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Association of Early-Life Social and Digital Media Experiences With Development of Autism Spectrum Disorder–Like Symptoms

Karen Frankel Heffler, MD; Danielle M. Sienko, MS; Keshab Subedi, MS, MSc; Kathleen A. McCann, MPhil; David S. Bennett, PhD

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Supplemental content

IMPORTANCE Despite growing evidence that parent-child interactions and time viewing digital media affect child development, these factors have rarely been studied in association with autism spectrum disorder (ASD) symptoms.

OBJECTIVE To determine the association of experiential factors, including social activities and screen viewing in the first 18 months of life, perinatal factors, and demographic factors, with ASD-like symptoms and risk on the Modified Checklist for Autism in Toddlers (M-CHAT) at 2 years.

DESIGN, SETTING, AND PARTICIPANTS Data for this cohort study were derived from the National Children's Study, a US multicenter epidemiological study of environmental influences on child health and development. A total of 2152 children were enrolled at birth from October 1, 2010, to October 31, 2012. Data were analyzed from December 1, 2017, to December 3, 2019.

EXPOSURES Caregivers reported whether the child viewed television and/or videos (yes or no) at 12 months of age, hours of viewing at 18 months of age, time spent by the caregiver reading to the child (number of days per week compared with daily) at 12 months of age, and frequency of playing with the child (daily or less than daily) at 12 months of age. Prematurity, maternal age at birth, child sex, household income, race/ethnicity, and caregiver English-language status were included in analysis.

MAIN OUTCOMES AND MEASURES Significant association of exposures with ASD risk by M-CHAT and/or ASD-like symptoms assessed by revised M-CHAT (M-CHAT-R) total score in multiple regression models.

RESULTS Among the 2152 children included in the analysis (1099 boys [51.1%]), television and/or video viewing (yes or no) at 12 months of age was significantly associated with greater ASD-like symptoms at 2 years of age (change, 4.2%; 95% CI, 0.1%-8.3%) but not with ASD risk (risk prevalence rates, 8.3% vs 4.4%; adjusted odds ratio [AOR], 1.40; 95% CI, 0.86-2.29). Similarly, parent-child play daily compared with less than daily was significantly associated with fewer ASD-like symptoms at 2 years of age (change, −8.9%; 95% CI, −16.5% to −0.9%) but not with ASD risk (risk prevalence rates, 6.4% vs 14.0%; AOR, 0.58; 95% CI, 0.31-1.08). However, high screen viewing at 18 months of age was not significantly associated with ASD-like symptoms (change, 10.7%; 95% CI, −2.0% to 23.0%) or ASD risk by M-CHAT (AOR, 1.18; 95% CI, 0.56-2.49) at 2 years of age.

CONCLUSIONS AND RELEVANCE This cohort study found greater screen exposure and less caregiver-child play early in life to be associated with later ASD-like symptoms. Further research is needed to evaluate experiential factors for potential risk or protective effects in ASD.

Author Affiliations: Department of Ophthalmology, Drexel University College of Medicine, Philadelphia, Pennsylvania (Heffler); Dornsife School of Public Health, Drexel University, Philadelphia, Pennsylvania (Sienko); Value Institute, Christianacare Health System, Wilmington, Delaware (Subedi); Social & Scientific Systems, Inc, Silver Spring, Maryland (McCann); Department of Psychiatry, Drexel University College of Medicine, Philadelphia, Pennsylvania (Bennett).

Corresponding Author: David S. Bennett, PhD, Department of Psychiatry, Drexel University College of Medicine, 4700 Wissahickon Ave, Philadelphia, PA 19144 (db36@drexel.edu).

