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National and State Estimates of Adults with Autism Spectrum Disorder

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Abstract

U.S. national and state population-based estimates of adults living with autism spectrum disorder (ASD) are nonexistent due to the lack of existing surveillance systems funded to address this need. Therefore, we estimated national and state prevalence of adults 18–84 years living with ASD using simulation in conjunction with Bayesian hierarchal models. In 2017, we estimated that approximately 2.21% (95% simulation interval (SI) 1.95%, 2.45%) or 5,437,988 U.S. adults aged 18 and older have ASD, with state prevalence ranging from 1.97% (95% SI 1.55%, 2.45%) in Louisiana to 2.42% (95% SI 1.93%, 2.99%) in Massachusetts. Prevalence and case estimates of adults living with ASD (diagnosed and undiagnosed) can help states estimate the need for diagnosing and providing services to those unidentified.

Keywords

Autism spectrum disorder; Developmental disabilities; Intellectual disability; Prevalence estimates; Modeling

Introduction

In the U.S. approximately 1.5 million children ages 3–17 years have been diagnosed with Autisms Spectrum Disorder (ASD), a developmental disability characterized by deficits in social communication and interaction, as well as restricted, repetitive behaviors (Kogan et al. 2018; American Psychiatric Association 2013). Prevalence estimates for adults are unknown due to a lack of existing surveillance systems to monitor the prevalence. ASD is a life-long disability that can require intensive support throughout life for some but not all with the condition (Roux et al. 2015; Croen et al 2015; Nicolaidis et al. 2014; Murphy et al. 2016). Based on data from 11 surveillance sites, 1.67% of 8-year-old children have

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Author Contributions PMD conceived of the study, wrote the manuscript except for the methods; CER provided statistical expertise and conducted the analysis, wrote the methods section of the manuscript; DM conducted an independent analysis for quality control, downloaded and prepared data for analysis, and created Figures 1 and 2; MM provided statistical and data expertise. All authors reviewed and approved the final manuscript as submitted and agreed to be accountable for all aspects of the work.

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ASD (Baio et al. 2018). As children with diagnosed ASD mature into adolescence and early adulthood, parents, service providers, and policy makers can support them by ensuring necessary services for adults with ASD are available to meet the demand.

National and state-based estimates of adults living with ASD could inform planning for programs and services; however, no U.S. estimates currently exist. Without data on ASD in adults, estimates of ASD prevalence among adults can be derived from applying existing data to models. Modeling of estimates has been done for national prevalence of congenital heart disease (Gilboa et al. 2016) and state-based prevalence of hepatitis C virus (Rosenberg et al. 2018). We estimated national and state prevalence of adults living with ASD using existing state-based data for children and adjusting for higher mortality rates among persons with ASD.

Methods

We used unpublished ASD prevalence data from NSCH (2016–2018), published ASD population mortality rates, 1999–2017 U.S. mortality rates by state, age, and sex, and 2017 population to develop an estimator of ASD prevalence and cases by state and sex, and nationally for 2017. For the unpublished ASD prevalence data, we calculated ASD prevalence for the age group 3–17 years, consistent with NSCH reports (Kogan et al 2018). In that study the age group 3–5 years had a prevalence of 1.97%, (95% CI 1.41–2.74) compared with 2.61 (95% CI 2.15–3.15) for ages 6–11 years and 2.65 (95% CI 2.27–3.10) for ages 12–17. A sensitivity analysis was run using data for ages 6–17 years to assess the effect of the choice of age group on the estimated number of adults with ASD.

Our estimator of the prevalence and cases of ASD for the ith state, jth age (year), and kth sex used the following equations and begins with the ages 3–17 prevalence estimate (see Supplemental material for derivation).

$$\gamma_{ijk}^{\text{adj}} = N_{ijk}\rho_{i(j-1)k}\frac{S_{ik}^{ASD}}{S_{ijk}^{POP}} \tag{1}$$

$$\rho_{ijk}^{\text{adj}} = \frac{\gamma_{ijk}^{\text{adj}}}{N_{ijk}} = \frac{1}{N_{ijk}}N_{ijk}\rho_{i(j-1)k}\frac{S_{ik}^{ASD}}{S_{ijk}^{POP}} = \rho_{i(j-1)k}\frac{S_{ik}^{ASD}}{S_{ijk}^{POP}} \tag{2}$$

where γ^{adj} is the number of ASD cases adjusted for the survival ratio of the ASD to population, N is the population, ρ is the ASD prevalence, survival rates for the adults with ASD and population are defined by S, and ρ^{adj} is the adjusted state, sex, and age (> 17) ASD prevalence rate. National and state estimates are obtained by summing over all ASD cases for ages 18–84 and then calculating the national and state ASD prevalence estimates. Estimates went up to age 84, reflecting the availability of general population mortality data. Our ASD prevalence estimator assumes that given the age 3–17 prevalence estimate, the prevalence decreases over time as a function of the ASD-to-population survival ratio.

