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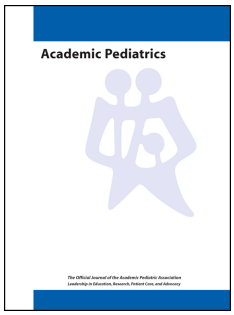

Children with Autism Spectrum Disorder and Screen Time: Results from a large, nationally representative US study

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Children with Autism Spectrum Disorder and Screen Time: Results from a large, nationally representative US study

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Short title: Autism and screen time.

Abbreviations: NSCH: National Survey of Children's Health, ASD: Autism spectrum disorder, FPL: Federal poverty line.

Key Words: autism, screen time, media, television, video, computer, National Survey of Children's Health, United States, media use.

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What's New?
More than half US children exceed screen time AAP recommendation. No evidence children with ASD differ from other US children in total, media, or computer leisure screen time; they display a milder age gradient for computer time than other children.

Abstract

Background/aims: To test the hypotheses that children with ASD have higher screen time than other children on a US nationally representative sample and that children with ASD are overrepresented among children who exceed the American Academy of Pediatrics (AAP) screen time recommendation (<= 2h/day).

Methods: The National Survey of Children's Health 2011-12, a nationally representative survey, asked parents to report their child's (ages 6-17) average daily media usage. ASD subpopulation (n=1393) was compared to children without ASD (non-ASD, n=64,163). Differences were compared using design-corrected F tests. Regression models were estimated for both groups separately. Adjusted Wald tests were used to rigorously test the hypotheses.

Results: More than half US children exceed the AAP screen time recommendation. Compared to non-ASD, children with ASD had similar amounts of total screen time (3.21 h/day vs. 3.46 h/day, p>.05), media (TV/video) time and computer/mobile device leisure time. Children with ASD have a milder age gradient than the general population on computer/mobile device usage. Children with ASD were proportionally represented among high users (>2h/day). Data did not support hypotheses.

Conclusions: In a large, nationally representative US sample, there was no evidence that children with ASD differ in their screen time habits from other children. Both groups have high screen time use. Caution should be exercised before assuming that children with ASD are at higher risk of exceeding AAP screen time recommendations. Efforts to promote adherence to the recommendation are needed, but they should neither target nor exclude children with ASD.

Introduction

Autism spectrum disorders (ASD) are characterized by social, communication and behavioral deficits. Children with ASD are known to have deep interests in relatively narrow subjects.[1] There is anecdotal evidence that children with ASD have great interest in computers and technology. In some cases, preoccupation with screen time activities can become problematic among children with ASD.[2-4] High screen time has been associated with poor health outcomes such as increased sleep problems and has also been identified as a barrier to physical activity among children with ASD.[5,6]

In the general population, studies have shown that almost half of children spend more than 2.2 h/day in screen time sedentary activities (television, video, leisure computer time, on any device). Screen time is negatively associated with household income, parental education, being female, and being white (vs. African American).[7-11] The American Academy of Pediatrics (AAP) recommends a maximum of two hours/day total screen time for leisure.[12]

Research on children with ASD's usage of screen time is limited. An early study estimated that children with ASD spent 2.3 h/day watching television and 1.7 h/day on the computer.[13] Other studies have reported that the majority of children with ASD spent most of their leisure time on screen time activities.[13,14] Recently, it was estimated that adolescents with ASD watch about 2 h/day of television but spend 5h/day using computers.[15] Children with ASD also differ in the type of content they use, engaging more in solitary activities (television) and less in socially interactive media.[14]

All these studies[13-15] do not have comparisons to the US general population of children, comparing instead to children who have other impairments or to siblings of children with ASD.

It is speculated, however, that children with ASD have a higher prevalence of screen time than the general population.

Consistent with the literature, this study hypothesizes that (H1) children with ASD will spend more time in screen based leisure activities than other children in the general US population, and that (H2) they will be over-represented among children who exceed the AAP recommendation (<= 2h/day total screen time).

