COVID-19 Severity Among American Indians and Alaska Natives in 16 States - January 1, 2020, to March 31, 2021

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Abstract

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Methods: Aggregate Social Vulnerability Index (SVI), COVID-19-related risk factor, hospitalization, and mortality data were obtained from 16 states for January 1, 2020-March 31, 2021. Generalized estimating equation Poisson regression models calculated age-adjusted cumulative incidences, incidence ratios (IR), and 95% confidence intervals (CI) comparing AI/AN and NHW persons by age, sex, and county-level SVI status.

Results: Race data were missing for 42.7% of COVID-19 cases, 24.7% of hospitalizations, and 10.1% of deaths. Risk of AI/AN COVID-19 mortality was 2.6 times that of NHW persons (IR 2.6, 95% CI: 1.7 – 3.4); risk of COVID-19-related hospitalization among AI/AN persons was 3.5 times that of NHW (IR: 3.5, 95% CI: 2.7 – 4.3). Severe COVID-19 outcomes were significantly higher for AI/AN persons compared to NHW persons across all age and sex groups. There was no statistically significant difference in COVID-19 outcomes by SVI status. Associations between severe COVID-19 outcomes and co-morbid risk factors were inconsistent.

Conclusions: Results describe increased risk of severe COVID-19 outcomes for AI/AN persons compared to NHW persons despite quality issues in public health surveillance data. Data linkages and improved ascertainment reduce race/ethnicity misclassification and improve data quality. COVID-19-related health burdens among AI/AN persons warrant improved access for AI/AN communities to medical countermeasures and healthcare resources.

Keywords

Epidemiology; COVID-19; American Indian/Alaska Native; Surveillance; Tribal Epidemiology

Cover Page Footnote

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ABSTRACT

Objective: To compare rates and risk factors of severe COVID-19-related outcomes between American Indian/Alaska Native (AI/AN) and non-Hispanic White people (NHW).

Methods: Aggregate Social Vulnerability Index (SVI), COVID-19-related risk factor, hospitalization, and mortality data were obtained from 16 states for January 1, 2020-March 31, 2021. Generalized estimating equation Poisson regression models calculated age-adjusted cumulative incidences, incidence ratios (IR), and 95% confidence intervals (CI) comparing AI/AN and NHW persons by age, sex, and county-level SVI status.

Results: Race data were missing for 42.7% of COVID-19 cases, 24.7% of hospitalizations, and 10.1% of deaths. Risk of AI/AN COVID-19 mortality was 2.6 times that of NHW persons (IR 2.6, 95% CI: 1.7 – 3.4); risk of COVID-19-related hospitalization among AI/AN persons was 3.5 times that of NHW (IR: 3.5, 95% CI: 2.7 – 4.3). Severe COVID-19 outcomes were significantly higher for AI/AN persons compared to NHW persons across all age and sex groups. There was no statistically significant difference in COVID-19 outcomes by SVI status. Associations between severe COVID-19 outcomes and co-morbid risk factors were inconsistent.

Conclusions: Results describe increased risk of severe COVID-19 outcomes for AI/AN persons compared to NHW persons despite quality issues in public health surveillance data. Data linkages and improved ascertainment reduce race/ethnicity misclassification and improve data quality. COVID-19-related health burdens among AI/AN persons warrant improved access for AI/AN communities to medical countermeasures and healthcare resources.

Keywords: Epidemiology; COVID-19; American Indian/Alaska Native; Surveillance; Tribal Epidemiology

INTRODUCTION

American Indian/Alaska Native (AI/AN) persons experience higher rates of infection, hospitalization, and mortality than the broader U.S. population from respiratory illnesses like influenza and pneumococcal disease (Castrodale et al., 2009; Groom et al., 2014; Singleton et al., 2015; Wenger et al., 2010). Similarly, recent studies have confirmed higher rates of COVID-19 infection, hospitalization, and mortality among AI/AN communities compared to non-Hispanic White (NHW) communities stemming in part from higher co-morbidities, disparities in social determinants of health, and the historical traumas of forced migration, attempted genocide, and forced cultural assimilation (Acosta et al., 2021; Arrazola et al., 2021; Hatcher et al., 2020; Qeadan et al., 2021; Rossen et al., 2021; Ward et al., 2022). One study evaluating excess mortality from COVID-19 found a disproportionately negative impact on AI/AN populations, particularly among younger adults (Rossen et al., 2021). Other studies of AI/AN communities examined relationships between adverse COVID-19-related outcomes and factors such as socioeconomic status, availability and uptake of vaccinations, and healthcare access (Acosta et al., 2021; Arrazola et al., 2021; Biggs et al., 2021; Hatcher et al., 2020; Qeadan et al., 2021; Rossen et al., 2021; Ward et al., 2022; Whiteman et al., 2021). In a separate study of age- and disability-eligible Medicare beneficiaries during the same period as this project, AI/AN persons had the highest rates of COVID-19-related hospitalization (Yuan et al., 2022). Hathaway (2021) illustrated an increase in

COVID-19 cases and complications among AI/AN persons compared to U.S. averages by Indian Health Service (IHS) region and social vulnerability scores.

