total hours of television exposure during both the week and weekends.

Dependent Variables

Fourth-grade teachers rated academic performance and psychosocial adjustment. Mathematics and reading achievement were measured with ratings of child performance relative to the distribution in the class. Children were rated as either near the top of the class (coded as 2) to near the bottom of the class (coded as −2). Teachers also completed the Social Behavior Questionnaire,[25-27] which comprises several factors pertaining to classroom behavior. The 3 factors of interest for this study were emotional distress (6 items: seemed to be unhappy or sad; was not as happy as other children; has no energy, was feeling tired; cried a lot; had trouble enjoying himself or herself; and is unable to make decisions; $\alpha = .79$); reactive aggression (4 items: reacted in an aggressive manner when teased; when contradicted; when someone accidentally hurt him or her [such as bumping in into him or her]; or when something was taken away from him/her; and reacted with anger and fighting; $\alpha = .89$); and victimization (3 items: was called names by other children; was hit or pushed by other children; and was made fun of by other children; $\alpha = .77$). A classroom engagement scale represented classroom task orientation, compliance, and persistence (11 items: works cooperatively with other children; follows directions; follows rules; follows instructions; completes work on time; works independently; listens attentively; works neatly and carefully; puts a lot of effort into work; participates in class; and asks questions when he or she does not understand; $\alpha = .94$). All of the teacher-reported factors were rated on a Likert scale with response options including 1 (never or not true), 2 (sometimes or somewhat true), and 3 (often or very true). Higher values indicate a higher degree of the factor. The Social Behavior Questionnaire represents a good predictor of future psychosocial adjustment and school success.[24]

Parents reported on several indicators of sedentariness: total hours of child of video game use during a typical week; physical fitness relative to other children (rated from 2, much more to −2, much less); physical activity, which reflected the number of minutes their child spent doing physically activity during the weekend; and physical effort, which represented how often the child engaged in effortful activity during free time in a typical week, both ranging from 1 (never/rarely) to 5 (very often). Parents also provided reports of the dietary consumption frequency of soft drinks, sweet snacks, and fruits and vegetables. Responses ranged from 1 (never) to 7 (4 times or more per day). Finally, measures of body mass index (BMI; calculated as weight in kilograms divided by height in meters squared) were measured by trained independent examiners who followed a standardized protocol detailed elsewhere.[28]

Control Variables

When children were aged approximately 17 months, parents provided data on variables that could possibly influence both television viewing and later outcomes: child's sex; temperament problems (reflecting the sum of parent ratings of difficult and unpredictable temperament); hours of continuous sleep; maternal education (finishing high school = 1 and not = 0); family makeup (2 parents = 1 and not = 0); parent-reported family functioning[29] and Social Behavior Questionnaire scores on impulsivity, emotional distress, and physical aggression; cognitive skills using the Imitation Sorting Task[30] given by a trained examiner (at 29 months); parent-reported total weekly hours of television exposure (in the fourth grade); and directly measured BMI at 17 months for analyses involving sedentariness.[27]

STATISTICAL ANALYSIS

This study required a substantial amount of data from several sources and waves. An attrition analysis that compared the 1314 retained cases with television exposure data at both 29 and 53 months and 806 nonretained cases from the original sample (n=2120) at 5 months (wave 1) on the baseline control variables revealed that children in the retained sample were less likely to come from single-parent families ($\bar{x}$=0.80 vs 0.81; t_{2039}=2.42; P=.04) and had more parent-reported physical aggression at 17 months ($\bar{x}$=1.25 vs 1.37; t_{2043}=2.06; P=.02). At the fourth-grade follow-up, complete data across all variables were available in approximately 50% to 65% of cases from teacher and parent reports. An attrition analysis that compared the complete and incomplete data on demographic measures revealed some differences. Compared with the nonretained cases, our retained sample in fourth grade had more educated mothers ($\bar{x}$=0.84 vs 0.78; t_{1309}=2.83; P=.005), watched less television at 29 months ($\bar{x}$=8.36 vs 9.08; t_{1312}=2.02; P=.04), comprised more girls (53%; t_{1312}=2.46; P=.01), and showed more temperament problems at 17 months ($\bar{x}$=0.53 vs 0.43; t_{1305}=2.74; P=.006). There were no between-group differences in family functioning and configuration. We imputed all missing data using the NORM multiple imputations program (http://www.stat.psu.edu/~jls/misoftwa.html).[31] By drawing values from the conditional distribution of the variables, NORM uses an iterative method based on and expectation-maximization algorithm to impute missing data, depending on the available and valid observations from the original data set.[31]