Methods

Sample

The National Survey of Children's Health (NSCH) 2011-12 is a random-digit, cross-sectional US nationally representative survey that interviewed 95,677 parents or guardians about a randomly selected child in their household. It was conducted between February 2011 and June 2012. It used the National Immunization Survey sampling frame and included cell phone only households as well as traditional lines. It reports a 23% response rate, lower than previous NSCH surveys because of the inclusion of cell-phone only households.[16] The public data file provides weights that adjust for nonresponse bias and allow generalization to the US noninstitutionalized child population. Information about the methods and approaches used for this survey, including consent procedures are available.[17] The analytic sample was restricted to parents of children 6 to 17 because media-related questions were only asked among parents of children in these ages.

Measures

Autism

Parents were first asked "please tell me if a doctor or other health care provider ever told you that [child] had the condition, even if the child does not have the condition now" with the condition being "Autism, Asperger's Disorder, pervasive developmental disorder or other autism

spectrum disorder?" Parents could answer yes, no or don't know. Later on, parents who had answered affirmatively were asked "does [child] currently have Autism?" with the same three possible answers. As in other studies,[16] an affirmative response to both questions was coded as the child having ASD.

Screen Time

In section 7 of the NSCH 2011-12 survey, there is a brief subdomain on media consumption. Parents were asked to estimate the daily average time that their child spent "in front of TV, watching TV programs, videos, DVDs or playing video games" on a weekday. Parents could answer by giving time in minutes or hours. This variable, media time, was recoded so the time was expressed in hours for all respondents.

Similarly, parents were asked to estimate the daily average time, on a weekday, of computer/mobile devices usage by asking "how much time does child usually spend with computers, cell phones, handheld video games, and other electronic devices, doing things other than school work?" This variable, computer/mobile device time, was recoded so the time was expressed in hours for all respondents. Total screen time was calculated by adding both variables. High users were children whose total screen time exceeded (> 2h/day) the AAP recommendation.

Known social determinants of screen time usage (covariates)

Standard social determinants in the typically developing population were age, gender, race and ethnicity, household income, and parental education. Age, gender, and Hispanic ethnicity were available directly from the survey as either a question that was asked or as a derived variable available in the public data file. Minority was coded as non-white (Black, other) vs. white. Household income was measured as a 5 category variable that placed the household in

one of the multiples of the federal poverty line (at or below 100% FPL, between 100-200% FPL, between 200-300% FPL, between 300-400% FPL and above 400% FPL). These categories were entered as indicator variables in the regression models. Parental education was coded as 1 if the highest level of parental education (mother, father or main guardian) was high school or lower, and zero otherwise.

Analysis

All statistical analyses were appropriately weighted to account for the complex survey design following CDC recommendations for this type of survey.[18] Cross tabulations used designed corrected F tests. Ordinary least squares was used to estimate the regression models. The dependent variables were positively skewed and were transformed with natural logs to normalize them before regression analyses. For each dependent variable two models with the same regressors were estimated, one for the ASD group and another for the non-ASD group. This approach was chosen because it does not assume that covariates are associated with the screen time outcomes in the same manner for both groups. Adjusted Wald tests were used to test the joint hypothesis that all regressors had the same coefficients in both models (model equality), and to test individually the same hypothesis for each regressor (coefficient equality). All analyses were performed using Stata 13 (Stata Corp, College Station, TX). P values were set at the.05 level.

Results

Prevalence & Division into Groups.

There were 1,393 children with ASD in the data set for an estimated ASD prevalence of 2% for children ages 6-17, consistent with previous reports.[16] There were 64,163 children without ASD in the study.

Table 1 compares both groups on the demographic variables known to be social determinants of screen time. Children with ASD were disproportionately male (82.80%, vs. 50.50%, $p<.001$) and underrepresented in households at or below the federal poverty line (FPL) (13.42% vs. 20.07%, $p<.01$). Children with ASD were proportionally represented in households with higher income levels than the FPL, and in all other households regardless of parental education, child's race, Hispanic ethnicity or child's age. Because the number of children with ASD is proportionately so small, the non-ASD group effectively mirrors the general US population, thus the differences between the ASD and non-ASD groups also describe how the ASD group differs from the US population.

Univariate Comparisons of Screen Time.

