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ORIGINAL PAPER

Hospitalization and Mortality for Insured Patients in the United States with COVID-19 with and without Autism Spectrum Disorder

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Abstract

Autism spectrum disorder (ASD) is a neuropsychiatric condition that may be associated with negative health outcomes. This retrospective cohort study reveals the odds of hospitalization and mortality based on ASD for a population of insured patients with COVID-19. The odds of hospitalization and mortality for people with ASD were found to be greater than individuals without ASD when adjusted for sociodemographic characteristics. Hospitalization and mortality was associated with a dose-response increase to comorbidity counts (1 to 5+). Odds of mortality remained greater for those with ASD when adjusting for comorbid health conditions. ASD is a risk factor for COVID-19 mortality. Comorbid health conditions play a particular role in increasing the odds of COVID-19 related hospitalization and death for ASD patients.

Keywords Autism spectrum disorder · COVID-19 pandemic · Multimorbidities · Mortality

Introduction

The earlier phases of the COVID-19 pandemic highlighted the unequal distribution of access to health care and disparate rates of coronavirus disease 2019 (COVID-19) related hospitalizations and deaths across age, race, ethnicity, and zip code in the United States. The Centers for Disease Control and Prevention documented increased risks of hospitalization and death from COVID-19 associated with comorbid medical conditions, such as obesity, diabetes, chronic obstructive pulmonary disease, chronic renal failure, cardiovascular disease, and pregnancy (NCIRD, 2019). The most acute phase of the COVID-19 was marked by extended shelter-in place mandates as the world awaited vaccinations and other important treatment options. COVID-19 vaccinations became available starting December 10, 2020 with the most vulnerable groups (i.e. persons over the age of 60, persons who are immunocompromised, or persons with chronic conditions) granted vaccine access first along with front-line healthcare workers followed by a second phase of vaccine rollout for the general population (Bubar et al., 2020).

In the United States, chronic medical conditions occur disproportionately across disability status (i.e. neurodevelopmental or mental disability), race, ethnicity, age, income, and geographic regions. There are reports of increased COVID-19 related morbidity and mortality among persons with developmental disabilities (Landes et al., 2020, 2021; Turk et al., 2020). These studies typically do not disaggregate diverse populations among individuals with developmental disabilities.

Considered a lifelong disability, Autism spectrum disorder (ASD) is a neurodevelopmental condition that falls on a spectrum of severity, and marked by social communication deficits combined with restricted interests and/or repetitive behaviors (APA, 2013; Hodges et al., 2020). According to current estimates from the Centers for Disease Control and Prevention (CDC), ASD prevalence is 1 in 44 children and adolescents with varying prevalence in adulthood (CDC, 2020). Prevalence of autism for the non-Hispanic White,

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non-Hispanic Black and Hispanic populations are 2.65%, 2.85%, and 1.94%, respectively (Yuan et al., 2021). Individuals with ASD are more likely to have comorbid conditions and resultant, higher health care utilization compared to the general population without ASD (Jariwala-Parikh et al., 2019; Sala et al., 2020). In a recent systematic review, the mean mortality age for adults with ASD was 54 compared to the age of 70 for the general population (Hirvikoski et al., 2016). The health outcomes of individuals with ASD who test positive for COVID-19 are largely unknown.

Patterns of physical health comorbidity linked with ASD include gastrointestinal (GI) impairment, metabolic disorders, immune impairment, hypothalamic-pituitary-adrenal (HPA) dysfunction, motor dysfunction and sensory dysfunction (Sala et al., 2020). These comorbidities can be linked to conditions such as bowel disorders, diabetes mellitus and sleep disorders. Dual diagnoses, whether physical or psychiatric, can potentially increase risk for an individual during the global COVID-19 pandemic. Psychiatric conditions, some of which have been exacerbated by the effects of the pandemic, can impact daily decision-making and lifestyle choices during the pandemic. Intellectual disability also displays a co-occurrence of 25% with ASD across studies as compared to a 1% prevalence rate among the U.S. population of children 3–17 years of age (Idring et al., 2015; Xie et al., 2020).

