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Social vulnerability and the prevalence of autism spectrum disorder among 8-year-old children, Autism and Developmental Disabilities Monitoring Network, 2020

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Abstract

Purpose: The Autism and Developmental Disabilities Monitoring (ADDM) Network estimates the prevalence of autism spectrum disorder (ASD) throughout the United States. Reports through 2010 found higher prevalence in areas of higher socioeconomic status. Reports since 2018 indicate a pattern change. We used CDC's Social Vulnerability Index (SVI) to examine the association of ASD prevalence and social vulnerability in ADDM Network sites.

Methods: Cases of ASD among 8-year-old children in 2020 were linked to SVI measures and population estimates. Tracts were categorized into tertiles (high, medium, and low) and prevalence, prevalence ratios (PRs), and 95 % confidence intervals (CIs) were calculated.

Results: Among 5998 children with ASD, we saw higher ASD prevalence in areas with high versus low vulnerability overall (26.18 per 1000; PR=1.06 (1.00–1.13)) and in areas with more minority residents (28.28 per 1000; PR=1.29 (1.21–1.38)), less transportation (27.32 per 1000; PR=1.13 (1.06–1.20)), and greater disability (26.83 per 1000; PR=1.09 (1.02–1.17)). This pattern was observed among White children (PR=1.48 {1.36–1.60}) but reversed among Black (PR=0.61 {0.53–0.70}), Asian (PR=0.58 {0.46–0.73}), and Hispanic (PR=0.83 {0.72–0.95}) children.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.annepidem.2025.02.014.

Conclusions: Disparities in prevalence of ASD by neighborhood-level social vulnerability persist. Directing resources toward providing equitable access to healthcare and support services could help close this gap.

Keywords

Autism spectrum disorder; ADDM; Prevalence; Social Vulnerability

Purpose

Autism spectrum disorder (ASD) is a developmental disability characterized by social and communication impairment and restricted or repetitive behaviors [1]. The Autism and Developmental Disabilities Monitoring (ADDM) Network is a population-based surveillance system that estimates the prevalence of ASD among 8-year-old children in communities throughout the U.S. [2]. ADDM Network reports based on data from 2002 to 2010 showed a higher prevalence of ASD in areas of higher socioeconomic status (SES) [3–5] which was thought to be, at least in part, attributed to ascertainment bias where children with more economic advantage having more access to diagnostic testing. In more recent reports based on data from 2018 and 2020, this association changed to indicate the highest prevalence of autism in areas of low SES [6,7].

Social vulnerability is the potential negative effect a community could experience from external stresses on human health [8]. The Centers for Disease Control and Prevention and Agency for Toxic Substances and Disease Registry (CDC/ATSDR) developed the Social Vulnerability Index (SVI) to help local officials identify communities that may need support before, during, or after disasters [8]. The SVI has also been applied to analyses of public health surveillance data [9–11]. The SVI includes census-based indicators grouped into four themes and an overall composite measure. In 2022, we used the SVI to examine the association between ASD prevalence and social vulnerability using data from one ADDM site [12]. Findings indicated that ASD prevalence was higher in areas of low compared to high vulnerability for two SVI themes, and in areas of medium compared to high vulnerability for all SVI themes. In this analysis, we build upon that work to describe patterns of ASD prevalence and social vulnerability across all ADDM sites in 2020. As a comparison, we also examine ASD prevalence and median household income, which has historically been used in ADDM Network analyses to examine SES.

Methods

Biennially, ADDM conducts population-based surveillance for ASD among 8-year-old children through record review at clinical and education sources [7]. Data for 2020 were collected in selected U.S. communities within 11 ADDM sites [7]. Our analysis included children if they were 8 years old (born in 2012), lived in the ADDM surveillance area for at least one day during the 2020 surveillance year, had a home address that could be geocoded to a census tract, and met the ASD case definition. Children were identified as ASD cases if they had documentation in health, service, or education records that they had ever received a written statement from a qualified professional diagnosing autism, a special education

classification of autism in public school, or an ASD ICD code (ICD-9 codes between 299.00 and 299.99 or ICD-10 codes in the F84 range except for F84.2) obtained from administrative or billing information. A child was classified as having intellectual disability (ID) if they had scores of ≤ 70 on their most recent test of cognitive ability or a statement about a child's intellectual disability from a qualified professional in a developmental evaluation [13]. We collected demographic data for sex, race, and Hispanic ethnicity from health and education records, or if missing from records, from birth certificates. Race was collected as Black or African American ("Black"), White, Asian or Pacific Islander ("Asian"), American Indian or Alaska Native ("AIAN"), or two or more races ("Multiracial"). For this analysis, race was considered separately from Hispanic ethnicity. Among 6245 children with autism that were included in the ADDM 2020 surveillance area, based on county of residence or attendance at school districts within the surveillance area, 247 (4 %) were excluded from our analysis because of missing census tract information.

