



Published in final edited form as:

Ann Epidemiol. 2023 July ; 83: 47–53.e1. doi:10.1016/j.annepidem.2023.04.009.

Social vulnerability and prevalence of Autism Spectrum Disorder, Metropolitan Atlanta Developmental Disabilities Surveillance Program (MADDSP)

Mary E. Patrick, MPH^{a,*}, Michelle M. Hughes, PhD^a, Akilah Ali, MPH^b, Kelly A. Shaw, PhD^a, Matthew J. Maenner, PhD^a

^aCenters for Disease Control and Prevention, National Center on Birth Defects and Developmental Disabilities, Atlanta, GA

^bOak Ridge Institute for Science and Education, Oak Ridge, TN

Abstract

Purpose: The Metropolitan Atlanta Developmental Disabilities Surveillance Program tracks autism spectrum disorder (ASD) in selected counties within Georgia as part of the Autism and Developmental Disabilities Monitoring (ADDM) Network. ADDM Network analyses have historically found a higher prevalence of ASD in areas of higher socioeconomic status.

Methods: We linked 2018 data from Centers for Disease Control and Prevention's Social Vulnerability Index (SVI) to two Metropolitan Atlanta Developmental Disabilities Surveillance Program counties by census tract, grouped census tracts into tertiles representing low, medium, and high social vulnerability, and calculated ASD prevalence for each tertile, overall and by each of four SVI themes.

Results: We found that overall prevalence was higher in areas of low compared to high vulnerability for the socioeconomic status and transportation themes, and in areas of medium compared to high vulnerability for all themes. This pattern was consistent among males but varied for females and by race or ethnicity.

Conclusions: Linking ASD prevalence to SVI metrics can improve the understanding of inequities among children with ASD in racial and ethnic minority groups or those living in low-resource settings. These methods can be applied to other ADDM Network surveillance sites and public health surveillance programs.

Keywords

Autism; Surveillance; Social vulnerability index

*Corresponding author. Centers for Disease Control and Prevention, National Center on Birth Defects and Developmental Disabilities, Child Development and Disability Branch, 4770 Buford Highway NE, MS:S106-4, Atlanta, GA 30341-3717. Tel.: (404) 639-3433. MEPatrick@cdc.gov (M.E. Patrick).

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.

Purpose

Autism spectrum disorder (ASD) is a developmental disability characterized by the occurrence of persistent impairments in social interaction and the presence of restricted, repetitive patterns of behaviors, interests, or activities [1]. The Autism and Developmental Disabilities Monitoring (ADDM) Network is a population-based surveillance system that estimates the prevalence of ASD and other developmental disabilities among children in selected communities throughout the U.S. [2]. ADDM is modeled after the work of the Metropolitan Atlanta Developmental Disabilities Surveillance Program (MADDSP), which has tracked ASD in selected counties within metropolitan Atlanta, Georgia since 1996 [3]. The most recent estimate of ASD prevalence among 8-year-old children in MADDSP was 21.8/1000 (1 in 46 8-year-old children) in 2018, similar to the 23.0/1000 (1 in 44) prevalence seen among all ADDM Network sites in 2018 [4]. Approximately a third of children with ASD in ADDM also had intellectual disability (ID).

Using single census variable measures of socioeconomic status (SES) (i.e., family poverty, college education, and median household income), ADDM Network reports based on data from 2002 to 2010 showed a higher prevalence of ASD in areas of higher SES [5–7]. While this association has been consistent over time for MADDSP, recently there has been an inverse association (lower prevalence in areas of higher SES) among other ADDM Network sites [4]. The Centers for Disease Control and Prevention developed the Social Vulnerability Index (SVI) to help public health officials and emergency response planners meet the needs of socially vulnerable populations in emergency response and recovery efforts [8]. Use of the SVI has been expanded beyond disaster relief efforts and has been applied to analyses of public health surveillance data by examining associations with COVID-19 vaccination rates [9] and stay-at-home orders [10], and emergency department visits for firearm injuries [11]. The SVI includes 15 census-based indicators, grouped into four themes (SES, household composition and disability, racial and ethnic minority status and language, and housing type and transportation) and an overall composite measure.

We applied SVI indicators to autism surveillance data from MADDSP to evaluate the application of a comprehensive SVI measure to describe patterns of ASD prevalence across communities and assess whether the prevalence of autism and co-occurring ID vary by SVI measure overall, by sex, and by race or ethnicity.

Methods

MADDSP conducts surveillance for 8-year-old children with ASD every 2 years. To identify children, staff request records from educational sources for children who receive special education services and from medical sources that evaluate and treat children with developmental disabilities based on select *International Classification of Diseases, Ninth Revision* (ICD-9) or *International Classification of Diseases, Tenth Revision* (ICD-10) codes for developmental disabilities. MADDSP staff then review records and abstract information for children who reside in the surveillance area. MADDSP conducts its work as a designated agent of the Georgia Department of Public Health and through memorandums of understanding with education sources.