While comorbidity burden increases the risk for COVID-19 complications, healthcare barriers can also play a role in elevating the risk for mortality. Quality of health care, impacted by factors such as implicit bias of healthcare providers, may be related to COVID-19 deaths (Yaya et al., 2020). "The forces driving the disparities seen with COVID-19 infections and deaths are the very same forces behind the disparities in access and outcomes occurring in our clinics and operating rooms every day"(Bonner et al., 2020, p. e224). Healthcare disadvantages that may exist for individuals with ASD include limitations on insurance coverage, high deductibles, decreased understanding of public health guidance, and lack of healthcare provider competence in neurodiversity (Hall et al., 2020).

The purpose of this study was to examine the odds of hospitalization and mortality among people with ASD in the US during the earliest phase of the COVID-19 pandemic following a diagnosis of COVID-19. The odds of hospitalization and mortality were adjusted for demographic variables and comorbidities. It was hypothesized that individuals with ASD would experience greater odds of hospitalization and mortality compared to those without ASD, adjusting for sociodemographic variables. Furthermore, it was hypothesized that ASD would continue to be associated with increased odds of hospitalization and mortality after adjusting for sociodemographic variables and comorbidities.

Methods

Participants

This was a retrospective, cross-sectional study of de-identified privately insured individuals in the U.S. diagnosed with COVID-19 (n = 752,237) between February 1, 2020 to September 30, 2020 based on aggregated medical claims data drawn from the FAIR Health, Inc. National Private Insurance Claims (FH NPIC®) repository database. FAIR Health is a nonprofit organization that compiles claims data from insurance companies nationwide. The International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM) codes, U07.1 (COVID-19), and B97.29 (Other coronavirus as the cause of diseases classified elsewhere) in any diagnostic position on the claim were used to identify COVID-19 patients. To be included in the study patients had to have a positive diagnosis of COVID-19 and be privately insured. This study was reviewed and approved as exempt by the Johns Hopkins Medicine Institutional Review Board.

Procedures

Individuals with ASD were identified utilizing ICD-10-CM codes of F84.0 (autistic disorder), F84.3 (Other childhood disintegrative disorder), F84.5 (Asperger's syndrome), F84.8 (Other pervasive developmental disorders), F84.9 (Pervasive developmental disorder, unspecified). Autism-related ICD-9 codes (299.0, 299.00, 299.01, 299.1, 299.11, 299.8, 299.80, 299.81, 299.9, 299.90) were converted to ICD-10 codes for analysis. The dependent variables were any hospitalization or death for patients while having a positive COVID-19 diagnosis during the study period.

The Centers for Medicare and Medicaid Services (CMS) Chronic Conditions Data Warehouse (CCW) was used to identify comorbidities for patients. Any patient with at least three claim lines in a three-year period with one of the 67 CCW chronic conditions was coded with that diagnosis. Each clinical condition labeled with the ICD-10 diagnosis codes and recoded as dummy variables (1 = has this condition; 0 = does not have this condition). Analyses adjusted for number of comorbidities [referent = No].

Sociodemographic variables were selected *a priori* based on social determinants of health associated with health outcomes. Sociodemographic characteristics included: age (years), sex, community composition of race, ethnicity, income, HRSA region, and the presence of the Affordable Health Care Act (ACA) in each state. Claims data was geocoded based on Census data in order to identify community composition of race, ethnicity and income, as well as HRSA region and states with the presence of ACA (Table 1).

Table 1 States within Health Resources and Services Administration Geographic Regions

Region	States
Region 1	Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont
Region 2	New Jersey, New York, Puerto Rico and U.S. Virgin Islands
Region 3	Delaware, District of Columbia, Maryland, Pennsylvania, Virginia, and West Virginia
Region 4	Alabama, Georgia, Florida, Kentucky, Mississippi, North Carolina, South Carolina, and Tennessee
Region 5	Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin
Region 6	Arkansas, Louisiana, New Mexico, Oklahoma, and Texas
Region 7	Iowa, Missouri, Nebraska, and Kansas

Sociodemographic variables were aggregated into groups to maintain anonymity. Groups for age included years: 0–18, 19–29 [referent], 30–39, 40–49, 50–59, 60–69, 70 and greater. Household income groups included: under $25,000, $25,001-$50,000, $50,001-$75,000, $75,001-$100,000, $100,001-$150,000 [referent]. Percent of racial and ethnic groups within the community were coded as the following: percent White (over 75% [referent]), percent Black/African American (51 to 75% [referent]), and percent Hispanic/Latino (51-75% [referent]). Eight HRSA regions were included (Region 5 referent, see Table 2) as were states with the presence of Affordable Health Care Act [referent = No].