The 2020 SVI includes 16 census-based indicators, grouped into four themes - Socioeconomic Status ("SES") (comprised of "Below 150 % Poverty", "Unemployed", "Housing Cost Burden", "No High School Diploma", "No Health Insurance"), Household Characteristics ("Household") (comprised of "Aged 65 and Older", "Aged 17 and Younger", "Civilian with a Disability", "Single-Parent Households", "English Language Proficiency"), Racial and Ethnic Minority Status ("Minority") (comprised of "Hispanic or Latino", "Non-Hispanic Black or African American", "Non-Hispanic Asian", "Non-Hispanic American Indian or Alaska Native", "Non-Hispanic Native Hawaiian or Pacific Islander", "Non-Hispanic Two or More Races", "Non-Hispanic Other Race"), and Housing Type and Transportation ("Transport") (comprised of "Multi-Unit Structures", "Mobile Homes", "Crowding", "No Vehicle", "Group Quarters"), and an overall composite measure ("Overall SVI") which encompasses all of these variables [14]. Our analysis included each of these themes, the Overall measure, and the individual census variable "Civilian with a Disability" ("Disability"), which was examined separately because ASD is a developmental disability. To create the SVI, each census tract was given a percentile ranking that represents the social vulnerability of that tract in comparison to other tracts within the United States. For example, a ranking of 0.75 indicates that 75 % of tracts in the U.S. are less vulnerable than the tract of interest and that 25 % of tracts are more vulnerable. Detailed methodology for the social vulnerability index can be found here: http://www.atsdr.cdc.gov/place-health/php/svi/index.html#cdc_generic_section_3-methodology

We obtained population counts and median household income in the past 12 months ("MHI") at the census tract level from the 2020 American Community Survey 5-year estimates [15]. Population counts of children aged 8 years were estimated overall, by race, and by ethnicity by dividing the number of children aged 5–9 years by five for each census tract. A weighted percentile for MHI was created by first ordering the tracts by MHI (low to high), calculating the cumulative population for each tract, and then dividing that sum by the total population.

Cases of ASD among 8-year-old children identified in ADDM in 2020 were linked to the MHI and SVI measures, and the population estimates by census tract. A total of 4588 census

tracts were included in the ADDM 2020 surveillance area, however, cases may not have been found in every tract. Tracts were then categorized into tertiles (high, medium, and low) for MHI and each SVI measure. Next, we summed ASD cases and population estimates overall and for each ADDM site by tertile. We then calculated the ASD prevalence per 1000 ((i.e., sum of cases for a tertile / population denominator for that tertile) * 1000) and 95 % confidence intervals (CI). Finally, we calculated prevalence ratios (PR) and 95 % CIs to compare the prevalence of ASD in high versus low and high versus medium tertiles. Differences were considered statistically significant if unrounded confidence intervals did not include 1.0. All analyses were conducted using R software (version 4.3.1; R Foundation) and additional R packages.

Results

A total of 5998 8-year-old children with ASD were included in the analysis (Supplemental Table 1). We saw higher ASD prevalence in areas with high versus low vulnerability for the Overall SVI theme (26.18 versus 24.60 per 1000; PR=1.06), and for the Minority (28.28 versus 21.88 per 1000; PR=1.29) and Transport (27.32 versus 24.18 per 1000; RR=1.13) themes and the Disability variable (26.83 versus 24.59 per 1000; PR=1.09) (Table 1). We also saw a relative 8 % higher prevalence in areas of high versus medium vulnerability for the Minority theme (28.28 versus 26.20 per 1000; PR=1.08), and a 9 % lower prevalence for the SES theme (24.95 vs. 27.35 per 1000; PR=0.91). We did not find any overall associations among tertiles for the Household theme. Stratified by sex, we saw a higher prevalence of ASD in areas of high vulnerability among males for the Overall (41.59 versus 38.64 per 1000; PR=1.08), Minority (PR=1.31), and Transport (PR=1.14) themes and the Disability variable (PR=1.10); and among females for the Minority (PR=1.23) theme (Table 2).

Patterns in the prevalence of ASD by race and ethnicity for the Overall theme are shown in Fig. 1. Among children who were White, we saw a relative 21–74 % higher prevalence of ASD in areas of high vulnerability for all SVI themes and the Disability variable (Table 3). Among Black children, these patterns were reversed with a 20–53 % lower ASD prevalence in areas of high vulnerability for all SVI themes and the Disability variable. Patterns among Asian children mirrored those among Black children, with a 29–45 % lower prevalence in areas of high vulnerability for all SVI themes, although no difference was observed for the Disability variable. Among multiracial children, we saw a 31 % lower ASD prevalence in areas of high vulnerability for the Household theme. Among children with Hispanic ethnicity, we found a lower ASD prevalence in areas of high vulnerability for the Overall (27.92 vs. 33.65 per 1000; PR=0.83) and SES (PR=0.85) themes. Comparisons between high and medium tertiles are provided in Table 3. We did not examine comparisons between tertiles for AIAN children due to the small sample size.