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Autism spectrum disorder (ASD) prevalence has increased to a current level of 1 in 59 children in the United States.[1] Although genetics impart 50% to 80% of risk in ASD, nongenetic contribution of risk is also significant but poorly understood.[2] Perinatal and demographic factors have been associated with ASD risk.[3-5] However, findings are inconsistent regarding the association between socioeconomic status and ASD prevalence[6,7] and differences in prevalence among minority and nonminority populations.[1,8]

Early experiential factors, such as screen media viewing and parental reading to and playing with one's children, have rarely been studied prospectively in association with ASD symptom outcomes. However, greater screen viewing has been associated with ASD and negative developmental outcomes.[9-15] Screens interfere with parent-child interactions[16] and offer little opportunity for learning for infants and toddlers compared with real-life social interactions.[17-19] In addition, socially engaged parenting has been associated with positive child developmental outcomes.[20-23] Because of the potential for these modifiable experiential factors to contribute to negative and positive child development, a better understanding of the association of these experiences with ASD outcomes may provide opportunities to somewhat mitigate genetic predisposition. Using longitudinal data from the National Children's Study (NCS), a US multicenter epidemiological study of environmental influences on child health and development,[24] we examined the extent to which early screen exposure and social engagement through play and reading as well as previously identified perinatal and demographic factors were each associated with later risk of ASD and ASD-like symptoms as measured by the Modified Checklist for Autism in Toddlers (M-CHAT).[25]

Key Points

Question Are screen media exposure and social and demographic factors associated with the risk for autism spectrum disorder (ASD) or ASD–like symptoms on the Modified Checklist for Autism in Toddlers at 2 years of age?

Findings This cohort study of 2152 children controlled for perinatal and demographic variables and found that television and/or video exposure and less caregiver-child interactive play at 12 months of age were each significantly associated with greater ASD-like symptoms, determined by total revised Modified Checklist for Autism in Toddlers score, but not with the risk of ASD. Additional perinatal and demographic findings are discussed.

Meaning Less screen exposure and more parent-child play at 12 months of age were associated with fewer ASD–like symptoms at 2 years of age, and more research on early experiential factors is recommended.

Methods

Data Source and Study Sample

Participants in this cohort study were enrolled at birth in the NCS from October 1, 2010, to October 31, 2012. Data for the present report are from the NCS Archive,[24] a publicly available repository of NCS data and samples in which 5608 children and their caregivers participated in at least a portion of the study visits from preconception through 42 months of age. Initially intended as a large national cohort study of environmental effects on children, the NCS was discontinued prematurely by the National Institutes of Health. For the present report, only children in the subcohort who had an M-CHAT score before NCS termination were included. This study was deemed exempt from formal approval by the Drexel University institutional review board and from informed consent because the NCS data source contained no personally identifying information. This study followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guideline.

The study cohort was not intended to be nationally representative. Experiential factors were assessed at 12 months of age, with screen exposure also assessed at 18 months of age. At the 12-month visit, caregivers answered questions assessing screen viewing frequency ("Does your child watch TV/DVDs?" [no or yes]), reading frequency ("How often does participant read or look at books with child?" [once a week or less; 2-4 days a week; 5-6 days a week; or every day]), and caregiver play frequency ("How often does participant play with toys with child?" [less than daily or daily]). At the 18-month visit, screen exposure was assessed with the question, "Over the past 30 days, on average, how many hours per day did child watch TV and/or DVDs?" Responses were none, 1 hour or less, 2 hours, 3 hours, 4 hours, and 5 or more hours. Given that prior retrospective research has found early screen exposure of more than 4 hours to be associated with ASD,[10] the 18-month screen exposure variable was recoded as 3 hours per day or less or 4 hours per day or more.

Perinatal and Demographic Factors

Gestational age was coded as very premature (<32 weeks), premature (32-35 weeks), or full term (≥36 weeks). Maternal age was coded as 34 years or younger, 35 to 39 years, or 40 years or older. Household income was recorded on a 4-point scale as less than $30 000, $30 000 to $49 999, $50 000 to $99 999, or $100 000 or more. English-speaking caregiver was recorded in response to the item, "Was the interview completed in English?" (no or yes). Race/ethnicity, included as a variable to examine whether outcomes differed across race/ethnicity, was recorded by parent response on the questionnaire to preset categories determined by the NCS, including non-Hispanic white, Hispanic, black, Asian, American Indian/Alaska Native, Native Hawaiian and other Pacific Islander, multiple ethnicities/races, or other. The race/ethnicity was recoded as Hispanic, non-Hispanic white, non-Hispanic black, or non-Hispanic other owing to a small number of respondents in each of the other race/ethnicity categories.