Our primary analysis focused on data collected in Georgia's DeKalb and Gwinnett Counties for 2018. Children were included in the analysis if they were 8 years old (born in 2010), lived in the surveillance area for at least 1 day during the 2018 surveillance year and had an address that could be geocoded to a census tract, and met the ASD case definition. Children met ASD case status if they had documentation in health, service, or education records that they had ever received any of the following: 1) a written statement from a qualified professional diagnosing autism, 2) a special education classification of autism (either primary exceptionality of ASD or an evaluation concluding criteria for autism eligibility was met) in public school, or 3) 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 ID based on scores of ≥ 70 on their most recent test of cognitive ability or a statement from a qualified professional about a child's cognitive ability in a developmental evaluation [12]. We also abstracted sex and race or ethnicity for each child. We excluded 56/514 (10%) of ASD cases that were included in the 2018 MADDSP surveillance area based on county of residence but could not be linked to the census tract.

We obtained SVI variables for 2018 by census tract for DeKalb and Gwinnett counties from the Centers for Disease Control and Prevention's publicly available SVI data [13]. We estimated the population of 8-year-old children by census tract using the American Community Survey's 5–9-year-old population estimates [14] and dividing by 5. We linked SVI data to 8-year-old ASD cases and population estimates by census tract. Next, we grouped census tracts into tertiles, classified as areas of high, medium, and low social vulnerability for each SVI measure (overall, 4 themes, and 15 individual indicators). We refer to the SVI measures as follows: "Overall" (overall SVI measure), "SES" (theme one: socioeconomic status), "Household" (theme two: household composition and disability), "Minority" (theme three: racial or ethnic minority status and language), and "Transportation" (theme four: housing type and transportation). We summed ASD cases and population estimates by these areas and calculated prevalence per 1000 (i.e., $[\text{number of 8-year-old children with ASD} / \text{8-year-old population}] \times 1000$) and 95% confidence intervals (95% CI) overall, by sex, and by race or ethnicity. We calculated prevalence ratios (PR) to compare the prevalence between low, medium, and high SVI tertiles; differences were considered statistically significant if CIs did not include 1.00. We also calculated the prevalence for each census tract, grouped prevalence into high, medium, and low SVI areas, and mapped census tracts using ArcGIS Pro [Environmental Systems Research Institute, Inc., Redlands, CA]. Analyses were conducted using SAS v9.4 [SAS Institute Inc., Cary, NC]. Due to small sample sizes, we do not present prevalence among Asian children within each theme.

To examine differences over time, we conducted a secondary analysis focused on the association of ASD prevalence with SVI overall and for the four themes for 2014 and 2016. This analysis used the same methods and surveillance area as described previously; however, the case definition for ASD in 2014 involved an additional step of clinician review. A detailed description of methods in classifying ASD cases and how they changed between years has been previously described [15].

Results

We identified 458 8-year-old children in 2018 who met the case definition for ASD. Eighty-three percent of the children were male; 43% of children were Black, 28% White, 14% Hispanic, 7% Asian, and 8% other or unknown race or ethnicity (Table A1). The population of 8-year-old children in the surveillance area was 23,136 yielding an overall ASD prevalence of 19.8 (95% CI 18.1–21.7) per 1000 children.

ASD prevalence varied across SVI themes (Table 1). Prevalence was higher in areas of low compared to high vulnerability for the SES (PR = 1.3 [95% CI 1.03–1.66]) and Transportation (PR = 1.6 [95% CI 1.24–1.98]) themes, and higher in areas of medium compared to high vulnerability for all themes. We further explored prevalence by sex and race or ethnicity (Table 1). Prevalence was higher among males than females across all tertiles for all themes. Associations between low versus high and medium versus high vulnerability among males were generally the same as those seen overall. Females had lower prevalence in areas of low compared to high vulnerability for the Minority theme (PR = 0.5 [95% CI 0.31–0.97]). Black children had higher ASD prevalence than Hispanic and White children across all tertiles for all themes (Table 1). Among Black children, the prevalence was significantly higher in areas of low compared to high vulnerability for the SES (PR = 1.5 [95% CI 1.03–2.31]) and Household (PR = 1.6 [95% CI 1.06–2.30]) themes, and in areas of medium compared to high vulnerability for the SES (PR = 1.6 [95% CI 1.13–2.13]), Household (PR = 1.5 [95% CI 1.07–2.01]), and Transportation (PR = 1.5 [95% CI 1.03–2.07]) themes. Among White children, the prevalence was higher in areas of low compared to high vulnerability for the Transportation theme (PR = 2.1 [95% CI 1.26–3.64]), and in areas of medium compared to high vulnerability for the Minority theme (PR = 1.8 [95% CI 1.15–2.98]). Among Hispanic children, the prevalence was significantly higher in areas of low compared to high vulnerability only for the SES theme (PR = 2.0 [95% CI 1.09–3.84]).

We also examined prevalence among the 352 children with information available on ID (Table 2). For children with ASD and no ID, we saw higher prevalence in areas with low compared to high vulnerability overall (PR = 1.8 [1.26–2.53]), and for the SES (PR = 2.15 [95% CI 1.47–3.10]), and Transportation themes (PR = 2.3 [1.61–3.36]), and in areas of medium compared to high vulnerability overall (PR = 1.7 [95% CI 1.22–2.47]), and for the SES (PR = 2.0 [95% CI 1.37–2.86]), Household (PR = 1.7 [95% CI 1.22–2.34]) and Transportation themes (PR = 1.9 [95% CI 1.28–2.78]). For children with both ASD and ID, we saw higher prevalence in areas of low compared to high vulnerability for the Transportation theme (PR = 1.5 [95% CI 1.02–2.28]).