Inputs into the models (Eqs. 1, 2) are presented in Table 1. Inputs assumed to be known are the population and mortality rates whereas the ages 3–17 prevalence and survival ratio are estimated. Using simulation, we incorporate the uncertainty of the ages 3–17 prevalence and survival ratio estimates into the model. Our inputs include 2016–18 state-based ASD numbers by sex for children ages 3–17 years from the National Survey of Children's Health (NSCH). NSCH is an annual, cross-sectional, complex design, address-based survey that collects information on the health and well-being of children ages 0–17 years using both web-based and paper and pencil methodologies. Children whose parents responded "yes" on two ASD questions were inCIuded: (1) "Has a doctor or other health care provider ever told you that your child has Autism or Autism Spectrum Disorder? Include diagnoses of Asperger's Disorder or Pervasive Developmental Disorder (PDD)"; (2) "If yes, does this child currently have the condition?" We used a two-step process to estimate the ages 3–17 ASD prevalence by state and sex. First, we used the NSCH ages 3–17 data and study design weights to estimate the logistic regression model regression coefficients and standard errors (SE) by state and sex. Our second stage used the NSCH logistic regression coefficients and SE in a Bayesian hierarchical meta-analysis model to estimate the partially pooled effects for each state and sex. Partial pooling assumes each state and sex has a different prevalence, but the data for all states and sex informs the prevalence estimate of each state and sex. We used partial pooling to reduce the influence of outliers and estimates from states with small numbers of observations, resulting in more statistically robust estimates (Gelman 2013). The 2017 state populations, by sex, were obtained from the National Center for Health Statistics (US DHHS 2018a, b). We estimated ASD prevalence separately for males and females as males are known to have higher rates of ASD diagnoses than females (Kogan et al. 2018; Baio et al. 2018).

Standardized mortality ratio (SMR) is a relative measure of excess mortality for one group compared to the general population. The SMR by sex was estimated using a meta-analysis method based on five studies (Supplement Table 1). We used a Bayesian hierarchical Poisson model with the observed mortality as the outcome and the expected mortality as the offset (Supplemental Methods) to estimate the partially pooled overall SMR by sex. We assumed that the SMR was the same across states because we had no information on state-specific mortality rates. We also assumed the SMR did not change across age groups, although the majority of the mortality studies followed persons with ASD only through middle age.

We used simulation to estimate the 2017 national and state prevalence and 95% simulation interval (SI) of men and women ages 18–84 living with ASD. First, we obtained the mortality rate by state and sex for ages 3–17, and 18–84 by year and strata (state, sex, and age). Second, we obtained the U.S. 2017 population data by state, sex, and age. Next, we estimated ages 3–17 meta-analysis prevalence and associated SE by state and sex and randomly drew 10,000 samples from a normal distribution using our estimated mean and SE meta-analysis estimates by sex for the SMRs (see Supplemental Table 1). Next, we randomly drew 10,000 prevalence samples using our meta-analysis estimates by state and sex. Lastly, we estimate the prevalence and ASD cases by state, sex, and age using Eqs. 1 and 2. Our simulation resulted in 10,000 estimates for the prevalence and ASD cases for age Class 18–84 by state and sex, and we summarize these results using the mean and 95% SI.

The male-to-female ASD prevalence ratio (PR) was calculated by state for each simulation and then summarized for all 10,000 simulations with the mean and 95% SI (see Supplement Fig. 1).

Results

In 2017, we estimated that 2.21% (95% SI 1.95%, 2.45%) or 5,437,988 (95% SI 4,798,561; 6,025,184) U.S. adults aged 18–84 years were living with ASD. State prevalence estimates ranged from 1.97% (95% SI 1.55%, 2.45%) in Louisiana to 2.42% (95% SI 1.93%, 2.99%) in Massachusetts (Table 2). The states with the greatest number of adults estimated to be living with ASD Included California (701,669 cases), Texas (449,631), New York (342,280) and Florida (329,131). No obvious geographic pattern for prevalence was found (Fig. 1).