Figure 1 shows the average number of total screen time hours, computer/mobile device hours and media hours within the two cohorts (ASD and non-ASD). On average, children with ASD spent 3.21 h/day of total screen time, with 1.81 h/day of media time and 1.40 h/day of computer/mobile device time. There were no statistical differences between the ASD and the non-ASD groups in any of the dependent variables ($F_{media} = 0.88$, $p>.05$; $F_{computer} = 2.78$, $p>.05$; $F_{total} = 2.54$, $p>.05$). In cases that lack statistical significance, it is important to characterize carefully the effect size. The 95% confidence interval for the ASD total screen time compared to the non-ASD average ranged from 33 fewer minutes/day to 3 additional minutes/day (with an average effect size of 15 fewer min/day compared to the non-ASD average).

Social Determinants of Screen Time

Although there were no differences on the dependent variables by group, it is possible for those variables to have different associations with known social determinants of screen time. Table 2 shows the six regression models looking at these associations. For the Non-ASD group

the models identified a positive age gradient (b=0.085), as well as identifying males (b=0.059), non-white children (b=0.151), and children in households where parents have a high school or lower education (b=0.135) as more likely to have increased total screen time. Hispanic children (b=-0.051) and children living in more affluent households (b=-0.101, b=-0.245) were more likely to have less screen time than comparable children. For the ASD group, the only significant predictor of total screen time was age (b=0.070). Media and computer/mobile device use had similar pattern of results. Computer/mobile device time was negatively associated with one of the more affluent household income variables (b=-0.374) in the ASD group but not in the total screen time and media time ASD regressions.

Testing if Children with ASD have different Social Determinants of Screen Time.

Table 3 shows the overall joint adjusted Wald test that all coefficients of regressors are equal across the ASD and non-ASD models. The model for computer/mobile device time was different for children with ASD ($F=3.49$, $p<.001$), but there was no evidence that children with ASD had different social determinants for media time ($F=0.91$, $p>.05$) or total screen time ($F=1.59$, $p>.05$). Individual coefficient adjusted Wald tests revealed that the difference in the model for computer/mobile device time stemmed from a difference in the age coefficients. Both models show an increasing gradient by age (more computer/mobile device time for older children), but it grows at a slower rate for children with ASD (b=0.076 ASD vs. b=0.122 non-ASD). The gradients are visually displayed in Figure 2.

Examining High Users

High users were defined as those exceeding the American Academy of Pediatrics total screen time recommendation of 2 h/day. Children with ASD were proportionally represented in the high user group (54.24% ASD vs. 56.32% non-ASD, Design-corrected $F=0.44$, $p>.05$).

More than half of US children exceed the AAP recommendation. Among school age children (6-12 years old), children with ASD were also proportionally represented (47.33% ASD vs. 45.96% non-ASD, F=0.11, p>.05) with almost 5 out 10 children exceeding the AAP recommendations. Proportional representation was also found among adolescents (65.39% ASD vs. 70.66% non-ASD, F=1.49, p>.05) with 7 out of 10 children exceeding the recommendation.

Discussion

In this nationally representative, large study I found no evidence to support the following two hypotheses: (H1) children with ASD will spend more time in screen based leisure activities than other children in the general US population, and (H2) children with ASD will be over-represented among children who exceed the AAP recommendation (<= 2 h/day total screen time).

I estimated that children with ASD, ages 6-17, spend 1.81 h/day for TV/video, 1.40 h/day for computer/mobile devices and 3.21 h/day in total leisure screen time activities. These estimates are smaller than previous estimates[2,13,15] probably because previous studies focused on adolescents while this study included younger school-age children who spend fewer hours in these activities. Compared with the non-ASD group, there were no significant differences in univariate averages for computer/mobile device time, media (television/video) time, or total screen time between both groups. The estimated effect sizes were 10 fewer minutes/day for computer/mobile device usage, 5 fewer minutes/day for television/video use, and 15 fewer minutes/day in total screen time for children with ASD. The social determinants of screen time were similar between both groups, except for a milder positive age gradient for computer/mobile device use among children with ASD. In all other respects, this study of 1393 children with ASD

produced results equivalent to those that would be obtained by sampling 1400 children at random from the larger nationally representative sample.