Figure 1 illustrates prevalence by tertile for each individual SVI indicator. ASD prevalence was higher in areas with low compared to high vulnerability for the SVI indicator of persons with incomes below the poverty threshold (PR = 1.4 [95% CI 1.10–1.74]), not having a vehicle (PR = 1.5 [95% CI 1.17–1.87]) and living in multi-unit structures (PR = 1.5 [95% CI 1.20–1.91]). Prevalence was higher in areas of medium compared to high vulnerability for all SES and Minority theme variables, civilian with a disability (PR = 1.3 [95% CI 1.03–1.66]), and not having a vehicle (PR = 1.4 [95% CI 1.06–1.75]).

We visualized the spatial distribution of social vulnerability and ASD prevalence in our surveillance area (Fig. 2). We saw higher ASD prevalence throughout most of Gwinnett County with a mix of high, medium, and lower vulnerability. In DeKalb County, we saw lower prevalence and high vulnerability in the south and low vulnerability with a range of prevalence in the northern part of the county.

Finally, we compared 2018 ASD prevalence by tertile of SVI theme to prevalence in 2014 and 2016 (Table 3). While case counts and prevalence were similar between years, we saw differences in prevalence between tertiles by year. ASD prevalence was significantly higher in areas of low compared to high vulnerability for the SES (PR = 1.3 [95% CI 1.03–1.66]) and Transportation themes (PR = 1.6 [95% CI 1.24–1.98]) in 2018, and higher in areas of medium compared to high vulnerability for all themes in 2018 and the SES (PR = 1.6 [95% CI 1.28–2.02]) and Household themes (PR = 1.3 [95% CI 1.04–1.61]) in 2016. We saw no significant differences between areas for any theme in 2014.

Conclusions

Disparities in the prevalence of ASD by race or ethnicity and SES have been frequently observed. These longstanding disparities appear to be changing, and more comprehensive measures can help understand these changes. The SVI includes more encompassing measures than the SES indicators used in previous ADDM analyses. Using these SVI indicators, we found that ASD prevalence was generally higher in areas of low or medium vulnerability compared to areas of high vulnerability. However, the opposite pattern (higher prevalence in areas of high vulnerability) was seen among females and Black children for the Minority theme. Spatially, we saw variable patterns across our surveillance area reinforcing the importance of examining these associations at the smallest geographical area possible to better understand local-level community differences.

While it may be possible that children in highly vulnerable communities are less affected by ASD, it is more likely that families with higher social vulnerability lack the resources needed to access developmental screenings which could result in an ASD diagnosis. Poverty, unemployment, per capita income, and living in multi-unit structures may indicate fewer financial resources, including health insurance, which can impact access to care. Limited English proficiency or not having a high school diploma may make understanding the processes necessary to access developmental evaluations or awareness of ASD symptoms more challenging, particularly when symptoms are mild. Increased access to resources that educate parents on child development, such as Learn the Signs. Act Early. [16], may help to fill this gap. Finally, not owning a vehicle or being a civilian with a disability may speak to physical barriers to the ability to access needed services.

The higher ASD prevalence observed among females and Black children in areas of high vulnerability for the Minority theme might indicate a process toward better identification of ASD; however, given long-standing disparities in identification among these groups [17,18], more remains to be done. Associations observed between SVI and ASD prevalence in 2016 and 2018, but not in 2014 could indicate shifts in the residency of children who are the most socially vulnerable or a widening of disparities in access to screening and diagnoses.

Applying SVI to future MADDSP data as well as other communities within ADDM could help to further explain variations between years.

Using a composite measure (the SVI) to assess associations between ASD prevalence and social vulnerability has several advantages. In previous ADDM network analyses, the association of SES and ASD prevalence was examined using individual census variables [4,6]. These variables were linked to ASD case data by census tract and tracts were ranked within and between ADDM sites. This method allowed for comparisons between ADDM sites but could not be applied to communities outside of the network. Because SVI measures are ranked nationally, applying SVI to ADDM surveillance allows for broader comparisons between communities and potentially also other diseases or conditions. In addition, the SVI expands beyond SES to examine a broader set of social factors that may play a role in explaining disparities in the identification of ASD within a community. While our findings related to ASD prevalence and SES are consistent with previous ADDM Network findings for Georgia [4,6], associations with the other SVI themes (Transportation, Minority, Housing) have not been previously described.

Our results are subject to some limitations. Data collected relies on the availability and completeness of existing records to ascertain ASD cases. Educational data are only collected from public schools; information for private or homeschooled students is not included. Sample sizes for some groups (females, Asian, and Hispanic children) were small, thus limiting our ability to detect statistical differences between tertiles. Records for 106 (23%) of children with ASD were missing information on cognitive ability; characteristics of these children may differ from children without this information. Our analysis is focused on separate groups of 8-year-old children each year, so we cannot describe trends over time. Our surveillance area is composed of one part of one metropolitan area and findings may differ when applied to other communities. Lastly, features associated with a census tract may not accurately represent the experiences of everyone living within that tract.