We estimate a series of ordinary least-squares regressions in which a number of fourth-grade indicators of well-being at 10 years of age are linearly regressed on early television exposure. This postulated relation can be interpreted as the effect of increasing exposure by 1 unit on a large array of later well-being measures that forecast later education and health trajectories. Each model features total hours of exposure per week for each individual child at 29 months as the first predictor and a continuous estimate of change in total weekly exposure from 29 to 53 months as a second predictor (ie, later time point subtracted from earlier time point). To best ensure an unbiased estimation of our effects, we account for possible omitted variable bias, which is likely to arise if preexisting individual or family characteristics are linked to our predictors. The influence of change is also above and beyond the 29-month baseline and concurrent television exposure. Thus, the reported analyses apply to this fully controlled model.

RESULTS

Television exposure at 29 months was a mean (SD) of 8.82 (6.17) hours for the entire week and rose to 14.85 (8.05) hours per week by 53 months. Similar to averages found with American children,[3] these quantities are within current recommendations of not more than 2 hours per day beyond 2 years of age, assuming that the content is developmentally appropriate.[1] Nevertheless, 11% of the children at 29 months and 23.4% of the children at 53 months viewed more than 2 hours of television daily.

Table 1 illustrates the relationship between the baseline controls and weekly hours of television exposure at 29 and 53 months. Children with more educated mothers experienced less exposure at 29 months (8.21 vs 11.29 hours; t_{1312}=6.01; P<.001) and less exposure at 53 months (14.53 vs 16.30 hours; t_{1312}=2.64; P=.01). Children from single-parent families experienced more exposure at 29 months (8.54 vs 10.01 hours; t_{1312}=2.88; P<.04).

Table 1. Standardized Regression Coefficients Reflecting the Relationship Between Baseline Child Characteristics and Televiewing at 29 and 53 Months

	β (SE)	
Independent Variables	29 Months	53 Months
Sex	0.04 (0.34)	0.04 (0.45)
Temperament (17 mo)	–0.02 (0.30)	0.02 (0.39)
Cognitive ability (29 mo)	–0.02 (0.22)	0.01 (0.29)
Impulsivity (17 mo)	0.00 (0.10)	–0.03 (0.13)
Emotional distress (17 mo)	0.01 (0.19)	0.01 (0.25)
Physical aggression (17 mo)	0.00 (0.14)	–0.02 (0.18)
Hours of sleep (17 mo)	–0.03 (0.10)	–0.03 (0.13)
Maternal education (17 mo)	–0.18 (.043)[a]	–0.07 (0.58)[b]
Family makeup (17 mo)	–0.06 (0.43)[b]	–0.05 (0.58)
Family functioning (17 mo)	0.02 (0.14)	0.03 (0.18)
Body mass index (17 mo)	–0.03 (0.05)	0.01 (0.07)
Adjusted R^2	0.04	0.01

Abbreviation: SE, standard error.
[a] P<.001.
[b] P≤.05.