Obviously, it is always possible that there are small undetected differences between the groups (absence of evidence is not evidence of absence). In that case, the best estimate of size and direction of such undetected differences are the effect sizes reported above which indicate children with ASD have just a few minutes less per day of total screen time than other children. Given that this study had a much larger sample size for children and adolescents with ASD than other published studies on the same topic,[2,6,13-15] the main conclusion of the study is that it is likely that whatever undetected differences really exist between the groups are too small (just a few minutes/day) to merit different practices or policies regarding media use for children with ASD.

In terms of the results for the US as a whole, this study estimates that children are spending about 2 h/day just on television and video with an additional 1.5-2 h/day on computer and mobile device leisure use. Compared with a previous study covering the 2001-2006 period, there are more children exceeding the AAP recommendation now.[19] Therefore, excessive screen time remains a problem in the US. The present study also corroborated the standard social determinants for screen time usage in the general population.[7-10] Being minority, living in lower income household, living with parents who have a lower education, being male and being non-Hispanic were associated with more screen time.

The American Academy of Pediatrics recommends 2h/day of leisure screen time. The investigation of high media users, defined as those who exceed the recommendation, found that children with ASD were proportionally represented in the high users group. About 4.5 out of 10 elementary school age children and 7 out of 10 adolescents exceed the AAP total screen time

recommendation. Better parental and teen education on the benefits of adhering to the recommendation, as well as realistic approaches to do so successfully, are needed. Families with a child with ASD and teens with ASD ought to receive the same information. More research is needed to understand how parents and teens who successfully meet the recommendations do so, as well as intervention research on what approaches result in substantial reductions of screen time.

In sum, pediatricians need to be aware that families and children with ASD are quite similar to other families regarding screen time use.

Limitations

There were some potential limitations. I was limited by the way questions were asked in the survey. In particular, I did not investigate content, or social vs. solitary use of media which may differ substantially for children with ASD.[2] Although there is no reason to believe parents reported media use differently by ASD status, it is possible that parents under report media consumption for their children. If so, our results underestimate the percentage of US children exceeding the guideline. In addition, the data collected in 2011-12 may be outdated as new media technologies that potentially change media habits have been introduced in the market since that time.

Conclusion

Caution should be exercised when making the assumption that children with ASD are at higher risk of exceeding the AAP total screen time recommendation. Parents of children with ASD should receive the same advice as other parents in following the Pediatric recommendation regarding screen time. Overall, the majority of families and children are not following the AAP recommendation for screen time usage. The national adherence to the 2 hr/day guideline has

deteriorated since 2006. Better, more effective, approaches to promote recommendation adherence are needed.

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Table 1. Demographic Characteristics by ASD group.

	No ASD			ASD			
	%	95%	CI	%	95%	CI	F
Child's age							1.23
6	8.30	[7.8,	8.8]	6.50	[4.5,	9.4]	
7	8.40	[7.9,	8.9]	6.80	[4.7,	9.7]	
8	8.00	[7.6,	8.5]	8.20	[5.6,	11.8]	
9	8.30	[7.8,	8.7]	8.60	[6.2,	11.8]	
10	8.40	[7.9,	8.9]	10.10	[6.2,	16.1]	
11	8.00	[7.6,	8.5]	12.60	[8.3,	18.7]	
12	8.60	[8.1,	9.1]	9.00	[6.5,	12.3]	
13	8.10	[7.6,	8.6]	8.00	[5.7,	11.2]	
14	8.30	[7.8,	8.8]	9.00	[5.6,	14.0]	
15	8.30	[7.9,	8.8]	7.70	[5.6,	10.6]	
16	8.90	[8.4,	9.5]	7.60	[5.2,	10.9]	
17	8.50	[8.0,	9.0]	6.00	[4.1,	8.6]	
Child is male							145.88***
Female	49.50	[48.6,	50.4]	17.20	[13.7,	21.5]	
Male	50.50	[49.6,	51.4]	82.80	[78.5,	86.3]	
Child is Minority							3.65
White	66.30	[65.4,	67.2]	73.00	[66.1,	79.0]	
Minority	33.70	[32.8,	34.6]	27.00	[21.0,	33.9]	
Hispanic ethnicity							1.44
No	77.70	[76.8,	78.6]	82.20	[74.4,	88.0]	
Yes	22.30	[21.4,	23.2]	17.80	[12.0,	25.6]	
Parental education							1.81
More than high school	45.00	[44.1,	45.9]	49.30	[43.2,	55.4]	
High school or less	55.00	[54.1,	55.9]	50.70	[44.6,	56.8]	
Household at or below FPL							10.68**
No	79.93	[79.1	80.7]	86.58	[82.9	89.6]	
Yes	20.07	[19.3	20.9]	13.42	[10.4	17.1]	
Household >FPL and < =2* FPL							0.00
No	78.10	[77.2,	78.9]	78.00	[72.9,	82.4]	
Yes	21.90	[21.1,	22.8]	22.00	[17.6,	27.1]	
Household >2* FPL and <=3*FPL							3.72
No	83.40	[82.7,	84.1]	77.60	[70.3,	83.5]	
Yes	16.60	[15.9,	17.3]	22.40	[16.5,	29.7]	
Household >3*FPL and <= 4*FPL							0.22
No	87.30	[86.7,	87.8]	86.30	[81.5,	90.0]	
Yes	12.70	[12.2,	13.3]	13.70	[10.0,	18.5]	
Household > 4*FPL							0.01
No	71.30	[70.6,	72.1]	71.60	[66.1,	76.4]	
Yes	28.70	[27.9,	29.4]	28.40	[23.6,	33.9]	