The estimated U.S. ASD prevalence for females was 0.86% (95% SI 0.60, 1.09), and by state ranged from 0.72% (95% SI 0.41, 1.11) in Arkansas to 0.97% (95% SI 0.50, 1.45) in Virginia (Table 3, Fig. 2). The estimated U.S. ASD prevalence among adult males was higher than females, at 3.62%, (95% SI 3.14, 4.04), and state estimates ranged from 3.17% (95% SI 2.33, 4.19) in South Dakota to 4.01% (95% SI 3.07, 5.14) in Massachusetts (Table 4, Fig. 2). State PRs for males versus females estimates ranged from 3.94 (95% SI 2.29, 6.48) in South Dakota to 5.08 (95% SI 2.84, 8.78) in Arkansas (see Supplemental Table 2). The male-to-female prevalence difference ranged from 2.32% points (95% SI 1.40, 3.39) for South Dakota to 3.16% points (95% SI 2.16, 4.35) for Connecticut (see Supplemental Table 2).

We conducted a sensitivity analysis to assess the estimated number of adults with ASD using the ASD estimated prevalence for the age group 6–17 years in the model compared with the age group 3–17 years. The estimated U.S. ASD prevalence was 2.38% (95% SI 2.10, 2.64) using data for the age group 6–17 years in the model compared with 2.21% (95% SI 1.95, 2.45) using data for the age group 3–17 years in the model (see Supplement for state estimates).

Discussion

Using existing data and adjusting for elevated mortality among persons living with ASD, we estimated national and state prevalence of adults 18–84 years of age living with ASD. Our estimate of 2.21% is higher than a study estimating ASD among adults in a community in England (1.0%) (Brugha et al. 2011). Our estimate may be higher because Brugha et al. was an empirical surveillance study conducted in one community in England among adults whereas the present analysis is a modeling study based on projecting prevalence from parent-report of children diagnosed with ASD in U.S. states to adults.

National and state ASD estimates in this analysis provide a general magnitude of the population of adults living with autism, but they have some important limitations. The prevalence of ASD among children, which was used to estimate prevalence among adults in our analysis, is based on parent report, which may under- or overestimate prevalence. For example, the estimates of ASD prevalence among children ages 3–17 years does not Include children with ASD who have not been diagnosed, leading to an underestimate of prevalence.

Conversely, it may overestimate prevalence, as parents may falsely report that their child was diagnosed if ASD was suspected or if the child failed a screener but did not receive a diagnosis.

Our assumption that the ASD prevalence among children ages 3–17 years during 2016–2018 (born during 1999–2015) and adults (born before 1999) is similar does not account for the possibility of environmental or gene-environment interactions associated with ASD that may have changed over time. Exposure to some risk factors may have varied among birth cohorts. However, few risk factors have consistently been associated with ASD and those that have been identified have accounted for a very small percent of increases in diagnosed ASD (Schieve et al. 2011; Quinlan et al. 2015). One study found that changes in preterm delivery, small-for-gestational age, multiple births, cesarean delivery, and assisted reproductive technology use contributed to less than 1% of the 57% increase in ASD among 8-year-old children born in 1994 compared to 1998 (Schieve et al. 2011). A study conducted among children in New York City found that changes in maternal and paternal age accounted for only 2.7% of the 143% increase in ASD among children ages 0–3 from 0.03% in 1994 to 0.43% in 2001 (Quinlan et al. 2015). The prevalence of ASD among adults may be equivalent to that among children in that at least one study by Brugha et al. 2011 showed the adult prevalence was comparable to the estimated ASD prevalence among children at the time the study was conducted.

Limited information is available on mortality among adults with ASD. However, studies have shown consistently that adults with ASD have higher mortality rates than those without (Picket et al. 2006; Mouridsen et al. 2008; Gillberg et al. 2010; Hirvikoski et al. 2016). Most of the mortality studies followed persons to an average age of 30–55 years. We assumed the SMR remained the same for ages above 50 years; however, additional mortality studies that Include older persons with ASD are needed to validate this assumption.

There was some variation in the prevalence of ASD by state, with the prevalence ranging from 1.97 to 2.42%. The prevalence estimates were estimated using a partial-pooling hierarchical model that naturally pulls the raw state prevalence estimates towards the mean U.S. estimate and pulls those with less data more towards the mean. Currently, there is no evidence that the prevalence of ASD should vary by geographic location; however, there is evidence that greater availability of screening and diagnostic services will increase the number of persons diagnosed with ASD (Rolthlz et al. 2017; Janvier et al. 2016). Male and female ASD prevalence estimates were substantially different, which is consistent with existing studies (Kogan et al. 2018; Baio et al. 2018). The reason for this difference is unknown but it may reflect, in part, differences in how ASD manifests in boys and girls leading to differential diagnosis by gender.