In 2020, COVID-19 was reported as the third leading cause of death overall and COVID-19-related mortality rates were highest among non-Hispanic AI/AN persons (Ahmad et al., 2022). Understanding the factors that affect AI/AN communities will contribute to more positive health outcomes in future responses, including future phases of the COVID-19 pandemic. This study assesses differences in rates of COVID-19-related mortality and hospitalization between AI/AN and NHW people using state-submitted public health surveillance data from January 1, 2020, to March 31, 2021. It expands on previous reports by exploring the possible contribution of underlying risk factors and social vulnerability in contributing to these disparities.

METHODS

Data Source

The Council of State and Territorial Epidemiologists (CSTE) invited all 50 State Epidemiologists to participate in this study by email. Sixteen states, home to 49% of the AI/AN population in the United States, submitted aggregated, county-level COVID-19 hospitalization and mortality data from the Centers for Disease Control and Prevention (CDC) COVID-19 case report form to CSTE (Centers for Disease Control and Prevention, 2021). States providing data were Alaska, Arizona, California, Maine, Minnesota, Mississippi, Montana, New Mexico, New York, North Dakota, Oklahoma, Oregon, South Dakota, Utah, Washington, and Wyoming. Reasons for non-participation included insufficient AI/AN cases, not having enough staff to support this project, data systems that did not flag or collect AI/AN race data, or not responding to the invitation from CSTE.

This state-submitted convenience sample included county-level public health surveillance data for COVID-19-related deaths, hospitalizations, and case comorbidities for NHW and AI/AN populations. In addition to counts for specific comorbid conditions or risky behaviors (e.g., being pregnant, current smoker, etc.), the presence of any comorbid condition/risk behavior or two or more conditions/behaviors was captured separately. States also provide aggregate counts of data completeness, noting the number of individuals whose race field was empty or listed as “other”, “unknown”, or “refused to answer” for COVID-19 cases, hospitalizations, and deaths. However, COVID-19 outcomes for individuals with missing or incomplete race data were not included. As this study was a secondary use of aggregated surveillance data provided by participating health departments to CSTE, Institutional Review Board approval was not obtained. The study did not have access to individual level information. Each participating agency adhered to their privacy and security policies for data suppression and release.

During the study period of January 1, 2020, to March 31, 2021, the 16 participating states reported 6,346,524 COVID-19 cases and 136,637 COVID-19-related deaths among AI/AN and NHW people. Fourteen states provided aggregate unsuppressed COVID-19 data for all age groups, excluding California and Wyoming due to state suppression guidelines for small numbers. Aggregate data for 384,308 COVID-19-related hospitalizations were received from 15 states (excluding New York). CSTE completed national aggregation, validation, and analysis.

Measures

Social Vulnerability Index (SVI) data from the CDC Agency for Toxic Substances and Disease Registry SVI 2018 database (Centers for Disease Control and Prevention et al., 2021) were

used to assess whether residents of socially vulnerable areas were more likely to suffer COVID-19-related hospitalization or death compared to non-residents. The SVI measure consists of 15 census tract-level variables. SVI is used in emergency management as a composite score calculated from four domains: (1) Socioeconomic Status (per capita income, percentage of residents below poverty line, unemployed, and with no high school diploma); (2) Household Composition and Disability (percentage aged ≥ 65 years, aged ≤ 17 years old, aged > 5 years with a disability, and single-parent households); (3) Minority Status and Language (percentage minority and who speak English "less than well"); and (4) Housing Type and Transportation (percentage of multi-unit structures, mobile homes, and households reporting crowding [more people than rooms in household], no vehicle, or group quarters). The SVI assigns rankings for relative vulnerability based on percentiles. Higher SVI values indicate greater vulnerability in that area (Centers for Disease Control and Prevention et al., 2021). Based on consultation with CDC experts, counties with an overall SVI rank of 90 or higher were considered areas with high social vulnerability; counties under 90 were considered lower social vulnerability.

Consistent with other research, the workgroup defined AI/AN race as AI/AN alone or in any combination with another race, including Hispanic AI/AN, Non-Hispanic AI/AN, and AI/AN of unknown/missing ethnicity (Arrazola et al., 2021; Denny et al., 2011; Hatcher et al., 2020; Joshi & Warren-Mears, 2019; Ward et al., 2022). AI/AN and NHW populations for each state were obtained from 2020 postcensal population estimates and were used as the population denominators for incidence calculations. The workgroup grouped cases, hospitalizations, and deaths that occurred to people ages 50 years and older into a single 50+ age group based on the way data were collected (10-year age groups) and to reflect age-based definitions of "Elder" used by many Tribes, Native-serving organizations, and previous research with AI/AN communities (Denny et al., 2011; Joshi & Warren-Mears, 2019; Kahn et al., 2016).