Among children with co-occurring intellectual disability, we saw a 17–60 % higher ASD prevalence in areas of high versus low vulnerability for all SVI themes (PRs=1.17–1.60) and the Disability variable (8.21 versus 6.26 per 1000; PR=1.31), and a higher prevalence when comparing high versus medium vulnerability for the Minority theme (PR=1.34) and Disability (PR=1.26) variable (Supplemental Table 2).

Patterns of ASD prevalence for the Overall SVI theme by ADDM site are shown in Fig. 2. Data for each SVI theme and the Disability variable by site are shown in Supplemental Table 3–8. We found a higher ASD prevalence in areas of high versus low vulnerability for all SVI themes in New Jersey (PRs=1.40–1.98), the Minority theme in Maryland (PR=1.75), the Transport theme in Utah (PR=1.36), and the Disability variable in Arizona (PR=1.61), Tennessee (PR=1.25), and Utah (PR=1.63). We also saw higher prevalence in areas of high versus medium vulnerability for the Minority theme in Georgia (RR=1.37) and New Jersey (PR=1.49), and the Transport theme in Arkansas (PR=1.46). We found the opposite pattern of lower prevalence in areas of high versus low vulnerability for the Overall (PR=0.83) theme in California, the SES theme in California (PR=0.80), Maryland (PR=0.67), Missouri (PR=0.80), and Tennessee (PR=0.73), and the Household theme in Arizona (PR=0.76) and Georgia (PR=0.70); and high versus medium vulnerability for the Overall theme in Minnesota (PR=0.74), the SES theme in California (PR=0.83), Minnesota (PR=0.67), Tennessee (PR=0.70), and Utah (PR=0.75), the Household theme in Maryland (PR=0.78) and Minnesota (PR=0.78), and the Minority theme in Arizona (PR=0.76), Missouri (PR=0.71), and Utah (PR=0.76). We saw no associations between tertiles for any SVI theme or the Disability variable in the Wisconsin ADDM site.

Finally, we examined the association between ASD prevalence and median household income tertiles. Figure 3 illustrates these differences by comparing the prevalence between high and low vulnerability tertiles for the Overall SVI theme and MHI. We saw a higher prevalence of ASD in areas of low MHI (i.e., high vulnerability) overall (PR=1.17), among males (PR=1.17) and females (PR=1.20), White children (PR=1.55), those with co-occurring intellectual disability (PR=1.55), and in Arizona (PR=1.33), New Jersey (PR=1.41), and Utah (PR=1.68) (Supplemental Table 9). The opposite pattern was present among Asian (PR=0.57) and Black (PR=0.71) children.

Conclusion

Overall, we found that children in more socially vulnerable areas have a higher prevalence of ASD than those living in less socially vulnerable areas. This was observed for most SVI themes, the Disability variable, and median household income. Results for children with co-occurring ID were consistent with these overall findings. While this is a reversal from the pattern seen in ADDM Network analyses from 2002 to 2010, it is consistent with recent ADDM publications [6,7,16], U.S. national survey data [17], and ASD trends over time in California [18]. Correlations between higher ASD prevalence and social disadvantage has also been observed in other countries, including Sweden [19], China [20], and the United Kingdom [21]. Our findings for children with co-occurring intellectual disability are also consistent with prior studies that show a clear gradient between intellectual disability and SES, with more intellectual disability (with or without ASD) occurring in lower SES groups [22,23].

When examining the association between SVI and race, we found that patterns among White children (comprising 58 % of children in the analysis) were consistent with the overall findings. In contrast, we observed an inverse association (i.e., lower ASD prevalence in more socially vulnerable areas) among Black, Asian, and Hispanic children. This inverse

association was evident across all SVI themes, the Disability variable, and MHI, and was especially strong for the Minority theme. Lower ASD prevalence among Black children living in lower-income areas is consistent with early ADDM publications and does not appear to have changed over time [5]. Our recent findings suggest that some children may still lack access to providers for developmental evaluations and/or are being diagnosed at a lower rate. An analysis of ASD testing practices in the ADDM Network found that Black children with ASD and children in lower-income neighborhoods received fewer ASD tests [24], lending support to this hypothesis. This could illustrate a consequence of social structures that would not be fully captured by income or poverty status. The SVI, however, does attempt to provide summary neighborhood-level measures that include lack of transportation and health insurance that could disproportionately affect access to Black children with ASD.

Associations between ASD prevalence and SVI measures varied by ADDM site. For example, we saw differences in ASD prevalence between tertiles for all SVI themes in New Jersey, but no differences in Wisconsin. The strongest differences between high and low tertiles by site were seen for the Minority theme in New Jersey and Maryland and the Disability variable in Utah and Arizona. In Georgia, we saw results for the Household theme that were consistent with an analysis of 2018 data [12], but we found an opposite pattern between 2018 and 2020 for the Minority theme in this same area. Interpreting these differences is complicated because the composition of the Minority and Household SVI themes changed between 2018 and 2020 (i.e., English language proficiency was moved from Minority to Household) [14]. Site-to-site variation likely reflects underlying differences in the demographic composition of the surveillance areas or of those receiving testing and diagnosis. These findings may be used by public health practitioners within areas to identify unique barriers to care and opportunities to increase access to testing and diagnosis within their populations.