Analytic Methods

Hierarchical multivariate, multinomial, logistic regression models were used to assess the odds of hospitalization and mortality for people diagnosed with COVID-19 who have ASD compared with those who do not have ASD. The first step of the model included sociodemographic variables only. The second step of the model included sociodemographic variables and ASD. The third step of the model included sociodemographic variables, ASD and comorbidity count. Some categories for variables did not have sufficient representation within this dataset to be differentiated in analyses (over 75% Black population, household income under $25,000); comparisons with those categories were not evaluated. No missing data existed among variables. Statistical analyses were performed with SAS version 9.4 (SAS Institute).

Results

Associations of Sociodemographic Characteristics, ASD and COVID-19 Hospitalizations

Hierarchical logistic regression models of hospitalization rates by sociodemographic characteristics demonstrated significant differences between referent groups across most study sociodemographic strata (Table 2). Lower odds of hospitalization occurred among younger patients (0–18 years) (OR 0.84, 95% CI 0.81–0.87) compared to the 19–29 years group adjusted for sociodemographic factors and following the addition of ASD, HRSA region and ACA status (OR 0.83, 95% CI 0.80–0.86). The male population had lower odds of hospitalization than the female population (OR 0.96, 95% CI 0.95–0.98) adjusted for sociodemographic variables. The odds ratio for the male population did not change following adjustment for ASD, HRSA region, ACA status, and other sociodemographic factors.

Analyses of neighborhoods by race and ethnicity demonstrated that, compared to communities with greater than 75% White population, communities with less than 25% White had the highest odds of hospitalization (OR 1.76, 95% CI 1.32–2.33) and following addition of ASD, HRSA region and ACA status (OR 1.33, 95% CI 1.00-1.78). Compared to communities that were majority Black (51–75%), communities with 25–50% Black population had lower odds of hospitalization (OR 0.81, 95% CI 0.75–0.88), while with the additions of ASD, HRSA region and ACA status, the odds of hospitalization were no longer significant. Communities with less than 25% Black population did not have significantly different odds in hospitalization (OR, 1.02, 95% CI 0.94–1.12). A slightly different pattern emerged for Hispanic communities. While Hispanic communities with 25–50% Hispanic had lower odds of hospitalization compared to communities with a 51–75% Hispanic population (OR 0.92, 95% CI 0.89–0.95), communities with greater than 75% Hispanic population also demonstrated lower odds of hospitalization (OR 0.86, 95% CI 0.80–0.92) compared to communities with 51–75% Hispanic population.

Odds of hospitalization varied across HRSA regions. Compared to HRSA Region 5 and adjusting for ACA coverage and ASD diagnosis, there were five regions (Region 3: OR 0.86, 95% CI 0.83–0.90; Region 4: OR 0.82, 95% CI 0.78–0.85; Region 6: OR 0.81, 95% CI 0.78–0.85; Region 9: OR 0.86, 95% CI 0.83–0.89; Region 10: OR 0.82, 95% CI 0.76–0.89) with significantly lower odds of hospitalization rates, and HRSA Region 1 had higher odds of hospitalization (OR 1.30, 95% CI 1.26–1.35). Adjusting for sociodemographic variables and HRSA regions, states that enacted ACA had lower odds of hospitalization (OR 0.95, 95% CI 0.91–0.98) compared to states that did not enact ACA.