Statistical Analyses

COVID-19-related mortality and hospitalization incidence among AI/AN persons were compared to NHW persons consistent with other publications (Acosta et al., 2021; Arrazola et al., 2021; Hatcher et al., 2020; Rossen et al., 2021; Ward et al., 2022). Rates were age-adjusted using the direct age standardization method with the U.S. 2000 standard population (Klein & Schoenborn, 2001). A generalized estimating equation Poisson regression model was used to calculate cumulative incidence (cumulative cases per 100,000 population), incidence ratios (IRs), and 95% confidence intervals (95% CIs) for AI/AN and NHW people by sex and age group. Generalized estimating equation models, which perform well for estimating rates with correlated data, were used to account for nonindependence (i.e., clustering) by participating states (Hanley et al., 2003).

To assess whether a county's high or low SVI status differentially affected COVID-19-related hospitalization or mortality between AI/AN and NHW people, another generalized estimating equation model was constructed comparing COVID-19-related hospitalization and mortality with an interaction term for SVI and race. When states suppressed cells where the number of deaths or hospitalizations in certain categories were below the threshold value set by state standards, the suppressed cells were excluded, and no computation was made to reduce the risk of misinterpretation or misuse of unstable rates.

RESULTS

Data Quality

Among all COVID-19 cases reported among participating states for the study period, 2,709,966 records (42.7%) had incomplete race data, including 20.1% for which race was listed as "unknown" and 21.2% for which race was specified as "other." Race data were incomplete for 10.1% of deaths reported, including 5.7% listed as "other" race, 3.5% as "unknown", and the remaining listed as "refused to answer." Death records had a lower percentage of incomplete race information than hospitalization records (10.1 vs. 24.7%, respectively).

COVID-19-related Mortality and Hospitalization Incidence

During the study period, 4,104 COVID-19-related deaths and 15,911 COVID-19-related hospitalizations were reported among AI/AN persons. Table 1 shows the number and incidence of COVID-19-related deaths and hospitalizations among AI/AN and NHW people by sex and age group. COVID-19-related mortality was higher for AI/AN persons than NHW persons across all categories; however, the disparity was largest for individuals between 20 and 49 years old. In this age group, AI/AN persons had more than eight times the risk of COVID-19-related mortality compared to NHW persons (IR 8.7, 95% CI: 4.8 - 15.8) and 4.4 times the risk of COVID-19-related hospitalization (IR 4.4, 95% CI 2.8 - 6.9). The overall incidence of COVID-19 hospitalization for AI/AN persons was 3.5 times the incidence of NHW persons (IR 3.5, 95% CI: 2.7 - 4.3). AI/AN men had over three times the risk of hospitalization with COVID-19 than NHW men (IR 3.3, 95% CI: 2.5 - 4.1); AI/AN women had twice the risk of COVID-19-hospitalization compared to NHW women (IR 2.2, 95% CI: 1.3-3.0).

The overall COVID-19-related age-adjusted mortality incidence for AI/AN persons was 2.6 times that of NHW persons (IR 2.6, 95% CI: 1.8 - 3.4). For both AI/AN and NHW people, men had higher COVID-19-related mortality than women. Incidence of COVID-19-related mortality increased with age for both AI/AN and NHW people (Table 1).

Table 1: Number and Incidence[†] of COVID-19-Related Deaths and Hospitalizations Among American Indian/Alaska Native[*] and Non-Hispanic White Persons – 14 states[**], January 1, 2020 – March 31, 2021.

	AI/AN N cases	AI/AN Cumulative Incidence /100k	NHW N cases	NHW Cumulative Incidence /100k	AI/AN vs. NHW Incidence Ratio
Death					
Total	4,104	222.6 (167.9-277.3)	51,405	85.9 (71.1-100.7)	2.6 (1.8-3.4)
Male	2,479	311.1 (230.0-392.3)	27,567	104.5 (86.6-122.4)	3.0 (2.0-4.0)
Female	1,624	156.0 (109.6-202.3)	24,055	71.2 (58.9- 83.6)	2.2 (1.3-3.0)
0-19 Years	#	0.7 (0.2 - 2.4)	19	0.2 (0.1 - 0.4)	3.2 (1.1 - 9.1)
20 – 49 Years	638	58.4 (29.9 - 114.0)	974	6.7 (4.7 - 9.7)	8.7 (4.8 - 15.8)
50+ Years	3,459	531.7 (336.3 - 840.4)	50,412	308.2 (220.5 - 430.7)	1.7 (1.0 - 3.1)
Hospitalization					
Total	15,911	836.9 (632.7-1,041.0)	90,035	239.6 (192.5- 286.7)	3.5 (2.7-4.3)
Male	7,493	873.5 (665.9-1,081.0)	47,584	264.0 (213.1- 314.9)	3.3 (2.5-4.1)
Female	8,404	815.5 (611.2-1,019.7)	42,611	220.6 (175.9- 265.3)	3.7 (2.8-4.6)
0-19 Years	466	55.5 (31.5 - 97.7)	1,736	29.2 (16.3 - 52.1)	1.9 (1.2 – 3.0)
20 – 49 Years	5,616	587.8 (332.2 - 1,040.0)	14,126	134.2 (83.6 - 215.5)	4.4 (2.8 - 6.9)
50+ Years	9,829	1,755.5 (1,132.0 - 2,722.6)	74,173	630.3 (443.6 - 895.6)	2.8 (1.9 - 4.1)