Table 2. Standardized Regression Coefficients Reflecting the Relation Between Preschool Televiewing and Teacher-reported Academic Adjustment in the Fourth Grade

	β (SE)		
Independent Variables[a]	Classroom Engagement	Victimization	Mathematics Success
Early televiewing	–0.07 (0.003)[c]	0.10 (0.01)[b]	–0.06 (0.01)[c]
Change in televiewing	0.03 (0.002)	0.06 (0.01)[c]	0.04 (0.004)
Concurrent televiewing	–0.05 (0.003)	0.06 (0.01)[c]	–0.04 (0.01)
Sex	–0.27 (0.03)[b]	0.17 (0.11)[b]	–0.05 (0.06)
Temperament	0.03 (0.03)	0.04 (0.09)	–0.01 (0.06)
Cognitive ability	–0.01 (0.02)	–0.02 (0.07)	–0.02 (0.04)
Impulsivity	–0.03 (0.01)	–0.09 (0.03)[b]	–0.06 (0.02)[c]
Emotional distress	0.08 (0.02)[b]	0.02 (0.06)	0.04 (0.04)
Physical aggression	–0.01 (0.01)	0.00 (0.05)	0.03 (0.03)
Hours of sleep	0.02 (0.01)	0.00 (0.03)	0.02 (0.02)
Maternal education	0.16 (0.04)[b]	–0.05 (0.14)	0.10 (0.08)[b]
Family makeup	0.13 (0.04)[b]	0.01 (0.14)	0.12 (0.08)[b]
Family functioning	–0.07 (0.01)[b]	0.03 (0.40)	–0.04 (0.03)
Adjusted R^2	0.15	0.05	0.05

Abbreviation: SE, standard error.
[a] All control variables were measured at 17 months, with the exception of cognitive ability (29 months) and concurrent televiewing (fourth grade).
[b] P<.001.
[c] P≤.05.

Table 2 and **Table 3** illustrate the relationship between preschool television exposure and indicators of academic adjustment and health habits in the fourth grade, as reported by teachers and parents, respectively. In terms of academic adjustment, higher levels of televiewing at 29 months predicted lower levels of classroom engagement and mathematics achievement. Every additional hour of early childhood television exposure corresponded to a 7% and 6% unit decrease in classroom engagement (unstandardized β=–0.01; 95% confidence interval [CI], –0.02 to –0.004) and math achievement (unstandardized β=–0.01; 95% CI, –0.03 to 0.01, respectively). Television exposure did not influence reading achievement (data not pre-

Table 3. Standardized Regression Coefficients Reflecting the Relation Between Preschool Televiewing and Parent Reports of Sedentary Habits in the Fourth Grade

	β (SE)			
Independent Variables[a]	Video Game Playing	Fitness	Weekend Physical Activity	Physical Effort
Early televiewing	0.10 (0.03)[c]	−0.09 (0.004)[c]	−.13 (0.37)[b]	−0.09 (0.01)[c]
Change in televiewing	0.10 (0.02)[b]	−0.10 (0.003)[c]	−0.11 (0.26)[b]	−0.06 (0.004)[d]
Concurrent televiewing	0.18 (0.03)[b]	−0.09 (0.004)[c]	−0.04 (0.32)	−0.10 (0.01)[b]
Sex	0.22 (0.35)[b]	0.02 (0.04)	0.17 (3.94)[b]	0.18 (0.06)[b]
Temperament	−0.03 (0.30)	0.02 (0.04)	0.01 (3.39)	0.02 (0.05)
Cognitive ability	−0.04 (0.23)	0.06 (0.03)	0.04 (2.53)	0.08 (0.04)[c]
Impulsivity	−0.05 (0.10)	0.02 (0.01)	0.07 (1.14)[d]	0.03 (0.2)
Emotional distress	0.06 (0.20)[d]	−0.05 (0.02)	−0.09 (2.17)[c]	−0.05 (0.04)
Physical aggression	0.00 (0.14)	0.05 (0.02)	0.04 (1.61)	0.05 (0.03)
Hours of sleep	0.00 (0.11)	−0.01 (0.01)	−0.02 (1.18)	−0.01 (0.02)
Maternal education	0.07 (0.46)[d]	0.09 (0.06)[c]	−0.03 (5.15)	−0.08 (0.08)[c]
Family configuration	−0.04 (0.45)	0.06 (0.06)[d]	0.01 (5.06)	−0.02 (0.08)
Family functioning	0.04 (0.14)	−0.10 (0.02)[b]	−0.13 (1.58)[b]	−0.07 (0.03)[c]
BMI	0.01 (0.06)	−0.01 (0.01)	−0.03 (0.62)	0.01 (0.01)
Adjusted R^2	0.11	0.05	0.07	0.06