Table 2 Adjusted Odds Ratios for COVD-19 Hospitalizations by ASD

Sample Characteristics (Referent)	Step 1:	Step 2:	Step 3:
N = 752,237	**Sociodemographics (without HRSA region and state ACA status)**	**Sociodemographics (with HRSA region and state ACA status) and ASD**	**Sociodemographics, ASD and Comorbidities**
Age (19–29 years)			
0 to 18 years	0.84 (0.81–0.87)***	0.83 (0.80–0.86)***	1.07 (1.03–1.12)**
30 to 39 years	1.91 (1.86–1.96)***	1.92 (1.86–1.97)***	1.51 (1.47–1.55)***
40 to 49 years	1.77 (1.71–1.81)***	1.77 (1.72–1.81)***	0.92 (0.90–0.95)***
50 to 59 years	2.54 (2.48–2.61)***	2.53 (2.46–2.59)***	0.98 (0.95–1.01)
60 to 69 years	3.89 (3.72-4.00)***	3.84 (3.74–3.95)***	1.16 (1.13–1.20)***
70 + years	10.78 (10.45–11.12)***	10.31 (10.00-10.64)***	1.83 (1.76–1.89)***
Sex (Female)			
Male	0.96 (0.95–0.98)***	0.96 (0.95–0.98)***	1.05 (1.03–1.06)***
% of Population White (over 75%)			
Less than 25%	1.76 (1.32–2.33)**	1.33 (1.00-1.78)*	1.25 (0.92–1.70)
25–50%	1.39 (1.35–1.44)***	1.28 (1.23–1.33)***	1.35 (1.29–1.40)***
51–75%	1.27 (1.25–1.29)***	1.26 (1.24–1.29)***	1.25 (1.23–1.28)***
% of Population Black (51–75%)			
Less than 25%	1.02 (0.94–1.12)	0.82 (0.75–0.89)***	0.89 (0.81–0.98)*
25–50%	0.81 (0.75–0.88)***	0.70 (0.64–0.76)	0.78 (0.72–0.85)***
% of Population Hispanic (51–75%)			
Less than 25%	0.99 (0.96–1.03)	0.89 (0.86–0.92)***	0.92 (0.88–0.95)***
25–50%	0.92 (0.89–0.95)***	0.88 (0.85–0.91)****	0.88 (0.85–0.91)***
Over 75%	0.86 (0.80–0.92)***	0.86 (0.80–0.92)***	0.92 (.85 – 1.00)*
Household Income ($100,001-$150,000)			
$25,001-$50,000	1.20 (1.16–1.24)***	1.30 (1.26–1.35)***	1.13 (1.09–1.18)***
$50,001-$75,000	1.13 (1.10–1.16)***	1.19 (1.15–1.22)***	1.09 (1.05–1.12)***
$75,001-$100,000	1.01 (0.98–1.04)	1.02 (0.99–1.05)	1.01 (.98-1.04)
HRSA Region (Region 5)			
Region 1		1.30 (1.26–1.35)***	1.06 (1.02–1.10)**
Region 2		1.02 (0.99–1.05)	0.75 (0.72–0.77)***
Region 3		0.86 (0.83–0.90)***	0.79 (0.75–0.83)***
Region 4		0.82 (0.78–0.85)***	0.81 (0.78–0.85)***
Region 6		0.81 (0.78–0.85)***	0.79 (0.76–0.82)***
Region 7		0.97 (0.92–1.02)	0.97 (0.92–1.03)
Region 8		1.02 (0.96–1.08)**	1.12 (1.05–1.20)**
Region 9		0.86 (0.83-.89)***	0.77 (0.74–0.80)***
Region 10		0.82 (0.76-.89)***	0.83 (0.76–0.90)***
ACA Coverage (No)			
Yes		0.95 (0.91–0.98)*	0.92 (0.89–0.96)***
ASD Diagnosis (No)			
Yes		3.04 (2.63–3.51)***	0.89 (0.77–1.03)
Number of Comorbidities (None)			
1			2.74 (2.65–2.83)***
2–3			4.70 (4.57–4.84)***
4–5			8.45 (8.21–8.70) ***
5+			23.71 (23.05–24.39)***

Note: ACA is the Affordable Care Act; ASD is autism spectrum disorder; HRSA is Health Resources and Services Administration. Sociodemographic variables included age, gender, % of population (White, Black, Hispanic), household income. Some categories for variables did not have sufficient representation to be differentiated in analyses and are thus not present (over 75% Black population, household income under $25,000).