Outcomes were assessed using the M-CHAT, a validated screening tool to assess ASD-like symptoms among toddlers aged 16 to 30 months.[25] Primary caregivers completed the 23-item M-CHAT, which uses a yes or no response format, when their child was 19 to 30 months of age (mean [SD], 26.6 [2.1] months). The M-CHAT has 2 different modes of scoring that served as outcomes. First, ASD risk was assessed using the original M-CHAT scoring, with a positive screen finding indicated

Table 1. Characteristics of the Study Participants

Parameter	Study participants, No. (%) (n = 2152)[a]
Child sex	
Male	1099 (51.1)
Female	1053 (48.9)
Gestational age, wk	
<32 (Very premature)	21 (1.0)
32-35 (Premature)	99 (4.6)
≥36 (Full term)	2009 (93.4)
Missing	23 (1.1)
Maternal age at birth, y	
≤34	1704 (79.2)
35-39	314 (14.6)
≥40	61 (2.8)
Missing	73 (3.4)
Race/ethnicity	
Hispanic	255 (11.85)
Non-Hispanic	
White	1527 (71.0)
Black	157 (7.3)
Other	196 (9.1)
Missing	17 (0.8)
Annual household income, $	
<30 000	602 (28.0)
30 000-49 999	327 (15.2)
50 000-99 999	626 (29.1)
≥100 000	346 (16.1)
Missing	251 (11.7)
Parent language	
English	2013 (93.5)
Other	139 (6.5)

[a] Percentages have been rounded and may not total 100.

by the endorsement of 2 or more critical items or 3 or more of any items.[25] Because the M-CHAT has a low positive predictive performance in the general population,[26] we also assessed ASD-like symptoms based on total score of the revised M-CHAT (M-CHAT-R), on which higher scores correlate with greater specificity.[27] Three questions included in the original M-CHAT were dropped on the M-CHAT-R owing to poor predictive performance.[27] Accordingly, total scores were based on summing the 20 M-CHAT questions that had content parallel to the M-CHAT-R items, with total scores ranging from 0 to 20 (higher scores indicate greater ASD-like symptoms).[27]

Data Analysis

Data were analyzed from December 1, 2017, to December 3, 2019. All variables related to characteristics of the study population were categorical. We present the patient characteristics as counts and percentages. We fitted a multiple logistic regression model to estimate the association of demographic, perinatal, and experiential factors with ASD risk. The covariates included in the logistic regression model were gestational age, maternal age at birth, child sex, family income, English-speaking status of parents, race/ethnicity, play frequency at 12 months, reading frequency at 12 months, screen exposure at 12 months, and screen exposure at 18 months. Likewise, a linear regression analysis was conducted using the total M-CHAT-R score as the outcome with the same covariates. In the linear regression model, the M-CHAT-R score was corrected for positive skew using a natural log transformation. For ease of interpretation, the results from the linear regression models are presented in terms of percentage change calculated as $(1 - e^{\beta}) \times 100$, where β indicates coefficients from the linear regression model. The percentage change can be interpreted as change in the expected M-CHAT-R score of a given category compared with that of the reference category of a variable in percentage scale. To correct for heteroskedasticity of the M-CHAT-R score in the linear regression, the robust linear model macro[28] with the HC3 variance-covariance matrix was used. For both logistic and linear regression analyses, E-values were computed for each significant risk factor to provide an estimate of unobserved confounding.[29] E-values estimate the minimum strength of association that an unmeasured confounder would need to have with the risk factor and outcome to nullify an observed association. Multiple imputation of 100 data sets was conducted to manage missing data (12.7% missing) with all study variables included in the imputation model. All analyses were conducted using SPSS software, version 24.0 (IBM Corporation).