To date, an empirical study of adult ASD prevalence in the U.S. has not been accomplished, perhaps because any single approach to ascertain adult ASD has challenges. There are no psychometrically validated tests of ASD for adults, which leads to uncertainty for studies using tests designed for children, such as the Autism Diagnostic Observation Schedule. In addition, mixed methods are likely needed in order to reach populations living independently and in group settings. A subset of persons might only be identified through the review of service records of those being served in group settings. Individuals with ASD who live independently may be disinclined to participate in a survey if recruited via phone or in person. Adults with ASD may be more difficult to recruit because they may not be enrolled in services or may not receive services in a wide variety of settings (e.g., schools, health care providers, community-based entities) resulting in challenges to comprehensive recruitment efforts. Once a validated tool to identify adults with ASD is created, a study could incorporate information from public school classifications or publicly-funded programs that serve individuals with ASD and population-based telephone or community surveys of adults with adjustments to address greater non-response among adults with ASD.

Overall, we estimated that 1 in 45 adults (95% SI, 41, 51), ages 18–84 years, are living with ASD. While these numbers are estimates, they do provide a place for states to think about available services for adults with ASD. We used the most current data available for all states to estimate the ASD prevalence among adults. This analysis may motivate some states to explore state-based data sources that may be more informative than data available for all states, and refine the estimates based on their existing local data.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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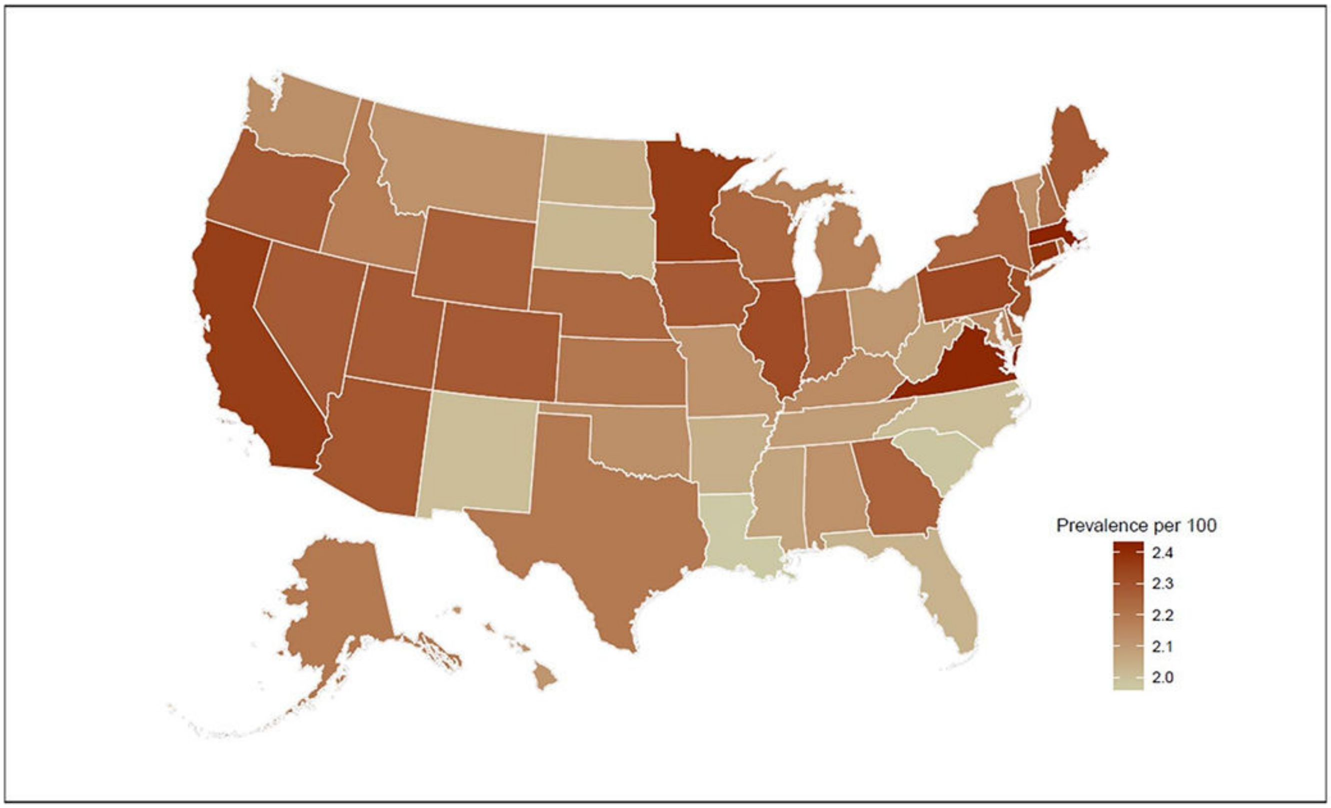