Linking SVI information to public health surveillance data can extend understanding of the associations between social determinants of health and other diseases or conditions. Experience gained from linking MADDSP data to SVI indicators will be applied to inform analyses in other ADDM sites. Results from this study can be used to improve understanding of inequities among children with ASD in racial and ethnic minority groups or those living in low-resource settings. Enhanced resources within these communities can lead to earlier identification and provision of services to improve outcomes.

Funding

This activity was supported through funding at the Centers for Disease Control and Prevention.

Table A1

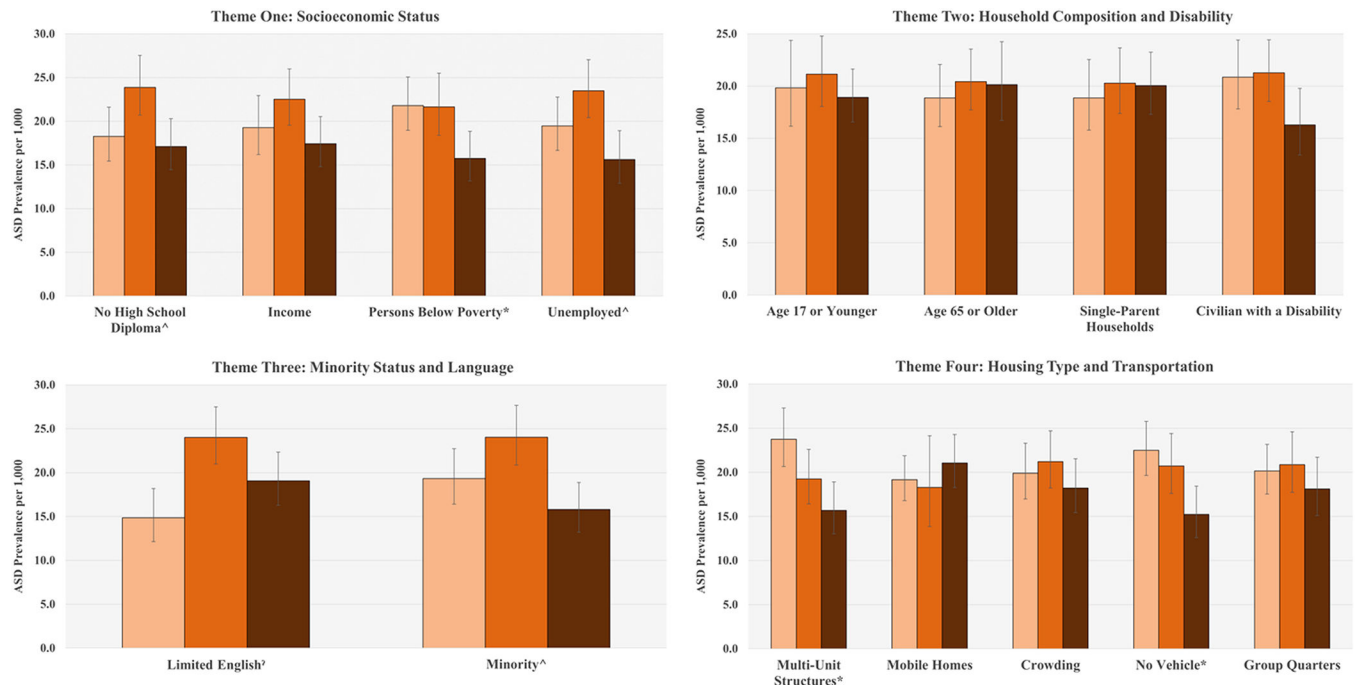
Description of 8-year-old children with ASD by SVI—MADDSP, 2018

SVI theme	Area	ASD cases		Female		Male		Asian non-Hispanic		Black non-Hispanic		White non-Hispanic		Hispanic		Other/unknown		Have information on intellectual disability status		Have intellectual disability	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Overall	Low	154	23	29	131	35	16	50	38	19	73	57	14	22	13	35	124	35	38	3	
	Med	173	32	41	141	37	8	25	89	45	37	29	21	33	18	49	135	38	54	4	
	High	131	24	30	107	28	8	25	71	36	18	14	28	44	6	16	93	26	43	4	
Socioeconomic status	Low	151	24	30	127	34	16	50	38	19	69	54	15	24	13	35	120	34	34	2	
	Med	189	36	46	153	40	8	25	99	50	43	34	21	33	18	49	153	43	63	4	
	High	118	19	24	99	26	8	25	61	31	16	13	27	43	6	16	79	22	38	4	
Household composition and disability status	Low	115	21	27	94	25	13	41	34	17	40	31	16	25	12	32	92	26	31	3	
	Med	201	37	47	164	43	17	53	65	33	68	53	38	60	13	35	154	44	55	3	
	High	142	21	27	121	32	2	6	99	50	20	16	9	14	12	32	106	30	49	4	
Racial/ethnic minority status and language	Low	129	18	23	111	29	6	19	54	27	56	44	7	11	6	16	92	26	33	3	
	Med	176	28	35	148	39	12	38	81	41	45	35	17	27	21	57	142	40	57	4	
	High	153	33	42	120	32	14	44	63	32	27	21	39	62	10	27	118	34	45	3	
Housing type and transportation	Low	196	34	43	162	43	18	56	67	34	71	55	21	33	19	51	167	47	64	3	
	Med	152	25	32	127	34	7	22	75	38	40	31	17	27	13	35	109	31	34	3	
	High	110	20	25	90	24	7	22	56	28	17	13	25	40	5	14	76	22	37	4	
	Total	458	79	17	379	83	32	7	198	43	128	28	63	14	37	8	352	77	135	3	