Overall, we found the same general pattern in ASD prevalence between tertiles using the SVI themes as we did with individual census variables (Disability and MHI). There are several factors to consider when deciding which approach to take in future analyses. Single-measure variables are easier to interpret and more quickly available from the U.S. Census Bureau. However, they only measure one aspect of a community, rather than the comprehensive view that an SVI theme can provide. For example, while disparities in median household income have the same general pattern as the SVI themes, themes might better pinpoint differing needs within the community (e.g., ensuring a culturally appropriate experience for families, a need for non-English-language materials, or better access to transportation). Ultimately, the decision of which measure to use should be driven by the specific question addressed.

Our analysis is subject to some limitations. Because ADDM sites are selected through an objective and competitive process, they are not intended to be representative of the states in which the sites are located and findings do not necessarily generalize to all children with ASD aged 8 years in the United States. In addition, the SVI theme and census variables used in this analysis are tract-level measures and, thus, are not meant to represent individual ASD cases within that census tract. The percentiles for the SVI themes and Disability variable

are based on census tracts for the entire U.S., whereas those for MHI in our analysis are based on the census tracts included in the ADDM surveillance area for 2020. Finally, census tract-level measures and the cross-sectional design of data collection allow for analysis of correlations but do not represent causation. There are many different factors over a child's lifespan that can impact an autism diagnosis and may not be captured in a cross-sectional analysis.

In summary, we found a higher ASD prevalence among children living in socially disadvantaged areas which may indicate a true increased burden of ASD in these areas. Although this association was consistent across SVI themes, the inconsistency of our results across racial groups and some variation in patterns between ADDM sites suggests that, despite progress in early identification of ASD [16], differences in access to diagnostic testing persist. Identifying disparities between communities helps direct resources to the areas of greatest need and advance the goal of equitable and accessible screening, services, and supports for all children. Local and state public health practitioners can use information about social vulnerability to better understand unique local opportunities to increase equitable access to diagnosis and treatment in their communities.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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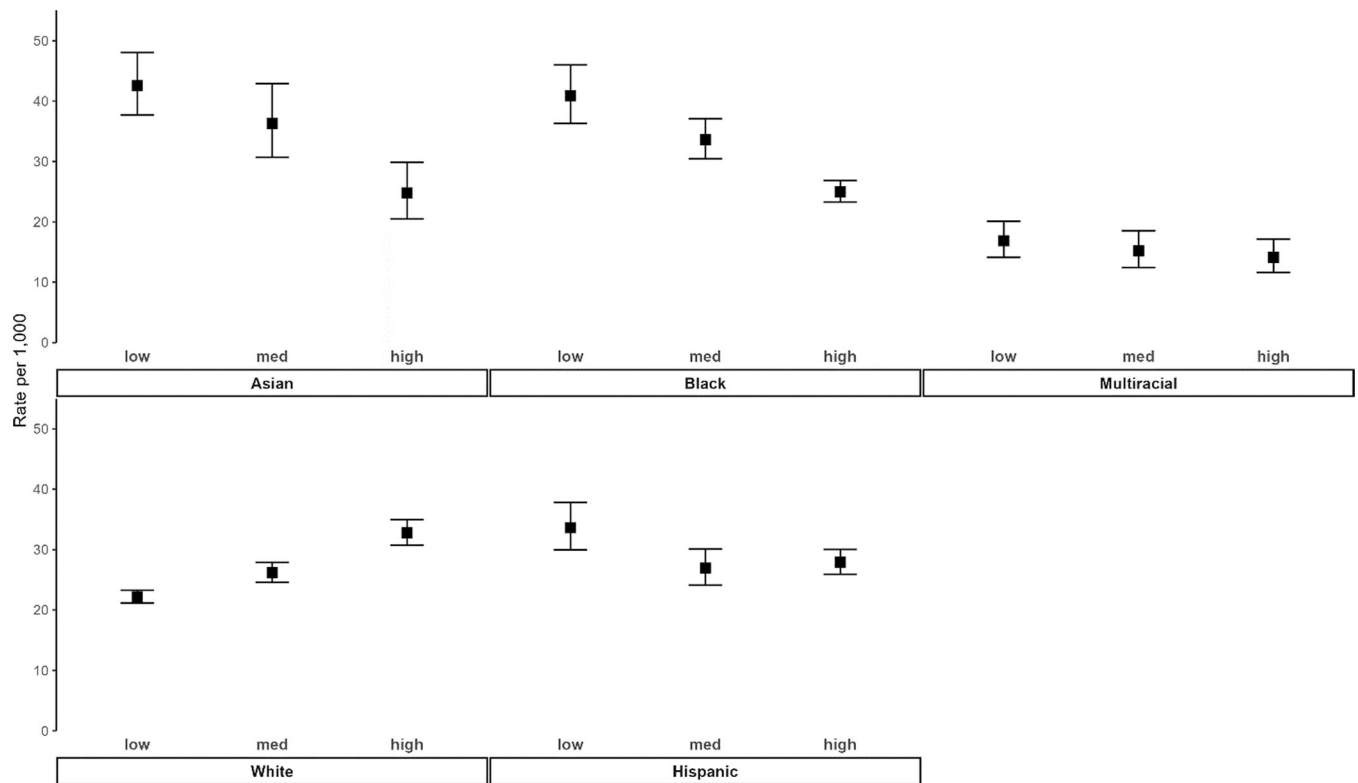