Fig. 1.
Estimated autism spectrum disorder prevalence among adults 18–84 years by state, 2017

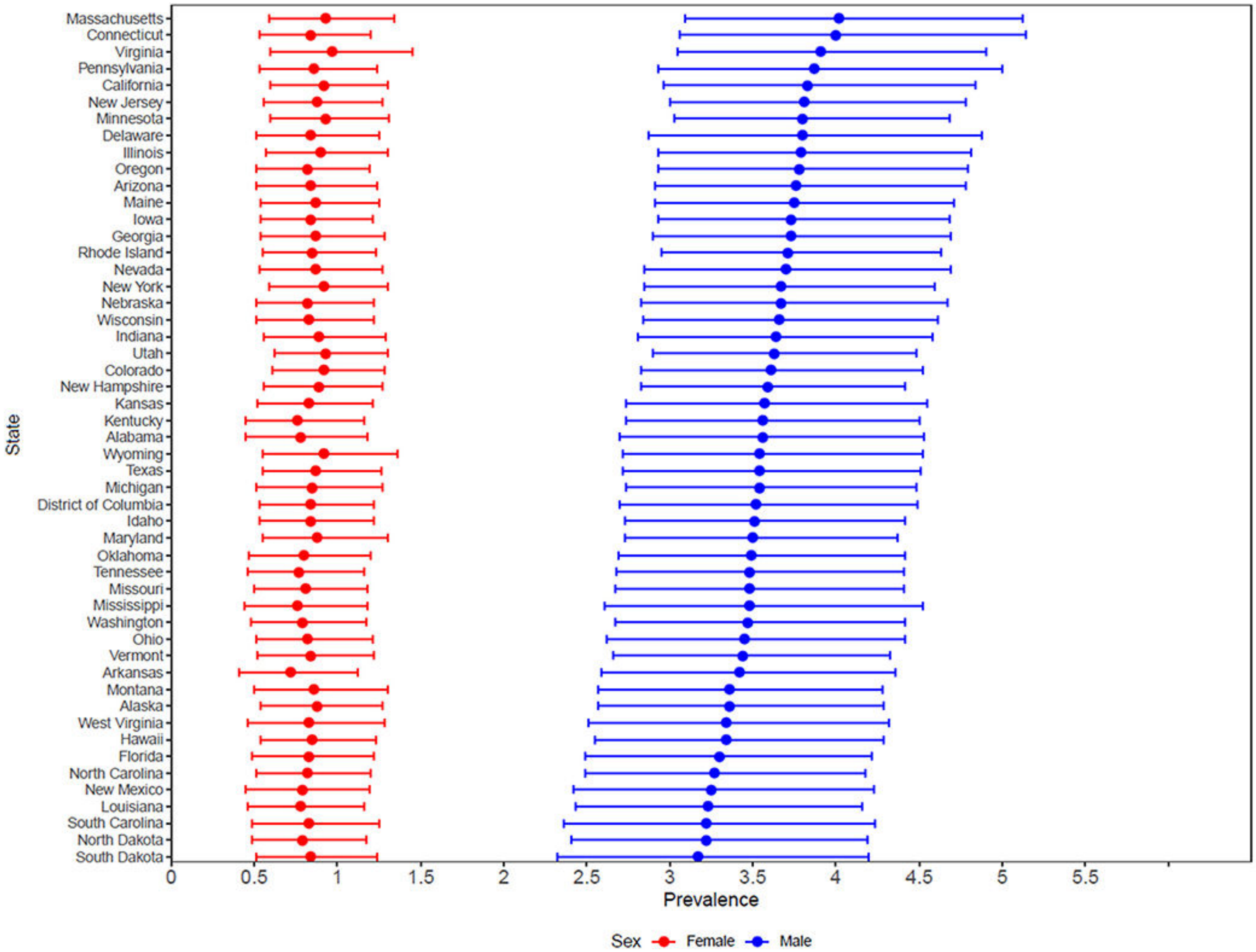

Fig. 2.
Estimated state autism spectrum disorder prevalence among adults 18–84 years by sex

Table 1

Data inputs used to estimate ASD prevalence among adults 18–84 years by state and sex