Note: FPL = federal poverty line, ** p<.01, *** p<.001.

Table 2. Multivariate OLS models of Social Determinants of Screen Time.

	COMPUTER TIME (ln)		MEDIA TIME (ln)		TOTAL TIME (ln)	
	ASD	Non-ASD	ASD	Non-ASD	ASD	Non-ASD
	b/se	**b/se**	**b/se**	**b/se**	**b/se**	**b/se**
Age	0.076***	0.122***	0.045*	0.032***	0.070***	0.085***
	-0.013	-0.003	-0.019	-0.002	-0.02	-0.002
Child is male	-0.11	0.021	0.107	0.105***	0.093	0.059***
	-0.096	-0.017	-0.106	-0.015	-0.124	-0.015
Child is not white	0.024	0.192***	-0.108	0.141***	-0.21	0.151***
	-0.098	-0.021	-0.23	-0.019	-0.241	-0.019
Child is Hispanic	0.275	-0.028	-0.819	-0.022	-0.795	-0.051*
	-0.196	-0.027	-0.432	-0.024	-0.476	-0.025
Parents have high school education or less	0.00	0.128***	0.027	0.126***	0.008	0.135***
	-0.09	-0.018	-0.101	-0.016	-0.112	-0.016
Income >100% and <=200% FPL	0.138	-0.068*	0.063	-0.035	0.158	-0.012
	-0.164	-0.032	-0.206	-0.027	-0.255	-0.028
Income >200% and <=300% FPL	-0.15	-0.104**	-0.403	-0.059*	-0.364	-0.02
	-0.155	-0.032	-0.317	-0.027	-0.35	-0.028
Income >300% and <=400% FPL	-0.374*	-0.182***	-0.083	-0.146***	-0.074	-0.101***
	-0.156	-0.033	-0.166	-0.029	-0.19	-0.03
Income >400% FPL	-0.206	-0.315***	-0.085	-0.274***	-0.047	-0.245***
	-0.149	-0.03	-0.148	-0.025	-0.174	-0.027
Constant	-0.477*	-1.286***	-0.033	-0.009	0.172	-0.084*
	-0.192	-0.043	-0.258	-0.038	-0.291	-0.039

* p<0.05, ** p<0.01, ***p<.001. ln - natural log transformation. b = coefficient, se - standard error

Table 3. Adjusted Wald Tests of Equality of Coefficients across ASD and Non-ASD equations.