Results

Participant Characteristics

A total of 3603 children had 2-year visits in the NCS, and of these, the parents of 2231 (61.9%) voluntarily completed the M-CHAT; 79 potential participants were ineligible owing to having multiple children from the same families. The population for this analysis included the remaining 2152 children (1099 boys [51.1%] and 1053 girls [48.9%]) (**Table 1**). Responders included biological parents for 1973 children (91.7%), guardians for 164 (7.6%), grandparents or other relatives for 11 (0.5%), teachers for 2 (0.1%), and child care providers for 2 (0.1%). eTable 1 in the Supplement gives characteristics of the study cohort (with completed M-CHAT) compared with the nonstudy cohort (children too young at NCS termination or parents did not elect to complete the M-CHAT). eTable 2 in the Supplement compares the county of origin of study and nonstudy NCS cohorts. Overall, 150 participants (7.0%) had positive screens on the M-CHAT, including 84 of 1099 boys (7.6%) vs 66 of 1053 girls (6.3%).

Experiential Exposures

The results of multiple logistic regression of ASD risk are presented in **Table 2**. The results from the multiple linear regression of the ASD-like symptoms (M-CHAT-R score) are given in **Table 3**.

When covaried with perinatal and demographic factors, television and/or video viewing at 12 months of age compared with no viewing was significantly associated with greater ASD-like symptoms by M-CHAT-R total score (change, 4.2%; 95% CI, 0.1%-8.3%) but was not significantly associated with

Table 2. Perinatal, Demographic, and Experiential Factors Associated With ASD Risk at 2 Years of Age: Results From the Multiple Logistic Regression Model of M-CHAT Cutoff Scoring

Variable	Prevalence of ASD risk, %	AOR (95% CI)
Perinatal Factors		
Gestational age, wk		
<32	8.8	3.19 (0.63-16.13)
32-35	17.2	2.49 (1.38-4.50)
≥36	6.4	1 [Reference]
Maternal age, y		
35-39	6.3	1.14 (0.91-3.44)
≥40	6.5	0.97 (0.81-3.17)
<35	7.1	1 [Reference]
Child sex		
Female	6.3	0.85 (0.60-1.21)
Male	7.6	1 [Reference]
Demographic Factors		
Annual household income, $		
30 000-49 999	7.0	0.34 (0.16-0.74)
50 000-99 999	4.0	0.43 (0.19-0.99)
≥100 000	2.8	0.89 (0.31-1.54)
<30 000	12.0	1 [Reference]
Parent language		
English	6.2	0.65 (0.34-1.25)
Other	16.2	1 [Reference]
Race/ethnicity		
Hispanic	14.0	3.38 (2.20-5.65)
Black	14.6	1.76 (0.91-3.44)
Other	13.5	1.60 (0.81-3.17)
Non-Hispanic white	4.1	1 [Reference]
Experiential Factors		
Play frequency at 12 mo		
Daily	6.4	0.58 (0.31-1.08)
Less than daily	14.0	1 [Reference]
Reading frequency at 12 mo, d/wk		
≤1	15.5	1.89 (0.84-4.24)
2-4	9.1	1.19 (0.51-2.79)
5-6	7.5	1.39 (0.67-2.87)
Daily	4.2	1 [Reference]
Screen exposure at 12 mo		
Yes	8.3	1.40 (0.86-2.29)
No	4.4	1 [Reference]
Screen exposure at 18 mo, h/d		
≥4	11.0	1.18 (0.56-2.49)
≤3	6.7	1 [Reference]

Abbreviations: AOR, adjusted odds ratio, ASD, autism spectrum disorder; M-CHAT, Modified Checklist for Autism in Toddlers.