Input	Data source for estimates	Link
2016–2018 estimated state prevalence of male and female children ages 3–17 years with diagnosed ASD reported by a parent	National survey of children's health, 2016–2018	https://mchb.hrsa.gov/data/national-surveys/questionnaires-datasets-supporting-documents
A meta-analysis of mortality studies used to estimate male and female mortality rates among persons with diagnosed ASD	Picket et al. (2006) All ages included among those receiving services in the California Department of Developmental Services 1/83–12/1997, 1/1998–12/2002 with autism diagnoses and died during the study time period. Comparison group adjusted for age	PMID: 16565885
	Mouridsen et al. (2008)	PMID: 18,579,647
	ASD was a clinical cohort, average age 43 years. Comparison group adjusted for age	https://doi.org/10.1177/1362361308091653
	Gillberg et al. (2010)	PMID: 19838782
	Population-based group of persons with ASD followed up to average age of 33 years. Comparison group adjusted for age	https://doi.org/10.1007/s10803-009-0883-4
	Hirvikoski et al. (2016)	PMID: 26541693
	All ages included: median age of death for persons with ASD = 55 years, control population = 70 years	https://doi.org/10.1192/bjp.bp.114.160192
2017 estimate of the state populations by sex	United States Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics, Bridged-Race Population Estimates, United States, postcensal population estimates, released by NCHS on 6/27/2018	https://wonder.cdc.gov/bridged-race-v2017.html
1999–2017 state mortality rates	Multiple Cause of Death Files, 1999–2017, as compiled from data provided by the 57 vital statistics jurisdictions through the Vital Statistics Cooperative Program	https://wonder.cdc.gov/ucd-icd10.html

Table 2

State estimated autism spectrum disorder prevalence among adults ages 18–84 years, cases, and associated 95% simulation interval

State	Cases	95% SI	Prevalence	95% SI
Alabama	78,072	61,527, 96,435	2.12	1.67, 2.61
Alaska	12,000	9559, 14,849	2.19	1.74, 2.71
Arizona	119,924	95,618, 147,485	2.29	1.82, 2.81
Arkansas	45,569	35,644, 56,735	2.03	1.59, 2.53
California	701,669	563,358, 863,471	2.36	1.89, 2.90
Colorado	96,917	78,736, 117,790	2.28	1.85, 2.77
Connecticut	65,337	51,985, 81,354	2.37	1.89, 2.96
Delaware	16,683	13,191, 20,742	2.26	1.79, 2.81
District of Columbia	11,700	9281, 14,425	2.10	1.67, 2.59
Florida	329,131	259,573, 407,473	2.03	1.60, 2.51
Georgia	174,612	139,616, 213,983	2.25	1.80, 2.75
Hawaii	22,797	18,103, 28,324	2.11	1.67, 2.62
Idaho	27,094	21,741, 33,212	2.18	1.75, 2.67
Illinois	223,353	178,832, 274,414	2.32	1.86, 2.85
Indiana	111,067	88,717, 136,349	2.24	1.79, 2.75
Iowa	53,243	43,024, 64,598	2.28	1.84, 2.77
Kansas	46,863	37,387, 57,849	2.19	1.75, 2.71
Kentucky	71,791	56,959, 88,657	2.13	1.69, 2.64
Louisiana	68,819	54,071, 85,662	1.97	1.55, 2.45
Maine	23,910	19,244, 29,167	2.28	1.83, 2.78
Maryland	98,200	78,844, 118,940	2.14	1.72, 2.59
Massachusetts	129,168	103,105, 159,372	2.42	1.93, 2.99
Michigan	164,360	130,831, 201,349	2.17	1.73, 2.66
Minnesota	97,881	80,695, 117,401	2.35	1.94, 2.82
Mississippi	45,911	35,708, 57,883	2.07	1.61, 2.61
Missouri	97,377	77,500, 119,708	2.12	1.68, 2.60
Montana	16,969	13,404, 21,053	2.12	1.68, 2.63
Nebraska	31,417	25,045, 38,775	2.24	1.79, 2.77

State	Cases	95% SI	Prevalence	95% SI
Nevada	51,799	41,333, 63,725	2.28	1.82, 2.81
New Hampshire	23,442	19,085, 28,268	2.22	1.81, 2.68
New Jersey	157,245	127,036, 191,192	2.30	1.86, 2.80
New Mexico	31,207	24,166, 39,369	2.00	1.55, 2.52
New York	342,280	276,658, 417,725	2.25	1.82, 2.74
North Carolina	155,953	123,603, 192,285	2.00	1.59, 2.47
North Dakota	11,501	8967, 14,435	2.05	1.60, 2.57
Ohio	185,315	145,971, 228,939	2.11	1.66, 2.60
Oklahoma	61,672	49,304, 75,780	2.13	1.70, 2.61
Oregon	72,727	58,308, 89,294	2.28	1.83, 2.80
Pennsylvania	228,572	180,929, 284,166	2.33	1.85, 2.90
Rhode Island	18,472	15,116, 22,343	2.24	1.83, 2.71
South Carolina	75,985	58,887, 95,248	1.98	1.54, 2.48
South Dakota	12,830	9881, 16,286	2.02	1.56, 2.57
Tennessee	106,083	84,068, 131,132	2.08	1.65, 2.58
Texas	449,631	358,411, 556,627	2.19	1.74, 2.71
Utah	48,818	40,003, 58,452	2.28	1.87, 2.73
Vermont	10,435	8367, 12,764	2.12	1.70, 2.59
Virginia	155,557	125,110, 189,742	2.41	1.94, 2.94
Washington	119,815	95,514, 149,233	2.13	1.70, 2.65
West Virginia	29,083	22,748, 36,322	2.07	1.62, 2.58
Wisconsin	97,977	78,734, 119,841	2.23	1.80, 2.73
Wyoming	9758	7755, 12,036	2.26	1.79, 2.78
Total	5,437,988	4,798,561, 6,025,184	2.21	1.95, 2.45