Fig. 1. Prevalence of Autism Spectrum Disorder among Children aged 8 years for the Overall Social Vulnerability Index (SVI) Theme Tertiles, by Race and Ethnicity – Autism and Developmental Disabilities Monitoring Network, 2020. Bars represent 95 % confidence intervals.

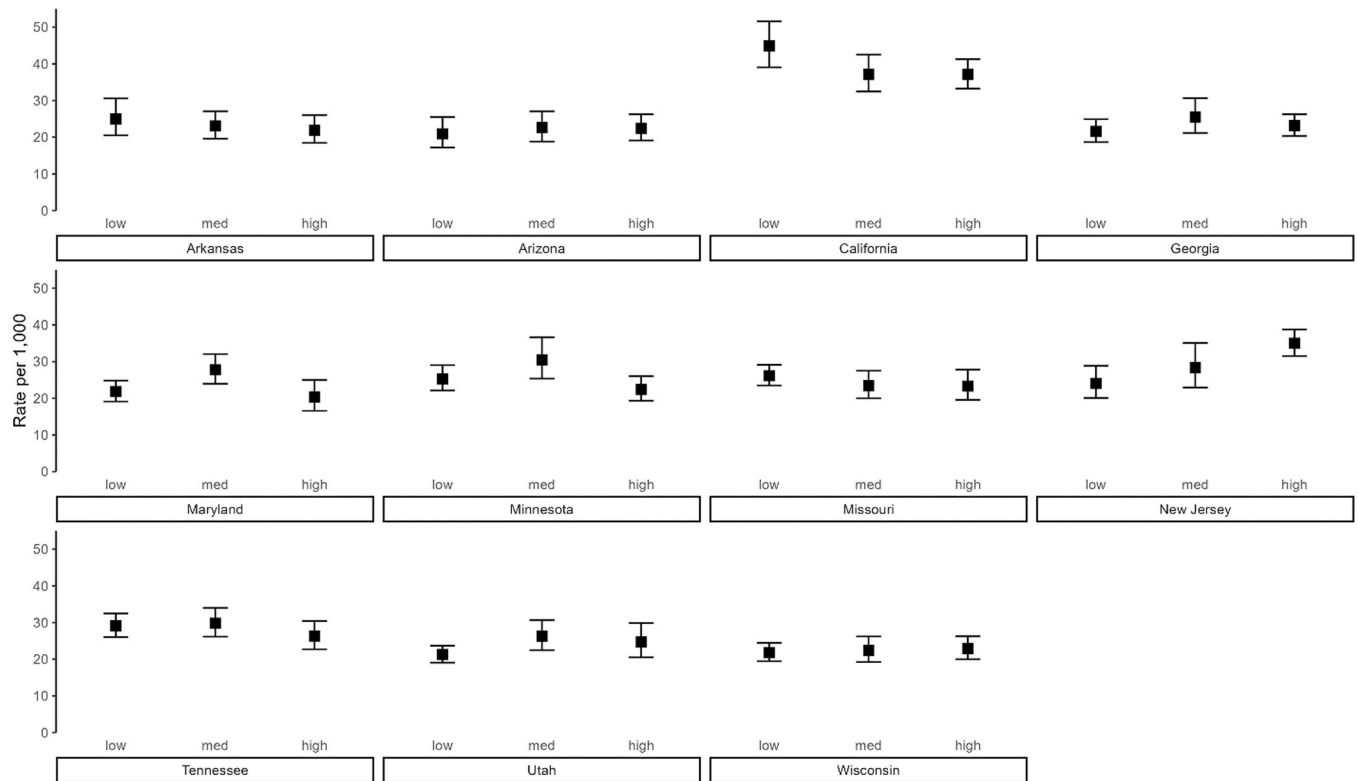


Figure 2.
Prevalence of Autism Spectrum Disorder among Children aged 8 years for the Overall Social Vulnerability Index (SVI) Theme, by Tertile and Site – Autism and Developmental Disabilities Monitoring Network, 2020. Bars represent 95 % confidence intervals.