*p ≤ 0.05 **p ≤ 0.01 ***p ≤ 0.001

Associations of Sociodemographic Characteristics, ASD and COVID-19 Mortality

Hierarchical logistic regression models of mortality rates by sociodemographic characteristics demonstrated significant differences between referent groups across most study sociodemographic strata (Table 3, Step 1 and Step 2). Results demonstrated lower odds of death among the youngest age group (0–18 years), compared to the reference group (19–29 years) (OR 0.32, 95% CI 0.16–0.62). Communities with less than 25% White population had the highest odds of mortality (OR 3.04, 95% CI 1.41–6.56). There were no significant associations between the percent of Black or Hispanic residents in a community and the odds of mortality related to COVID-19. Communities with average incomes $25,001-$50,000 (OR 1.26, 95% CI 1.12–1.41) and $75,001-$100,000 (OR 1.11, 95% CI 1.01–1.22) had higher odds of mortality compared to communities with incomes $100,001-$150,000.

Adjusting for ACA status and ASD, three HRSA Regions (Regions 3: OR 1.16, 95% CI 1.01–1.34, Region 6: OR 1.21, 95% CI 1.04–1.40, Region 10: OR 1.40, 95% CI 1.10–1.79) had higher odds of death compared to HRSA Region 5. HRSA Region 9 (OR 0.86, 95% CI 0.75–0.98) also had lower odds of mortality compared to HRSA Region 5. Adjusting for all other sociodemographic variables, states that enacted ACA did not have a significantly different odds of mortality compared to states that did not enact ACA.

Associations of COVID-19 Hospitalization with ASD and Comorbidities

Individuals with ASD had higher odds of being hospitalized for COVID-19 (OR 3.04, 95% CI 2.63–3.51) compared to those without ASD after adjusting for sociodemographic characteristics, without comorbidities. Adjusting for sociodemographics and comorbidities, individuals with ASD did not have significantly different odds of being hospitalized for COVID-19 than individuals without ASD. The odds of COVID-19 hospitalization demonstrated a dose-response association to additional comorbidities. Compared to zero comorbidities, odds of hospitalization were 2.74 times higher (95% CI 2.65–2.83) for one comorbidity to 23.71 times higher (95% CI 23.05–24.39) for five or more comorbidities.

Associations of COVID-19 Mortality with ASD and Comorbidities

Odds of COVID-19 mortality were 3.87 times higher (95% CI 2.10–7.12) among individuals with ASD than those without ASD, adjusted for sociodemographic characteristics. The odds of COVID-19 mortality demonstrated a dose-response to the number of comorbidities. Compared to zero comorbidities, odds of mortality were 4.98 times higher (95% CI 3.74–6.63) for one comorbidity to 52.50 times higher (95% CI 40.91–67.37) for five or more comorbidities. Following adjustment for comorbidities, the odds of mortality for individuals with ASD decreased (OR 1.81, 95% CI 1.00 to 3.28) but remained statistically significant.

Discussion

This study is a novel investigation of the odds of COVID-19 related hospitalization and mortality among individuals with ASD during the most acute phase of the global pandemic The study considers the role of multiple sociodemographic factors and comorbidities, supported the hypothesis that individuals with ASD had higher odds of COVID-19 related hospitalization and mortality than individuals without ASD. Co-morbidities also played a significant role in increasing the odds of COVID-19 related hospitalization and mortality. Individuals with ASD have been reported to have higher risks of having at least one additional comorbidity (Supekar et al., 2017). Few studies have analyzed the impact of comorbidities on hospitalization and mortality for persons with ASD and COVID-19. This study sought to examine the hypothesized disproportionate hospitalizations and fatal outcomes due COVID-19 among individuals with ASD. Results of the study may also suggest that individuals with ASD may experience greater risk for severe COVID-19 outcomes, possibly due to increased prevalence of comorbidities (Hirvikoski et al., 2016; Khan et al., 2020; Singh et al., 2020).

After adjusting for comorbidities, individuals with ASD had greater odds of mortality compared to the general population of COVID-19 positive patients. There is mounting research evidence that physiological ASD profiles can include underlying immunological deficiencies related to neuro-inflammation and neuro-immune abnormalities (Masi et al., 2017; Siniscalco et al., 2018). Consistent with previous research, comorbidities played a significant independent role in increasing the odds of hospitalizations and were more strongly related to hospitalizations associated with COVID-19 than ASD, given that COVID-19 related hospitalization and ASD were not significant after adjusting for comorbid illness. Although mortality attributable to COVID-19 remained significant, the odds of mortality associated with ASD were reduced after controlling for comorbidities.