References

- [1]. American Psychiatric Association. Diagnostic and statistical manual of mental disorders. 5th ed. Arlington, VA: American Psychiatric Association; 2013.
- [2]. Autism and Developmental Disabilities Monitoring (ADDM) Network. (<https://www.cdc.gov/ncbddd/autism/addm.html>). National Center on Birth Defects and Developmental Disabilities, Centers for Disease Control and Prevention. Accessed: 10/26/2022.
- [3]. Metropolitan Atlanta Developmental Disabilities Surveillance Program (MADDSP). (<https://www.cdc.gov/ncbddd/autism/maddsp.html>). National Center on Birth Defects and Developmental Disabilities, Centers for Disease Control and Prevention. Accessed: 10/26/2022.
- [4]. Maenner MJ, Shaw KA, Bakian AV, Bilder DA, Durkin MS, Esler A, et al. Prevalence and characteristics of Autism spectrum disorder among children aged 8 years - Autism and developmental disabilities monitoring network, 11 sites, United States, 2018. MMWR Surveill Summ 2021;70(11):1–16. 10.15585/mmwr.ss7011a1 (<https://www.cdc.gov/mmwr/volumes/70/ss/ss7011a1.htm>).
- [5]. Maenner MJ, Arneson CL, Durkin MS. Socioeconomic disparity in the prevalence of autism spectrum disorder in Wisconsin. Wis Med J 2009;108(5):37–9. 17.

- [6]. Durkin MS, Maenner MJ, Baio J, Christensen D, Daniels J, Fitzgerald R, et al. Autism spectrum disorder among US children (2002–2010): socioeconomic, racial, and ethnic disparities. *Am J Public Health* 2017;107(11):1818–26. 10.2105/AJPH.2017.304032 [PubMed: 28933930]
- [7]. Durkin MS, Maenner MJ, Meaney FJ, Levy SE, DiGuseppi C, Nicholas JS, et al. Socioeconomic inequality in the prevalence of autism spectrum disorder: evidence from a U.S. cross-sectional study. *PLoS One* 2010;5(7):e11551. 10.1371/journal.pone.0011551 [PubMed: 20634960]
- [8]. CDC/ATSDR Social Vulnerability Index. (<https://www.atsdr.cdc.gov/placeandhealth/svi/index.html>). Agency for Toxic Substances and Disease Registry. Accessed: 9/21/2021.
- [9]. Hughes MM, Wang A, Grossman MK, Pun E, Whiteman A, Deng L, et al. County-level COVID-19 vaccination coverage and social vulnerability - United States, December 14, 2020–March 1, 2021. *MMWR Morb Mortal Wkly Rep* 2021;70(12):431–6. 10.15585/mmwr.mm7012e1 [PubMed: 33764963]
- [10]. Fletcher K, Espey J, Grossman M, Sharpe D, Curriero F, Wilt G, et al. Social vulnerability and county stay-at-home behavior during COVID-19 stay-at-home orders, United States, April 7–April 20, 2020. *Ann Epidemiol* 2021;64:76–82. [PubMed: 34500085]
- [11]. Van Dyke ME, Chen MS, Sheppard M, Sharpe JD, Radhakrishnan L, Dahlberg LL, et al. County-level social vulnerability and emergency department visits for firearm injuries—10 U.S. Jurisdictions, January 1, 2018–December 31, 2021. *MMWR Morb Mortal Wkly Rep* 2022;71:873–7. 10.15585/mmwr.mm7127a1 [PubMed: 35797204]
- [12]. Patrick ME, Shaw KA, Dietz PM, Baio J, Yeargin-Allsopp M, Bilder DA, et al. Prevalence of intellectual disability among eight-year-old children from selected communities in the United States, 2014. *Disabil Health J* 2021;14(2):101023. 10.1016/j.dhjo.2020.101023. Epub 2020 Nov 15. [PubMed: 33272883]
- [13]. CDC/ATSDR Data and Documentation Download. (https://www.atsdr.cdc.gov/placeandhealth/svi/data_documentation_download.html). Agency for Toxic Substances and Disease Registry. Accessed: 9/21/2021.
- [14]. Census Bureau. 2018 American Community Survey 5-year estimates. Washington, DC: Department of Commerce, Census Bureau; 2021(<https://data.census.gov/cedsci/>).
- [15]. Maenner MJ, Graves SJ, Peacock G, Honein MA, Boyle CA, Dietz PM. Comparison of 2 case definitions for ascertaining the prevalence of Autism Spectrum Disorder among 8-year-old children. *Am J Epidemiol* 2021;190(10):2198–207. 10.1093/aje/kwab106 [PubMed: 33847734]
- [16]. Learn the Signs. Act Early. (<https://www.cdc.gov/ncbddd/actearly/index.html>). National Center on Birth Defects and Developmental Disabilities, Centers for Disease Control and Prevention. Accessed: 10/26/2022.
- [17]. Mandell DS, Listerud J, Levy SE, Pinto-Martin JA. Race differences in the age at diagnosis among Medicaid-eligible children with autism. *J Am Acad Child Adolesc Psychiatry* 2002;41(12):1447–53. 10.1097/00004583-200212000-00016. [PubMed: 12447031]
- [18]. Wiggins LD, Durkin M, Esler A, Lee LC, Zahorodny W, Rice C, et al. Disparities in documented diagnoses of autism spectrum disorder based on demographic, individual, and service factors. *Autism Res* 2020;13:464–73.