Table 3

Estimated autism spectrum disorder prevalence among females ages 18–84 years, cases, and associated 95% simulation interval

State	Cases	95% SI	Prevalence	95% SI
Alabama	15,072	8617, 22,982	0.79	0.45, 1.20
Alaska	2275	1399, 3291	0.88	0.54, 1.27
Arizona	22,274	13,559, 32,654	0.84	0.51, 1.23
Arkansas	8230	4690, 12,697	0.72	0.41, 1.11
California	137,645	89,272, 195,797	0.92	0.60, 1.31
Colorado	19,454	12,731, 27,303	0.92	0.60, 1.29
Connecticut	11,799	7494, 16,905	0.84	0.53, 1.20
Delaware	3212	1887, 4743	0.84	0.49, 1.24
District of Columbia	2470	1570, 3634	0.84	0.53, 1.23
Florida	69,038	40,683, 101,477	0.83	0.49, 1.22
Georgia	35,043	21,353, 51,568	0.87	0.53, 1.28
Hawaii	4592	2864, 6629	0.86	0.53, 1.24
Idaho	5241	3278, 7601	0.84	0.53, 1.22
Illinois	44,364	28,116, 63,603	0.90	0.57, 1.29
Indiana	22,492	13,811, 32,950	0.89	0.55, 1.30
Iowa	9822	6255, 14,075	0.84	0.53, 1.20
Kansas	8848	5478, 12,832	0.83	0.51, 1.20
Kentucky	13,109	7528, 19,922	0.77	0.44, 1.16
Louisiana	13,979	8248, 21,019	0.78	0.46, 1.17
Maine	4685	2909, 6775	0.87	0.54, 1.26
Maryland	21,097	12,870, 31,034	0.89	0.54, 1.30
Massachusetts	25,678	16,523, 37,094	0.93	0.60, 1.35
Michigan	32,847	19,687, 49,002	0.85	0.51, 1.27
Minnesota	19,328	12,650, 27,220	0.93	0.61, 1.30
Mississippi	8842	4986, 13,560	0.77	0.43, 1.18
Missouri	19,177	11,751, 28,060	0.82	0.50, 1.19
Montana	3430	1984, 5146	0.87	0.50, 1.30
Nebraska	5774	3615, 8476	0.82	0.52, 1.21

State	Cases	95% SI	Prevalence	95% SI
Nevada	9863	6058, 14,443	0.87	0.53, 1.27
New Hampshire	4722	2960, 6732	0.89	0.56, 1.27
New Jersey	30,829	19,381, 44,681	0.88	0.55, 1.27
New Mexico	6215	3548, 9505	0.79	0.45, 1.20
New York	72,438	46,913, 103,195	0.92	0.60, 1.31
North Carolina	33,070	20,403, 47,816	0.82	0.51, 1.19
North Dakota	2129	1308, 3177	0.79	0.48, 1.18
Ohio	37,205	22,486, 54,560	0.83	0.50, 1.21
Oklahoma	11,752	7023, 17,555	0.80	0.48, 1.20
Oregon	13,170	8255, 19,271	0.82	0.51, 1.20
Pennsylvania	43,191	26,449, 62,380	0.86	0.53, 1.25
Rhode Island	3628	2333, 5220	0.85	0.55, 1.23
South Carolina	16,609	9750, 24,644	0.84	0.49, 1.24
South Dakota	2645	1620, 3885	0.85	0.52, 1.24
Tennessee	20,306	12,014, 30,315	0.77	0.46, 1.16
Texas	90,422	57,760, 129,614	0.87	0.56, 1.25
Utah	9968	6557, 13,971	0.93	0.61, 1.31
Vermont	2087	1293, 3040	0.84	0.52, 1.22
Virginia	32,011	19,580, 47,823	0.97	0.59, 1.45
Washington	22,146	13,537, 33,310	0.79	0.48, 1.18
West Virginia	5910	3328, 9096	0.83	0.47, 1.28
Wisconsin	18,244	11,342, 26,895	0.83	0.52, 1.22
Wyoming	1943	1157, 2893	0.92	0.55, 1.37
Total	1,080,322	752,142, 1,359,152	0.86	0.60, 1.09