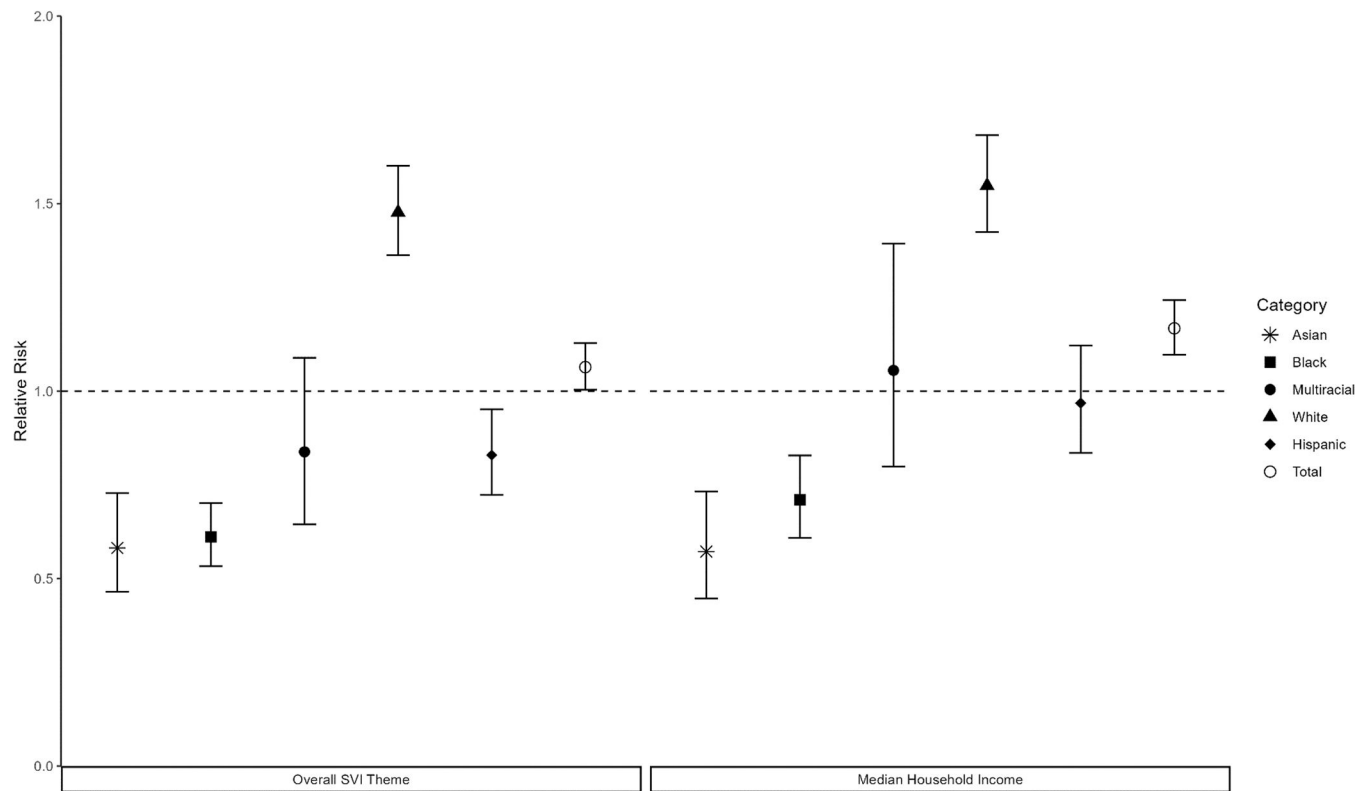


Figure 3. Relative Risk of the Prevalence of Autism Spectrum Disorder among Children aged 8 years for High versus Low Vulnerability, Overall Social Vulnerability Index (SVI) Theme and Median Household Income, by Race and Ethnicity – Autism and Developmental Disabilities Monitoring Network, 2020. Bars represent 95 % confidence intervals. Note: Low median household income equals high social vulnerability.

Table 1

Prevalence and Relative Risk of Autism Spectrum Disorder among Children aged 8 years by Social Vulnerability Index (SVI) Theme and Disability Variable – Autism and Developmental Disability Monitoring Network, 2020.

SVI Theme	Low Vulnerability		Medium Vulnerability		High Vulnerability		PR High versus Low		PR High versus Medium	
	N per 1000	(95 % CI)	N per 1000	(95 % CI)	N per 1000	(95 % CI)	PR (95 % CI)		PR (95 % CI)	
Overall	24.60	(23.64–25.60)	26.77	(25.52–28.09)	26.18	(25.08–27.32)	1.06	(1.00–1.13) *	0.98	(0.92–1.04)
SES	25.19	(24.21–26.21)	27.35	(26.09–28.66)	24.95	(23.86–26.08)	0.99	(0.93–1.05)	0.91	(0.86–0.97) *
Household	25.05	(24.01–26.14)	26.71	(25.60–27.87)	25.32	(24.21–26.49)	1.01	(0.95–1.08)	0.95	(0.89–1.01)
Minority	21.88	(20.82–22.99)	26.20	(25.09–27.36)	28.28	(27.20–29.40)	1.29	(1.21–1.38) *	1.08	(1.02–1.14) *
Transport	24.18	(23.20–25.19)	26.05	(24.91–27.23)	27.32	(26.13–28.57)	1.13	(1.06–1.20) *	1.05	(0.99–1.12)
Disability	24.59	(23.70–25.51)	26.62	(25.52–27.77)	26.83	(25.35–28.38)	1.09	(1.02–1.17) *	1.01	(0.94–1.08)

* = statistically significant
CI= Confidence Interval
PR = Prevalence Ratio
SES = Socioeconomic Status

Table 2

Prevalence and Relative Risk of Autism Spectrum Disorder among Children aged 8 years, by Social Vulnerability Index (SVI) Theme and Disability Variable, by Sex – Autism and Developmental Disabilities Monitoring Network, 2020.