**Fig. 1.**

Prevalence of ASD by SVI indicator and tertile—MADDSP, 2018. *Significant difference between low and high tertiles; [^]significant difference between medium and high tertiles; [?]significant difference between low and medium tertiles. SVI indicators are 15 variables from the 2014–2018 American Community Survey: 1) “Poverty” percentage of persons with incomes below poverty threshold, 2) “Unemployed” percentage of civilian population (aged ≥ 16 years) that is unemployed, 3) “Income” per capita income, 4) “No High School Diploma” percentage of persons aged ≥ 25 years with no high school diploma, 5) “Age 65 or Older” percentage of persons aged ≥ 65 years, 6) “Age 17 or Younger” percentage of persons aged ≤ 17 years, 7) “Civilian with a Disability” percentage of civilian noninstitutionalized population with a disability, 8) “Single-Parent Households” percentage of single-parent households with children aged < 18 years, 9) “Minority” percentage of persons who are racial or ethnic minorities (i.e., all persons except those who are non-Hispanic White), 10) “Limited English” percentage of persons aged ≥ 5 years who speak English “less than well,” 11) “Multi-Unit Housing” percentage of housing in structures with ≥ 10 units, 12) “Mobile Homes” percentage of housing structures that are mobile homes, 13) “Crowding” percentage households with more persons than rooms, 14) “No Vehicle” percentage of households with no vehicle available, and 15) “Group Quarters” percentage of persons in group quarters.



Fig. 2.
Prevalence of ASD among 8-year-old children and SVI by census tract—MADDSP, 2018.

Table 1

Prevalence of ASD among 8-year-old children by SVI—MADDSP, 2018

Category	SVI theme	ASD prevalence (95% CI)			Rate ratio for relative differences in ASD prevalence (95% CI)		
		Low social vulnerability	Medium social vulnerability	High social vulnerability	Low versus high estimate	Medium versus high estimate	
Total	Overall	20.0 (17.1–23.4)	23.2 (20.0–27.0)	16.4 (13.8–19.5)	1.2 (0.97–1.54)	1.4 (1.13–1.78)	
	Socioeconomic status	20.6 (17.5–24.1)	22.8 (19.7–26.2)	15.8 (13.2–18.9)	1.3 (1.03–1.66)	1.4 (1.15–1.82)	
	Household composition and disability status	17.8 (14.9–21.4)	23.8 (20.7–27.3)	17.3 (14.6–20.3)	1.0 (0.81–1.32)	1.4 (1.11–1.71)	
	Racial/ethnic minority status and language	16.9 (14.3–20.1)	23.7 (20.4–27.4)	18.9 (16.2–22.2)	0.9 (0.71–1.13)	1.2 (1.01–1.55)	
	Housing type and transportation	23.5 (20.5–27.1)	20.3 (17.4–23.9)	15.0 (12.4–18.1)	1.6 (1.24–1.98)	1.4 (1.06–1.73)	
Male	Overall	34.2 (28.8–40.6)	37.7 (32.0–44.5)	25.3 (20.9–30.6)	1.4 (1.05–1.74)	1.5 (1.16–1.92)	
	Socioeconomic status	34.8 (29.3–41.4)	36.6 (31.3–42.9)	24.9 (20.5–30.4)	1.4 (1.07–1.82)	1.5 (1.14–1.89)	
	Household composition and disability status	28.5 (23.3–34.8)	38.4 (33.0–44.8)	28.7 (24.0–34.3)	1.0 (0.76–1.30)	1.3 (1.06–1.69)	
	Racial/ethnic minority status and language	29.3 (24.4–35.3)	39.2 (33.4–46.1)	28.3 (23.7–33.9)	1.0 (0.80–1.34)	1.4 (1.09–1.76)	
	Housing type and transportation	38.8 (33.3–45.3)	33.4 (28.1–39.8)	23.6 (19.2–29.0)	1.6 (1.27–2.13)	1.4 (1.08–1.86)	
Female	Overall	5.9 (3.9–8.9)	8.8 (6.2–12.4)	6.4 (4.3–9.5)	0.9 (0.53–1.65)	1.4 (0.81–2.33)	
	Socioeconomic status	6.5 (4.4–9.7)	8.9 (6.4–12.3)	5.4 (3.4–8.5)	1.2 (0.66–2.20)	1.6 (0.94–2.86)	
	Household composition and disability status	6.7 (4.4–10.2)	9.0 (6.5–12.4)	5.2 (3.4–8.0)	1.3 (0.70–2.33)	1.7 (1.00–2.92)	
	Racial/ethnic minority status and language	4.7 (3.0–7.5)	7.8 (5.4–11.3)	8.6 (6.1–12.1)	0.5 (0.31–0.97)	0.9 (0.55–1.50)	
	Housing type and transportation	8.3 (5.9–11.6)	6.8 (4.6–10.1)	5.7 (3.7–8.8)	1.5 (0.84–2.54)	1.2 (0.67–2.16)	
Black	Overall	22.1 (16.1–30.4)	24.1 (19.6–29.7)	19.0 (15.1–24.0)	1.2 (0.78–1.72)	1.3 (0.93–1.73)	
	Socioeconomic status	25.2 (18.3–34.6)	25.4 (20.8–30.9)	16.3 (12.7–21.0)	1.5 (1.03–2.31)	1.6 (1.13–2.13)	
	Household composition and disability status	28.2 (20.1–39.4)	26.5 (20.8–33.8)	18.0 (14.8–22.0)	1.6 (1.06–2.30)	1.5 (1.07–2.01)	
	Racial/ethnic minority status and language	18.0 (13.7–23.4)	22.6 (18.1–28.1)	24.7 (19.3–31.7)	0.7 (0.50–1.04)	0.9 (0.66–1.27)	
	Housing type and transportation	24.1 (19.0–30.6)	24.6 (19.6–30.9)	16.9 (13.0–21.9)	1.4 (1.00–2.04)	1.5 (1.03–2.07)	
White	Overall	16.4 (13.0–20.6)	15.6 (11.3–21.6)	8.9 (5.6–14.1)	1.8 (1.10–3.08)	1.8 (1.00–3.08)	