Abbreviations: BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); SE, standard error.
[a] All control variables were measured at 17 months, with the exception of cognitive ability (29 months) and concurrent televiewing (fourth grade).
[b] $P < .001$.
[c] $P < .01$.
[d] $P \leq .05$.

sented). Victimization was the only psychosocial adjustment variable influenced by television exposure. Each 1-hour increase in early childhood exposure corresponded to a 10% unit increase in the teacher-rated measure of victimization (unstandardized β = 0.03; 95% CI, 0.01 to 0.05). Preschool increments in exposure between 29 and 53 months were associated with a smaller unit influence on victimization (unstandardized β = 0.01; 95% CI, −0.01 to 0.03) compared with the influence of sex and early family characteristics on later classroom engagement.

With respect to indicators of sedentary habits in the fourth grade, every additional hour of exposure in 29 months corresponded to a 10% unit increase in video game use (unstandardized β = 0.10; 95% CI, 0.04 and 0.16), 9% unit decrease in general fitness score (unstandardized β = −0.01; 95% CI, −0.002 to −0.02), 13% unit decrease in time spent in weekend physical activity (unstandardized β = −1.53; 95% CI, 0.81 to 2.25), and a lesser inclination toward activities that involve physical effort by 9% (unstandardized β = −0.02; 95% CI, −0.04 to 0.00). Preschool increments in exposure also made a unique contribution to the above habits, beyond the 29-month effects.

As illustrated in **Table 4**, 29-month and preschool increments in television exposure predicted 5% and 3% unit increases in the probability of being categorized as overweight in the fourth grade, according to age and sex BMI reference ranges (unstandardized β = 0.05; 95% CI, 0.01 to 0.09 and unstandardized β = 0.03; 95% CI, 0.01 to 0.05), respectively. Early television exposure also predicted lower scores on fruit and vegetable intake by 16% (unstandardized β = −0.04; 95% CI, 0.06 to −0.02) and higher consumption scores for soft drinks and snacks by 9% and 10% (unstandardized β = 0.02; 95% CI, 0.00 to 0.04 and unstandardized β = 0.01; 95% CI, 0.00 to 0.02), respectively. Increments in preschool exposure only predicted increased snacking scores among the dietary intake variables (unstandardized β = 0.01; 95% CI, 0.00 to 0.02).

COMMENT

Early childhood is characterized by critical periods in both cognitive and behavioral development.[32] Cognitively, the early years culminate in developmental expansion of intellectual skills that help children better process information, transact with their environment, and eventually use logic to understand mathematical and scientific operations.[33] Behaviorally, viewing habits begin early and persist into the school years, much like other lifestyle practices.[2,34] Developmental dispositions crystallize and subsequently influence adjustment and preferred activities.[35]

As expected, we observed modest, yet nontrivial prospective associations between early television exposure and fourth-grade outcomes. Preschool increments in exposure also made a unique contribution to developmental risk. This contribution is also above and beyond the influence of exposure at 29 months.