	COMPUTER TIME (ln) b(ASD)-b(Non-ASD)=0		MEDIA TIME (ln) b(ASD)-b(Non-ASD)=0		TOTAL TIME (ln) b(ASD)-b(Non-ASD)=0	
	F	**p**	**F**	**p**	**F**	**p**
Overall Adjusted Wald Test (all coefficients)	3.49	0.0003	0.91	ns	1.59	ns
Individual Coefficients						
Age	12.78	0.0004	0.46	ns	0.56	ns
Child is male	1.82	ns	0.00	ns	0.07	ns
Child is not white	2.82	ns	1.16	ns	2.24	ns
Child is Hispanic	2.34	ns	3.39	ns	2.44	ns
Parents have high school education or less	1.97	ns	0.92	ns	1.25	ns
Income >100% and <=200% FPL	1.53	ns	0.22	ns	0.44	ns
Income >200% and <=300% FPL	0.09	ns	1.17	ns	0.96	ns
Income >300% and <=400% FPL	1.44	ns	0.14	ns	0.02	ns
Income >400% FPL	0.52	ns	1.56	ns	1.26	ns

Figure 1.Average Screen Time Spent per Day.

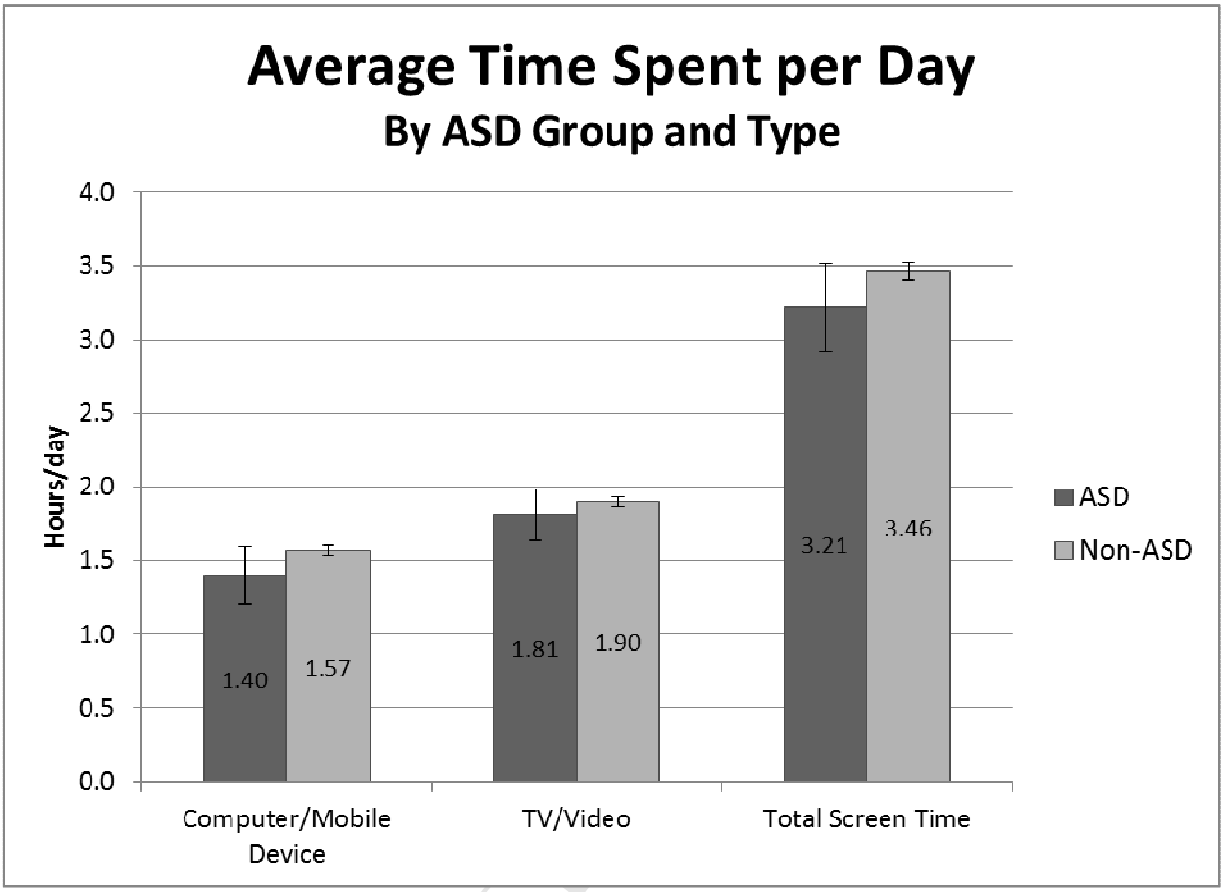

Figure 2. Age gradient of average computer/mobile device time by ASD group.