Category	SVI Theme	Low Vulnerability		Medium Vulnerability		High Vulnerability		PR High versus Low		PR High versus Medium	
		N per 1000	(95 % CI)	N per 1000	(95 % CI)	N per 1000	(95 % CI)	PR (95 % CI)		PR (95 % CI)	
Male	Overall	38.64	(36.96–40.39)	41.75	(39.57–44.05)	41.59	(39.66–43.60)	1.08	(1.01–1.15)*	1.00	(0.93–1.07)
	SES	39.53	(37.83–41.30)	42.73	(40.55–45.02)	39.67	(37.76–41.66)	1.00	(0.94–1.07)	0.93	(0.86–1.00)*
	Household	39.40	(37.58–41.31)	41.71	(39.80–43.71)	40.19	(38.23–42.25)	1.02	(0.95–1.09)	0.96	(0.90–1.03)
	Minority	33.95	(32.12–35.87)	41.85	(39.89–43.91)	44.38	(42.51–46.32)	1.31	(1.22–1.40)*	1.06	(0.99–1.13)
	Transport	37.74	(36.05–39.50)	41.56	(39.57–43.65)	42.84	(40.76–45.01)	1.14	(1.06–1.21)*	1.03	(0.96–1.11)
Female	Disability	38.50	(36.95–40.12)	42.15	(40.22–44.17)	42.26	(39.68–45.00)	1.10	(1.02–1.18)*	1.00	(0.93–1.08)
	Overall	10.10	(9.24–11.05)	11.25	(10.11–12.52)	10.24	(9.28–11.30)	1.01	(0.89–1.16)	0.91	(0.79–1.05)
	SES	10.17	(9.30–11.13)	11.55	(10.42–12.81)	9.88	(8.93–10.93)	0.97	(0.85–1.11)	0.86	(0.74–0.99)*
	Household	10.41	(9.47–11.44)	10.65	(9.66–11.74)	10.28	(9.29–11.37)	0.99	(0.86–1.13)	0.97	(0.84–1.11)
	Minority	9.22	(8.26–10.29)	10.54	(9.57–11.62)	11.34	(10.38–12.39)	1.23	(1.07–1.42)*	1.08	(0.94–1.23)
Transport	Disability	10.02	(9.14–10.98)	10.16	(9.18–11.25)	11.31	(10.24–12.50)	1.13	(0.99–1.29)	1.11	(0.97–1.28)
	Disability	10.17	(9.36–11.04)	10.50	(9.52–11.57)	11.05	(9.74–12.53)	1.09	(0.93–1.26)	1.05	(0.90–1.23)

* = statistically significant

CI= Confidence Interval

PR = Prevalence Ratio

SES = Socioeconomic Status

Table 3

Prevalence and Relative Risk of Autism Spectrum Disorder among Children aged 8 years, by Social Vulnerability Index (SVI) Theme, Race, and Ethnicity – Autism and Developmental Disabilities Monitoring Network, 2020.