Table 3. Perinatal, Demographic, and Experiential Factors Associated With ASD-Like Symptoms at 2 Years of Age: Results From the Multiple Linear Regression Model of M-CHAT-R Total Score

Variable	M-CHAT-R score, median (IQR)	Change, % (95% CI)[a]
Perinatal Factors		
Gestational age, wk		
<32	1 (0 to 2)	10.6 (−14.7 to 43.6)
32-35	1 (0 to 1)	12.7 (1.6 to 25.2)
≥36	0 (0 to 1)	[Reference]
Maternal age, y		
35-39	0 (0 to 1)	2.2 (−3.4 to 8.2)
≥40	0 (0 to 1)	−6.1 (−15.7 to 4.6)
<35	0 (0 to 1)	[Reference]
Child sex		
Female	0 (0 to 1)	−1.6 (−5.3 to 2.3)
Male	0 (0 to 1)	[Reference]
Demographic Factors		
Annual household income, $		
30 000-49 999	0 (0 to 1)	−4.6 (−10.2 to 1.5)
50 000-99 999	0 (0 to 1)	−9.3 (−13.8 to −4.7)
≥100 000	0 (0 to 1)	−13.8 (−17.7 to −7.8)
<30 000	0 (0 to 1)	[Reference]
Parent language		
English	0 (0 to 1)	−19.3 (−26.2 to −10.5)
Other	1 (0 to 2)	[Reference]
Race/ethnicity		
Hispanic	1 (0 to 2)	17.4 (8.7 to 26.7)
Black	1 (0 to 1)	23.9 (12.9 to 35.8)
Other	0 (0 to 1)	16.5 (7.0 to 27.0)
Non-Hispanic white	0 (0 to 1)	[Reference]
Experiential Factors		
Play frequency at 12 mo		
Daily	0 (0 to 1)	−8.9 (−16.5 to −0.9)
Less than daily	0 (0 to 2)	[Reference]
Reading frequency at 12 mo, d/wk		
≤1	1 (0 to 1)	7.4 (−3.5 to 19.5)
2-4	0 (0 to 1)	0.7 (−4.9 to 6.7)
5-6	0 (0 to 1)	−2.2 (−7.8 to 3.8)
Daily	0 (0 to 1)	[Reference]
Screen exposure at 12 mo		
Yes	0 (0 to 1)	4.2 (0.1 to 8.3)
No	0 (0 to 1)	[Reference]
Screen exposure at 18 mo, h/d		
≥4	0 (0 to 1)	10.7 (−2.0 to 23.0)
≤3	0 (0 to 1)	[Reference]

Abbreviations: ASD, autism spectrum disorder; IQR, interquartile range; M-CHAT-R, Modified Checklist for Autism in Toddlers, Revised.

[a] Can be interpreted as the percentage difference in the expected M-CHAT-R score of a given category compared with that of the reference category of a variable.

ASD risk by M-CHAT (risk prevalence rates, 8.3% vs 4.4%; adjusted odds ratio [AOR], 1.40; 95% CI, 0.86-2.29). Parental play every day vs play less than every day was significantly associated with fewer ASD-like symptoms (change, −8.9%; 95% CI, −16.5% to −0.9%) but not with ASD risk (risk prevalence rates, 6.4% vs 14.0%; AOR, 0.58; 95% CI, 0.31-1.08). Screen viewing of 4 hours or greater compared with 3 hours or less per day at 18 months of age was not significantly associated with ASD-like symptoms (change, 10.7%; 95% CI, −2.0% to 23.0%) or ASD

risk (AOR, 1.18; 95% CI, 0.56-2.49) at 2 years of age. In addition, reading to one's child less than daily compared with daily at 12 months of age was not significantly associated with ASD-like symptoms or ASD risk.