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Table 4

Estimated autism spectrum disorder prevalence among males ages 18–84 years, cases, and associated 95% simulation interval

State	Cases	95% SI	Prevalence	95% SI
Alabama	63,000	48,122, 79,991	3.55	2.71, 4.51
Alaska	9725	7481, 12,391	3.36	2.59, 4.28
Arizona	97,650	75,258, 123,694	3.76	2.89, 4.76
Arkansas	37,339	28,428, 47,714	3.41	2.60, 4.36
California	564,024	436,565, 712,719	3.82	2.96, 4.83
Colorado	77,463	60,754, 96,994	3.61	2.83, 4.52
Connecticut	53,538	41,196, 69,048	3.99	3.07, 5.15
Delaware	13,471	10,262, 17,304	3.80	2.89, 4.88
District of Columbia	9230	7052, 11,767	3.52	2.69, 4.48
Florida	260,093	197,052, 333,489	3.30	2.50, 4.23
Georgia	139,569	107,666, 175,620	3.72	2.87, 4.69
Hawaii	18,205	13,855, 23,302	3.34	2.54, 4.28
Idaho	21,853	16,906, 27,494	3.51	2.71, 4.41
Illinois	178,988	138,499, 226,962	3.79	2.93, 4.80
Indiana	88,575	68,532, 111,810	3.63	2.81, 4.59
Iowa	43,421	33,901, 54,102	3.73	2.91, 4.65
Kansas	38,015	29,328, 48,321	3.57	2.75, 4.54
Kentucky	58,682	44,945, 74,249	3.56	2.72, 4.50
Louisiana	54,840	41,315, 70,670	3.23	2.43, 4.16
Maine	19,225	14,960, 24,183	3.75	2.91, 4.71
Maryland	77,103	60,286, 96,019	3.49	2.73, 4.35
Massachusetts	103,490	79,250, 132,425	4.01	3.07, 5.14
Michigan	131,513	101,753, 166,068	3.54	2.74, 4.47
Minnesota	78,554	62,673, 96,695	3.79	3.03, 4.67
Mississippi	37,069	27,818, 48,132	3.48	2.61, 4.52
Missouri	78,200	60,239, 98,988	3.48	2.68, 4.40
Montana	13,538	10,318, 17,252	3.36	2.56, 4.28
Nebraska	25,642	19,722, 32,701	3.67	2.82, 4.68

State	Cases	95% SI	Prevalence	95% SI
Nevada	41,935	32,438, 53,010	3.69	2.86, 4.67
New Hampshire	18,720	14,879, 23,148	3.58	2.85, 4.43
New Jersey	126,416	99,304, 158,245	3.81	2.99, 4.77
New Mexico	24,992	18,581, 32,421	3.25	2.41, 4.21
New York	269,842	210,546, 338,482	3.67	2.86, 4.60
North Carolina	122,883	93,683, 157,051	3.26	2.49, 4.17
North Dakota	9372	7026, 12,121	3.22	2.41, 4.16
Ohio	148,110	111,942, 188,693	3.45	2.61, 4.39
Oklahoma	49,920	38,731, 63,029	3.49	2.71, 4.40
Oregon	59,557	46,065, 75,500	3.78	2.92, 4.79
Pennsylvania	185,382	140,420, 238,656	3.87	2.93, 4.98
Rhode Island	14,844	11,772, 18,395	3.71	2.94, 4.60
South Carolina	59,376	43,786, 77,343	3.22	2.37, 4.19
South Dakota	10,185	7500, 13,455	3.17	2.33, 4.19
Tennessee	85,777	66,069, 108,994	3.48	2.68, 4.42
Texas	359,209	274,707, 459,695	3.53	2.70, 4.52
Utah	38,850	30,928, 47,667	3.63	2.89, 4.46
Vermont	8348	6457, 10,507	3.44	2.66, 4.32
Virginia	123,546	96,564, 154,991	3.91	3.05, 4.90
Washington	97,669	75,180, 125,363	3.47	2.67, 4.45
West Virginia	23,173	17,458, 29,832	3.33	2.51, 4.29
Wisconsin	79,733	62,161, 99,939	3.65	2.85, 4.58
Wyoming	7815	6017, 9936	3.53	2.72, 4.49
Total	4,357,667	3,788,037, 4,867,213	3.62	3.14, 4.04