Category	SVI theme	ASD prevalence (95% CI)			Rate ratio for relative differences in ASD prevalence (95% CI)		
		Low social vulnerability	Medium social vulnerability	High social vulnerability	Low versus high estimate	Medium versus high estimate	
Hispanic	Socioeconomic status	15.8 (12.4–20.0)	15.8 (11.7–21.2)	9.2 (5.6–15.0)	1.7 (1.00–2.96)	1.7 (0.97–3.05)	
	Household composition and disability status	10.9 (8.0–14.8)	18.9 (14.9–24.0)	12.7 (8.2–19.6)	0.9 (0.50–1.47)	1.5 (0.91–2.46)	
	Racial/ethnic minority status and language	15.0 (11.6–19.5)	18.5 (13.8–24.8)	10.0 (6.9–14.6)	1.5 (0.95–2.37)	1.8 (1.15–2.98)	
	Housing type and transportation	17.7 (14.1–22.4)	14.3 (10.5–19.5)	8.3 (5.1–13.3)	2.1 (1.26–3.64)	1.7 (0.98–3.05)	
	Overall	15.9 (9.4–26.8)	12.7 (8.3–19.4)	9.6 (6.7–14.0)	1.6 (0.87–3.12)	1.3 (0.75–2.31)	
	Socioeconomic status	20.2 (12.2–33.5)	10.6 (6.9–16.3)	9.9 (6.8–14.4)	2.0 (1.09–3.84)	1.1 (0.61–1.90)	
	Household composition and disability status	10.5 (6.4–17.2)	13.6 (9.9–18.7)	8.0 (4.1–15.3)	1.3 (0.58–2.99)	1.7 (0.83–3.54)	
	Racial/ethnic minority status and language	13.6 (6.5–28.5)	15.2 (9.5–24.5)	10.2 (7.5–14.0)	1.3 (0.59–2.97)	1.5 (0.84–2.63)	
	Housing type and transportation	15.1 (9.8–23.1)	10.5 (6.5–16.9)	10.3 (6.9–15.2)	1.5 (0.82–2.63)	1.0 (0.55–1.90)	

Significance for all bold values are $p < 0.05$ and are indicated by the confidence intervals.