Perinatal and Demographic Factors

Gestational age of 32 to 35 weeks (compared with ≥36 weeks) was associated with greater ASD risk by M-CHAT (AOR, 2.49; 95% CI, 1.38-4.50) and with greater ASD-like symptoms (change, 12.7%; 95% CI, 1.6%-25.2%) when controlling for the other factors. Less than 32 weeks' gestation did not show a significant association with either outcome, likely owing to the modest sample of very premature infants. Family income of $30 000 to $49 999 compared with less than $30 000 was associated with lower ASD risk (AOR, 0.34; 95% CI, 0.16-0.74) but not with ASD-like symptoms, whereas family income of $50 000 to $99 999 was associated with both lower ASD risk (AOR, 0.43; 95% CI, 0.19-0.99) and fewer ASD-like symptoms (change, −9.3%; 95% CI, −13.8% to −4.7%), and family income of $100 000 or more was associated only with fewer ASD-like symptoms (change, −13.8%; 95% CI, −17.7% to −7.8%). Hispanic ethnicity compared with non-Hispanic white ethnicity was associated with a higher ASD risk (AOR, 3.38; 95% CI, 2.20-5.65) and greater ASD-like symptoms (change, 17.4%; 95% CI, 8.7%-26.7%). Black (change, 23.9%; 95% CI, 12.9%-35.8%) and other (change, 16.5%; 95% CI, 7.0%-27.0%) race/ethnicity compared with non-Hispanic white race/ethnicity were both associated with greater ASD-like symptoms but not with ASD risk. Having an English-speaking parent compared with a non-English-speaking parent (change, −19.3%; 95% CI, −26.2% to −10.5%) was associated with fewer ASD-like symptoms. Maternal age and child sex were not significantly associated with ASD risk or symptoms. The E-value for the observed association between significant variables and ASD risk ranged from 4.08 to 6.21 for ASD risk, indicating that the findings could be explained away by an unmeasured confounder associated with both the individual variable and ASD risk if it had an OR of 4.08 or greater but that weaker confounding would not do so. The E-values for significant risk factors for ASD-like symptoms were smaller, ranging from 1.25 to 1.78 (eTable 3 in the Supplement).

Discussion

Experiential Exposures

The present study is unique in assessing association of early experiential exposures with ASD risk and ASD-like symptoms by M-CHAT scores at 2 years of age. A retrospective study[10] found that 2-year-old children with ASD had an earlier age of screen viewing (beginning at 6 months) and had more than 4 hours of daily screen viewing on average during the early years. Given the limited nature of the screen information (viewing of television and/or videos [yes or no]) at 12 months in the present study, the association with increased ASD-like symptoms, although modest, is notable. Others have similarly reported concerns regarding negative social and cognitive outcomes associated with screen viewing in children with ASD.[30] Higher screen exposure in young children interferes with social learning,[16] is associated with altered brain processing,[15] and theoretically could promote visual brain hyperconnectivity.[31] In siblings of children with ASD who go on to develop ASD, overgrowth of the visually related brain areas at 6 to 12 months of age is one of the earliest findings.[32] However, children predisposed to ASD may have a preference for screens, or parents of children already displaying ASD symptoms may be more reliant on screens to soothe a child with self-regulation issues.[33] Other factors that affect early screen use are mothers' own screen time and their beliefs regarding children's television time.[34]

We found daily parent-child play, compared with less than daily, to be associated with fewer ASD-like symptoms. Although this association was also modest, it is important to consider the potential mitigating effect of more parent-child play on a child's social development, particularly as it relates to ASD. In typically developing children, parent-child interaction correlates with brain development,[35] and parent-child play-based intervention in toddlers with ASD is associated with improvement in ASD symptoms.[36] However, the association between parent-child play and ASD-like symptoms could be driven by the behavior of children who are beginning to develop ASD symptoms because they may be more difficult to engage socially. Assessing early social experiences more broadly and at an earlier age (eg, 6 months) before a child begins to exhibit ASD symptoms or brain manifestations would help to better establish the directionality of an association between social experiences and ASD symptoms in early childhood.