Immunological profiles of persons with ASD may play a role in the increased risk for mortality for the population of individuals with ASD. The link between autism and

Table 3 Adjusted Odds Ratios for COVID-19 Mortality by ASD

Sample Characteristics (Referent)	Step 1:	Step 2:	Step 3:
N = 752,237	Sociodemographics (without HRSA region and state ACA status)	Sociodemographics (with HRSA region and state ACA status) and ASD	Sociodemographics, ASD and Comorbidities
Age (19–29 years)			
0 to 18 years	0.32 (0.16–0.62)**	0.31 (0.16–0.61)**	0.43 (0.22–0.83)** *
30 to 39 years	2.59 (1.95–3.44)***	2.60 (1.96–3.46)***	1.78 (1.34–2.37)***
40 to 49 years	7.42 (5.75–9.59)***	7.46 (5.77–9.63)***	3.29 (2.54–4.26)***
50 to 59 years	19.33 (15.13–24.71)***	19.42 (15.19–24.82)***	6.15 (4.80–7.88)***
60 to 69 years	47.56 (37.27–60.68)***	47.68 (37.36–60.85)***	11.67 (9.11–14.94)***
70 + years	195.86 (153.60-249.73)***	194.62 (152.57-248.26)***	30.72 (23.97–39.37)***
Gender (Female)			
Male	1.89 (1.80–1.99)***	1.89 (1.80–1.99)***	1.95 (1.85–2.05)***
% of Population White (Over 75%)			
Less than 25%	3.04 (1.41–6.56)*	3.53 (1.62–7.72)	3.59 (1.63–7.89)**
25–50%	1.76 (1.57–1.97)***	1.78 (1.56–2.03)***	1.81 (1.59–2.06)***
51–75%	1.27 (1.19–1.35)***	1.30 (1.22–1.39)***	1.29 (1.21–1.38)***
% of Population Black (51–75%)			
Less than 25%	0.95 (0.75–1.20)	0.91 (0.70–1.19)	0.97 (0.74–1.27)
25–50%	0.87 (0.68–1.11)	0.97 (0.76–1.23)	1.10 (0.86–1.41)
% of Population Hispanic (51–75%)			
Less than 25%	0.96 (0.86–1.08)	0.82 (0.73–0.92)**	0.84 (0.74–0.94)**
25–50%	0.90 (0.81–1.01)	0.90 (0.80–1.01)	0.91 (0.81–1.03)
Over 75%	1.30 (1.02–1.67)	1.26 (0.98–1.61)	1.34 (1.04–1.72)*
Household Income ($100,000-$150,000)			
$25,001-$50,000	1.26 (1.12–1.41)*	1.22 (1.08–1.37)**	1.05 (0.93–1.18)
$50,000-$75,000	1.20 (1.09–1.31)**	1.21 (1.10–1.34)**	1.10 (0.99–1.21)
$75,000-$100,000	1.11 (1.01–1.22)*	1.10 (1.00-1.21)	1.08 (0.98–1.19)
HRSA Region (Region 5)			
Region 1		1.07 (0.94–1.21)	0.85 (0.75–0.96)*
Region 2		1.07 (0.96–1.20)	0.88 (0.79-1.00)*
Region 3		1.16 (1.01–1.34)*	1.06 (0.92–1.23)
Region 4		1.12 (0.95–1.31)	1.14 (0.97–1.34)
Region 6		1.21 (1.04–1.40)*	1.20 (1.03–1.39)*
Region 7		1.16 (0.96–1.41)	1.15 (0.95–1.39)
Region 8		1.11 (0.87–1.43)	1.26 (0.98–1.62)
Region 9		0.86 (0.75–0.98)*	0.80 (0.70–0.92)**
Region 10		1.40 (1.10–1.79)**	1.43 (1.12–1.83) **
ACA Coverage (No)			
Yes		1.05 (0.92–1.19)	1.02 (0.90–1.17)
ASD Diagnosis (No)			
Yes		3.87 (2.10–7.12)***	1.81 (1.00-3.28) *
Number of Comorbidities (None)			
1			4.98 (3.74–6.63)***
2–3			13.34 (10.34–17.21)***
4–5			23.48 (18.23–30.24)***
5+			52.50 (40.91–67.37)***