First, the results support previous suggestions that early childhood television exposure undermines attention.[23] Higher levels of early childhood television exposure predicted less task-oriented, persistent, and autonomous learning behavior in the classroom, according teachers. Our classroom engagement variable assessed "learning-related strategies" that encompass a constellation of required autonomous behaviors including but not limited to attention, self-discipline, self-investment, and productivity over pleasure despite boredom and/or frustration.[36-38] As such, they assess essential attention-related executive function skills in the classroom. We must bear in mind that early television exposure was measured at

Table 4. Standardized Regression Coefficients Reflecting the Relation Between Preschool Televiewing and Fourth-Grade Measures of Body Mass Index and Dietary Intake

	β (SE)			
Independent Variables[a]	Body Mass Index[b]	Fruits and Vegetables	Soft Drinks	Snacks
Early televiewing	0.05 (0.02)[d]	−0.16 (0.01)[c]	0.09 (0.01)[d]	0.10 (0.004)[d]
Change in televiewing	0.03 (0.01)[d]	−0.06 (0.01)	0.03 (0.004)	0.09 (0.003)[d]
Concurrent televiewing	0.01 (0.01)	−0.06 (0.01)[e]	0.05 (0.01)	0.06 (0.003)[e]
Sex	0.36 (0.18)[e]	−0.07 (0.07)[e]	0.13 (0.06)[c]	0.03 (0.04)
Temperament	−0.32 (0.15)[e]	−0.02 (0.06)	0.04 (0.05)	0.01 (0.03)
Cognitive ability	−0.27 (0.11)[e]	0.03 (0.05)	−0.07 (0.04)[e]	−0.03 (0.03)
Impulsivity	−0.03 (0.05)	−0.01 (0.02)	−0.03 (0.02)	0.01 (0.01)
Emotional distress	0.08 (0.10)	0.06 (0.04)[e]	−0.07 (0.04)[e]	0.02 (0.02)
Physical aggression	−0.001 (0.07)	0.04 (0.03)	0.11 (0.03)[c]	0.03 (0.02)
Hours of sleep	−0.13 (0.05)[e]	0.11 (0.02)[c]	0.06 (0.02)[e]	−0.01 (0.01)
Maternal education	−0.15 (0.23)	0.12 (.10)[c]	−0.03 (0.08)	−0.14 (0.05)[c]
Family configuration	−0.42 (0.23)	0.06 (0.09)[e]	0.01 (0.08)	−0.05 (0.05)
Family functioning	0.17 (0.07)[e]	−0.08 (0.03)[d]	0.05 (0.03)	0.03 (0.02)
Body mass index	0.14 (0.07)[c]	0.01 (0.01)	−0.01 (0.01)	0.00 (0.01)
Adjusted R squared	0.05	0.08	0.05	0.05

Abbreviation: SE, standard error.
[a] All control variables were measured at 17 months, with the exception of cognitive ability (29 months) and concurrent televiewing (fourth grade).
[b] Calculated as weight in kilograms divided by height in meters squared.
[c] $P < .001$.
[d] $P < .01$.
[e] $P \leq .05$.

a time of substantial growth in the brain regions recruited for the foundations of such effortful control processes,[6,34] which then forecast cognitive skills in kindergarten[39,40] and adolescence.[41] Because these require the successful development of effortful control,[37] our results suggest that early television exposure could eventually foster risk toward a more passive rather than active disposition when attending to learning situations.

Our results also suggest a prospective long-term association between early television exposure and mathematical achievement but, surprisingly, no beneficial or harmful effects on later reading achievement. Cognitive neuroscience suggests a comparatively stronger relationship between early attention and foundational mathematical skills than between early attention and foundational reading skills.[39] Given that early exposure negatively influences attention,[23] it might be that disrupted attentional processes undermine mathematical achievement by virtue of their common foundational links in early childhood.[42] A forthcoming study also finds a prospective association between kindergarten number knowledge and second-grade classroom engagement, as expected, with no links between receptive vocabulary and later classroom engagement.[36] Further investigation is warranted before more can be said about the role of attention as an explanatory factor in cognitive outcomes. As for the lack of significant results for reading achievement, it could be that the negative effect of early exposure on cognitive skills and small benefit of preschool exposure on reading recognition skills at the first grade transition shown in a previous study[23] fade once reading skills are consolidated by the middle grades.