Demographic and Perinatal Factors

The present study found lower family income to be associated with both greater ASD risk on the M-CHAT screen and greater ASD-like symptoms. Some US studies have reported a higher prevalence of ASD among families with higher incomes,[6,37] whereas studies performed in countries with universal health care reported lower family income associated with greater ASD prevalence.[7] These differences may reflect a diagnosis bias or limited access to specialists for those with fewer resources in countries without universal health care.[7]

An association between immigrant status of the mother and higher rates of ASD in the child has been previously reported.[5] By using non-English speaking as a proxy for caregivers' immigrant status, we found a similar association with ASD-like symptoms. In addition, we found greater ASD risk and ASD-like symptoms to be present among Hispanic children compared with non-Hispanic white children. One study found that minority children have a higher initial rate of positive screening than white children on the M-CHAT-R and a lower rate of positive screening at follow-up but a similar rate of ASD diagnosis.[38] Historically, lower prevalence rates of ASD have been reported in Hispanic children compared with black children, who have had lower rates than non-Hispanic white children, but these differences are narrowing.[1] Nonetheless, higher rates of ASD in Hispanic and African American or black children compared to non-Hispanic white children have previously been reported.[8]

Preterm birth was associated with ASD risk and ASD-like symptoms at 2 years of age in line with prior research.[3] The present study did not show any association of maternal age with children's ASD risk or ASD-like symptoms once other risk factors were covaried. Greater ASD risk in the offspring of both the oldest and youngest groups of mothers[4,39] and no association of maternal age with ASD risk[40] have been reported. Differences in age groupings across studies may partially explain these inconsistent findings. We did not find a significant difference between sexes in either outcome. This finding may be partially owing to our outcomes being based on a symptom questionnaire rather than diagnosis because girls with a similar level of ASD symptoms as boys are less likely to receive a diagnosis, and the higher language ability of girls may partially mask the diagnosis.[41,42]

Limitations

The present study has several limitations. First, analyses were limited by the available data from the NCS. Although ASD-like symptoms as reported primarily by caregivers on the M-CHAT suggest increased risk of an ASD diagnosis, there are significant false-positive results on initial screening that can be differentially affected by factors such as race/ethnicity and parental educational attainment.[38] In addition, the cohort had a self-selection bias determined by parent interest in completing the M-CHAT. Future prospective research on experiential risk factors would benefit from use of an actual ASD diagnosis. Second, the assessments of screen exposure and caregiver-child interactions were based on single items that do not fully capture the quantity, type, and quality of screen exposure or parent-child interaction. Assessment of screen exposure at an even earlier age that includes exposure time to all types of screens and the content and context of viewing could provide a more accurate estimate of the association between screen exposure and ASD. Optimally, the reading and play data would also include more comprehensive assessments across multiple ages. The current experiential factors data were based on caregiver self-report. Use of a daily diary or recording device to detect daily activity regarding caregiver-child joint activities and screen exposure may provide more accurate data. Third, the finding that some exposure factors were associated with ASD-like symptoms but not ASD risk raises the concern that the significant difference in ASD-like symptoms driving this association could potentially be at the lower level of symptoms, possibly representing a variance in ASD-like symptoms in the typical population. Last, based on our reported E-values, a relatively small amount of confounding by variables not included in our regression models could affect the findings.

Conclusions

This study is unique in prospectively finding that child screen viewing at 12 months of age was associated with greater ASD-like symptoms, whereas more parent play with the child at 12 months of age was associated with fewer ASD-like symptoms. Although modest in our findings, this outcome is an important area of research because these factors are potentially modifiable through parental education. We suggest that pediatricians thoroughly educate parents regarding the American Academy of Pediatrics recommendations to avoid screen viewing in children younger than 18 months.[43] We also found prematurity, minority race/ethnicity, and lower family income to be associated with greater ASD risk and ASD-like symptoms on the M-CHAT, adding to the literature regarding perinatal and demographic risk factors. We suggest the need for future studies that assess experiential factors early in life and later autism diagnosis to further assess the possible role of modifiable risk and protective factors among children at risk for ASD. Earlier assessment of modifiable experiential factors, such as screen viewing, playing with a child, and other indicators of social interaction, as well as consideration of gene-factor interactions and the use of brain imaging studies, would further assess the extent to which such factors could present an increased risk or protective role in ASD.

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