Note: ACA is the Affordable Care Act; ASD is autism spectrum disorder; HRSA is Health Resources and Services Administration. Sociodemographic variables included age, gender, % of population (White, Black, Hispanic), household income. Some categories for variables did not have sufficient representation to be differentiated in analyses and are thus not present (over 75% Black population, household income under $25,000).

*p ≤ 0.05 **p ≤ 0.01 ***p ≤ 0.001

comorbidity burden, for example intellectual disability, may increase the risk of poor health outcomes due to decreased access and understanding of infection mitigation strategies. Severe autism is associated with obesity (Healy et al., 2019), which has been linked to negative outcomes associated with COVID-19 and may increase severe COVID-19 related outcomes for this population as well. ASD has varied phenotypic, cognitive, and neurobehavioral characteristics that should be taken into consideration when providing healthcare.

Societal context is an additional layer for understanding increased risk for comorbidity in ASD groups including societal exclusion and more sedentary lifestyles. Although our study did not look at such interactions, the impact of ableism, racism, and poverty may link to disproportionate health outcomes for multiply marginalized individuals. These factors may increase mental health disorders and also contribute to negative coping styles (i.e., withdrawn behaviors, depression, overconsumption of unhealthy foods, smoking, and lack of exercise).

During the initial phase of the COVID-19 global pandemic, individuals with ASD were especially prone to experience a variety of pandemic-related challenges including greater difficulties with adapting to change in routines, emotional state volatility, disruption in community-based services and potential regression in skills acquired from therapeutic or community interventions (Baweja et al., 2021; Davidson et al., 2021; Martínez-González et al., 2021). Having autism is commonly associated with strict rule adherence (Bishop et al., 2018), which could be a protective factor for their health by leading to consistently following mask mandates and preventing contracting the novel coronavirus from public settings. Individuals with ASD can be more socially inhibited which may also yield a reduction in exposure to the coronavirus. However, adults with severe ASD or dual ASD and intellectual disability, have greater odds of living in crowded residential facilities, having in home support services, and experiencing avoidable hospitalizations (Schott et al., 2021). Because of these risk factors, persons with ASD should continue to be prioritized for COVID-19 vaccination shots and booster shots. Universal design messaging is needed to ensure understanding of COVID-19 prevention strategies as the pandemic ebbs and flows and case numbers rise in communities that reflect community-level endemics. Persons with ASD also should be supported in utilizing at-home tests and seeking routine healthcare to stay up-to-date on ways to achieved optimized health and cultivate immunity from viral diseases.

Limitations

Our study has several potential limitations. First, populations with insurance may represent a more financially stable population who can access healthcare systems. This national sample of over 700,000 privately insured claims may represent individuals who have the most optimal health outcomes, thus limiting generalizability. The use of medical claims to establish inclusion of patients with ASD could yield a bias in severity of ASD in the overall sample. Some research suggests elevated risk of mortality for populations with ASD adjusted for level of functioning (Hirvikoski et al., 2016). In the current study, comorbidity count was based on aggregated data thus co-occurrence of intellectual disability could not be determined. FAIR Health data are nationally representative but do not include claims from all private payors in the U.S., and therefore not all privately insured individuals in the U.S. were represented in this study.

Clinical Importance and Future Studies

This large national sample of claims data assists in the understanding and identification of factors related to severity of COVID-19. The presence of healthcare biases related to both race and disability may amplify the risk of adverse COVID-19 outcomes for individuals with ASD. Future studies would benefit from an intersectional analysis of large cohort data to further understand the interactions between disability, race, ethnicity, geographic region and socioeconomic status on COVD-19 outcomes. These health equity analyses may better inform public policy, practice, and outreach for diverse populations within the autism community.

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Declarations

Conflict of Interest The authors of the study do not have any conflicts of interest to disclose.

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