Mental health professionals estimate diagnostic and prognostic clinical decisions regarding children by using normative indicators of social and academic functioning. This study examined emotional distress, reactive aggression, and victimization as respective indicators of internalizing, externalizing, and peer rejection experiences at school. Higher levels of early childhood television exposure predicted greater chances of peer rejection experiences such as being teased, assaulted, or insulted by other students, according to teachers. The long-term nature and significance beyond sex and preexisting individual and familial factors makes this result noteworthy. Social interactions are considered essential components of early childhood experience. Because there are only so many hours in a day, more televiewing leaves less time for such foundational experiences. Nevertheless, we found no links to reactive aggression. This is unusual in the context of the victimization finding. Usually, in population-based samples, being more prone to victimization translates into being more prone to using aggression to retaliate.[43] Taken in context, our results suggest that reduced time for critical social interactions in early childhood owing to displaced time spent watching television may present later specific risks of developing inadequate social skills.

Early and preschool television exposure were prospectively linked to sedentariness, with 29-month exposure predicting 9% to 13% unit decreases across all 4 indicators. The finding for video game playing likely illustrates developmental continuity in screen time from early to middle childhood. The statistical control of concurrent television exposure makes the prospective associations even more noteworthy.

Last, we observed consistent prospective associations between early exposure and fourth-grade BMI and dietary intake, above and beyond preexisting childhood BMI. Although early exposure predicted higher BMI and intake of sweets and soft drinks, its most negative influence was on fruit and vegetable intake. Also, preschool

increments in televiewing predicted higher levels of sweet snacking and BMI. It is more than plausible that the early years are particularly crucial for behavioral dispositions toward sweet snacking while engaging in hands-free and inactive leisurely pursuits like watching television. Suggestive advertisements for these types of food may further exacerbate this association.[6,14]

Preexisting maternal or familial factors predicted television exposure and were consistently related to most of the dependent variables, making them, in addition to sex, essential as controls. The other variables implemented as controls did not achieve importance as predictors of television exposure. Moreover, child temperament, early behavior, and sex did not predict early television exposure or preschool changes in exposure. This means that mothers did not favor more television exposure for boys or children with temperamental or behavioral problems. This finding, although far from the main objective of the study, is interesting given that it rules out alternative explanations about parental use of television as a buffer for negative interactions with more challenging children. Although some controls factors were unrelated to the television variables, their inclusion was substantively justified in relation to the outcome variables.

We underscore several limitations associated with using population-based longitudinal studies for secondary analyses. First, the measure of television exposure was not ideal because it did not comprise a finely tuned scale of televiewing quantity nor did it assess the actual quality and content of television exposure. Nevertheless, the measure used was robust enough to estimate the unique contribution of total weekly hours of exposure in relation to later well-being on a broad range of outcomes.[34] Second, there is concern about attrition bias because selection criteria required having data at both 29 and 53 months. This resulted in a lower risk sample for analysis. Third, children were not individually tested for achievement in mathematics and reading. Teacher reports may not have been sensitive enough to detect more compelling results regarding verbal skills. Achievement tests would have been ideal.

Because it seems so innocuous and entertaining, a population-level understanding of the developmental risks associated with television exposure remains challenging.[5,44] In the spirit of preventive medicine, which concerns itself with promoting health and preventing illness,[45] we conceptualized children's outcomes at 10 years of age as markers for subsequent mental and physical health. The results, which only address early childhood exposure in terms of quantity, are compelling, given that we might have expected the prospective associations to disappear after 5 years. Remarkably, the results suggested adverse effects despite having a low-risk sample, making the "potential for harm" public health argument stronger. Exposure at 29 months had the most consistent negative prospective associations across domains. They proportionately exceeded or were as large as concurrent television exposure. There are no studies, to our knowledge, that address the potential long-term effects of early television exposure on a comprehensive range of key developmental variables with several data sources and a consistent application of preexisting control variables. Our findings, spanning different levels of child functioning, support the need for better parental compliance with American Academy of Pediatrics television exposure guidelines for young children.[1]

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