Category	SVI Theme	Low Vulnerability		Medium Vulnerability		High Vulnerability		PR High versus Low		PR High versus Medium	
		N per 1000	(95 % CI)	N per 1000	(95 % CI)	N per 1000	(95 % CI)	PR (95 % CI)		PR (95 % CI)	
White	Overall	22.19	(21.16–23.28)	26.16	(24.56–27.86)	32.77	(30.72–34.96)	1.48	(1.36–1.60)*	1.25	(1.14–1.37)*
	SES	22.93	(21.86–24.04)	26.51	(24.94–28.18)	30.09	(28.11–32.20)	1.31	(1.21–1.43)*	1.13	(1.04–1.24)*
	Household	22.29	(21.14–23.50)	26.21	(24.80–27.70)	29.95	(28.10–31.93)	1.34	(1.24–1.46)*	1.14	(1.05–1.24)*
	Minority	20.44	(19.36–21.59)	26.16	(24.80–27.59)	35.62	(33.40–37.98)	1.74	(1.60–1.90)*	1.36	(1.25–1.48)*
	Transport	21.80	(20.71–22.94)	26.77	(25.26–28.37)	31.00	(29.11–33.02)	1.42	(1.31–1.54)*	1.16	(1.06–1.26)*
Black	Disability	23.02	(21.95–24.15)	27.89	(26.39–29.47)	27.75	(25.65–30.02)	1.21	(1.10–1.32)*	1.00	(0.90–1.10)
	Overall	40.89	(36.34–45.99)	33.60	(30.43–37.09)	25.00	(23.30–26.83)	0.61	(0.53–0.70)*	0.74	(0.66–0.84)*
	SES	40.44	(36.05–45.34)	33.83	(30.65–37.32)	24.78	(23.07–26.60)	0.61	(0.54–0.70)*	0.73	(0.65–0.83)*
	Household	39.19	(35.31–43.49)	30.35	(27.77–33.17)	24.73	(22.83–26.79)	0.63	(0.55–0.72)*	0.81	(0.72–0.92)*
	Minority	57.65	(47.53–69.76)	32.82	(29.28–36.77)	27.03	(25.44–28.72)	0.47	(0.38–0.57)*	0.85	(0.75–0.97)*
Asian	Transport	34.98	(31.73–38.54)	27.93	(25.50–30.57)	26.98	(24.85–29.29)	0.77	(0.68–0.88)*	0.97	(0.85–1.09)
	Disability	33.90	(31.13–36.90)	26.90	(24.62–29.39)	27.09	(24.62–29.80)	0.80	(0.70–0.91)*	1.07	(0.94–1.23)
	Overall	42.55	(37.67–48.03)	36.30	(30.70–42.89)	24.76	(20.50–29.88)	0.58	(0.46–0.73)*	0.68	(0.53–0.88)*
	SES	42.68	(37.95–47.98)	34.98	(29.54–41.38)	23.69	(19.29–29.06)	0.55	(0.44–0.70)*	0.68	(0.52–0.88)*
	Household	39.92	(34.75–45.81)	37.20	(32.12–43.05)	28.33	(23.77–33.75)	0.71	(0.57–0.89)*	0.76	(0.61–0.96)*
Multiracial	Minority	47.83	(38.15–59.81)	34.27	(29.71–39.49)	33.56	(29.56–38.08)	0.70	(0.54–0.91)*	0.98	(0.81–1.19)
	Transport	41.89	(36.77–47.70)	34.58	(29.38–40.67)	28.66	(24.17–33.95)	0.68	(0.55–0.85)*	0.83	(0.65–1.05)
	Disability	36.79	(32.87–41.16)	32.04	(27.27–37.63)	38.36	(29.30–50.09)	1.04	(0.78–1.40)	1.20	(0.87–1.64)
	Overall	16.86	(14.15–20.08)	15.19	(12.45–18.54)	14.13	(11.63–17.16)	0.84	(0.64–1.09)	0.93	(0.70–1.23)
	SES	16.07	(13.47–19.17)	17.34	(14.34–20.95)	13.07	(10.67–16.00)	0.81	(0.62–1.06)	0.75	(0.57–1.00)*
Household	Minority	17.80	(14.94–21.20)	16.28	(13.53–19.58)	12.22	(9.89–15.08)	0.69	(0.52–0.90)*	0.75	(0.57–0.99)*
	Minority	16.04	(12.58–20.42)	14.90	(12.49–17.76)	15.64	(13.20–18.51)	0.98	(0.73–1.31)	1.05	(0.82–1.34)
	Transport	14.26	(11.77–17.26)	15.74	(13.06–18.95)	16.38	(13.56–19.77)	1.15	(0.88–1.50)	1.04	(0.80–1.36)

Category	SVI Theme	Low Vulnerability	Medium Vulnerability	High Vulnerability	PR High versus Low	PR High versus Medium
		N per 1000 (95 % CI)	N per 1000 (95 % CI)	N per 1000 (95 % CI)	PR (95 % CI)	PR (95 % CI)
Hispanic	Disability	13.77 (11.72–16.18)	17.50 (14.64–20.92)	16.41 (12.63–21.29)	1.19 (0.88–1.62)	0.94 (0.68–1.29)
	Overall	33.65 (29.95–37.80)	26.94 (24.10–30.09)	27.92 (25.94–30.04)	0.83 (0.72–0.95)*	1.04 (0.91–1.18)
	SES	31.48 (27.94–35.45)	31.21 (28.17–34.56)	26.63 (24.69–28.72)	0.85 (0.73–0.97)*	0.85 (0.75–0.97)*
	Household	30.75 (27.44–34.44)	28.65 (26.03–31.51)	27.86 (25.70–30.19)	0.91 (0.79–1.04)	0.97 (0.86–1.10)
	Minority	31.75 (26.64–37.81)	27.42 (24.77–30.35)	28.93 (27.00–30.98)	0.91 (0.75–1.10)	1.05 (0.93–1.19)
	Transport	29.98 (26.79–33.54)	27.48 (24.88–30.33)	28.96 (26.76–31.35)	0.97 (0.84–1.11)	1.05 (0.93–1.20)
	Disability	26.90 (24.79–29.19)	31.04 (28.52–33.78)	28.57 (24.85–32.81)	1.06 (0.90–1.25)	0.92 (0.78–1.08)

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