Prevalence of ASD among 8-year-old children by ID status and SVI—MADDSP, 2018

Table 2

SVI theme	Category*	ASD prevalence (95% CI)			Rate ratio for relative differences in ASD prevalence (95% CI)		
		Low social vulnerability	Medium social vulnerability	High social vulnerability	Low versus high estimate	Medium versus high estimate	
Overall	ASD only	11.2 (9.0–13.8)	10.9 (8.8–13.5)	6.3 (4.7–8.3)	1.8 (1.26–2.53)	1.7 (1.22–2.47)	
	ASD and ID	4.9 (3.6–6.8)	7.3 (5.6–9.5)	5.4 (4.0–7.3)	0.9 (0.59–1.42)	1.3 (0.90–2.01)	
Socioeconomic status	ASD only	11.7 (9.5–14.5)	10.8 (8.8–13.3)	5.5 (4.0–7.4)	2.1 (1.47–3.10)	2.0 (1.37–2.86)	
	ASD and ID	4.6 (3.3–6.5)	7.6 (5.9–9.7)	5.1 (3.7–7.0)	0.9 (0.57–1.45)	1.5 (1.00–2.24)	
Household composition and disability status	ASD only	9.5 (7.4–12.2)	11.7 (9.6–14.3)	6.9 (5.3–9.0)	1.4 (0.95–1.96)	1.7 (1.22–2.34)	
	ASD and ID	4.8 (3.4–6.8)	6.5 (5.0–8.5)	6.0 (4.5–7.9)	0.8 (0.52–1.27)	1.1 (0.74–1.60)	
Racial/ethnic minority status and language	ASD only	7.8 (6.0–10.0)	11.4 (9.2–14.1)	9.0 (7.2–11.4)	0.9 (0.61–1.21)	1.3 (0.93–1.73)	
	ASD and ID	4.3 (3.1–6.1)	7.7 (5.9–9.9)	5.6 (4.2–7.5)	0.8 (0.50–1.22)	1.4 (0.93–2.03)	
Housing type and transportation	ASD only	12.4 (10.2–15.0)	10.0 (8.0–12.6)	5.3 (3.9–7.3)	2.3 (1.61–3.36)	1.9 (1.28–2.78)	
	ASD and ID	7.7 (6.0–9.8)	4.6 (3.3–6.4)	5.0 (3.7–7.0)	1.5 (1.02–2.28)	0.9 (0.57–1.44)	

Significance for all bold values are $p < 0.05$ and are indicated by the confidence intervals.

* Limited to children with information on intellectual functioning.

Table 3
Prevalence of ASD among 8-year-old children by SVI—MADDSP, 2014–2018

SVI theme	Year	ASD prevalence (95% CI)			Rate ratio for relative differences in ASD prevalence (95% CI)		
		Low social vulnerability	Medium social vulnerability	High social vulnerability	Low versus high estimate	Medium versus high estimate	
Overall	2014	19.1 (16.3–22.5)	18.34 (15.6–21.6)	19.16 (16.3–22.5)	1.0 (0.79–1.25)	1.0 (0.76–1.20)	
	2016	20.8 (17.8–24.3)	20.71 (17.8–24.2)	17.1 (14.4–20.2)	1.2 (0.97–1.53)	1.2 (0.96–1.52)	
	2018	20.0 (17.1–23.4)	23.2 (20.0–27.0)	16.4 (13.8–19.5)	1.2 (0.97–1.54)	1.4 (1.13–1.78)	
Socioeconomic status	2014	18.2 (15.4–21.6)	19.3 (16.6–22.5)	19.0 (16.0–22.5)	1.0 (0.76–1.22)	1.0 (0.81–1.28)	
	2016	19.0 (16.1–22.4)	24.2 (21.1–27.8)	15.1 (12.6–18.1)	1.3 (0.98–1.61)	1.6 (1.28–2.02)	
	2018	20.6 (17.5–24.1)	22.8 (19.7–26.2)	15.8 (13.2–18.9)	1.3 (1.03–1.66)	1.4 (1.15–1.82)	
Household composition and disability status	2014	20.2 (17.0–24.0)	19.6 (16.8–22.8)	17.1 (14.5–20.2)	1.2 (0.93–1.49)	1.1 (0.92–1.43)	
	2016	19.0 (15.8–22.8)	22.0 (19.2–25.2)	17.0 (14.3–20.1)	1.1 (0.87–1.44)	1.3 (1.04–1.61)	
Racial/ethnic minority status and language	2018	17.8 (14.9–21.4)	23.8 (20.7–27.3)	17.3 (14.6–20.3)	1.0 (0.81–1.32)	1.4 (1.11–1.71)	
	2014	19.2 (16.1–23.0)	18.6 (16.0–21.7)	18.8 (16.1–22.1)	1.0 (0.80–1.30)	1.0 (0.79–1.23)	
Housing type and transportation	2016	19.0 (16.1–22.6)	20.3 (17.4–23.6)	19.2 (16.4–22.5)	1.0 (0.79–1.25)	1.1 (0.85–1.31)	
	2018	16.9 (14.3–20.1)	23.7 (20.4–27.4)	18.9 (16.2–22.2)	0.9 (0.71–1.13)	1.2 (1.01–1.55)	
	2014	17.6 (15.0–20.6)	18.6 (15.7–22.0)	20.7 (17.7–24.3)	0.8 (0.68–1.06)	0.9 (0.71–1.13)	
	2016	21.9 (19.0–25.2)	18.3 (15.4–21.6)	17.8 (15.0–21.2)	1.2 (0.98–1.53)	1.0 (0.80–1.31)	
	2018	23.5 (20.5–27.1)	20.3 (17.4–23.9)	15.0 (12.4–18.1)	1.6 (1.24–1.98)	1.4 (1.06–1.73)	

Significance for all bold values are $p < 0.05$ and are indicated by the confidence intervals.