Notes. AI/AN: American Indians/Alaska Natives; AI/AN[*] includes Hispanic AI/AN, non-Hispanic AI/AN, and AI/AN individuals with unknown ethnicity; NHW: non-Hispanic White alone; † Incidences are age-adjusted to the 2000 standard population estimates and presented per 100,000 population; **Fourteen participating states include Alaska, Arizona, Maine, Minnesota, Mississippi, Montana, New Mexico, New York, North Dakota, Oklahoma, Oregon, South Dakota, Utah, Washington. New York State only included mortality data. # Suppressed numbers for data with N < 10

Social Vulnerability Index

Of 761 counties for which COVID-19-related deaths and hospitalizations were reported, 83 were classified as high SVI and 678 were classified as lower SVI. A greater percentage of AI/AN persons live in high SVI counties relative to NHW persons (AI/AN = 717,990 [18.8%] vs NHW = 3,571,163 [6.7%]; data not shown). Information was available for 650 and 702 counties

for COVID-19-related deaths and hospitalizations, respectively. When stratified by SVI, there was no statistically significant difference in COVID-19-related mortality or hospitalization between AI/AN and NHW people (Table 2). Crude incidence rates were higher for both races in high SVI areas relative to low SVI counties.

Table 2: COVID-19-Related Hospitalizations and Deaths Among American Indian/Alaska Native* and Non-Hispanic White Persons Comparing High† SVI Counties to Lower SVI counties – 16 states**, January 1, 2020 – March 31, 2021.

	SVI Status	Race	N cases	Population	Cumulative Incidence / 100k	Incidence Ratio
Death	Lower	AI/AN	3,400	2,802,324	121.3 (89.0 - 165.3)	0.9 (0.6 - 1.3)
		NHW	61,418	45,251,455	135.7 (119.2 - 154.6)	
	High	AI/AN	1,292	633,072	204.1 (113.7 - 366.3)	1.04 (0.5 - 2.1)
		NHW	6,360	3,231,850	196.8 (149.0 - 259.9)	
Hospitalization	Lower	AI/AN	12,448	2,846,231	437.4 (319.9 - 597.9)	1.3 (0.9 - 1.9)
		NHW	133,082	40,225,022	330.8 (272.4 - 401.8)	
	High	AI/AN	4,551	650,146	700.0 (381.1 - 1,285.9)	1.3 (0.6 - 2.6)
		NHW	17,096	3,073,059	556.3 (405.4 - 763.4)	

Notes. AI/AN: American Indian/Alaska Native; SVI: Social Vulnerability Index; AI/AN* includes Hispanic AI/AN, non-Hispanic AI/AN, and AI/AN individuals with unknown ethnicity; NHW: non-Hispanic White alone; † High SVI defined as greater than 90th percentile. **Sixteen participating states include: Alaska, Arizona, California, Maine, Minnesota, Mississippi, Montana, New Mexico, New York, North Dakota, Oklahoma, Oregon, South Dakota, Utah, Washington, and Wyoming. Total counties analyzed (N = 761). Total counties with unsuppressed information for both AI/AN and NHW: Deaths (N = 650), Hospitalizations (N = 706).

COVID-19 Severity Risk Factors

Risk factor data had a high degree of missingness and variability. Across 15 states that provided data on comorbid risk factors (e.g., smoking, diabetes, etc.), the median interquartile range (IQR) percentage of COVID-19-related hospitalizations for which comorbidities were listed as Unknown/NA was 23% (IQR = 29%) for NHW persons and 31% (IQR = 31%) for AI/AN persons. For COVID-19-related deaths, median percentages of records with comorbidities listed as Unknown/NA were 24% (IQR=25%) for NHW persons and 24% (IQR = 25%) for AI/AN persons. Additionally, the number of states collecting each risk factor was highly variable. Twelve risk factors were collected by at least 10 states, but only six risk factors were collected by all states.

Five risk factors were excluded from the analysis because less than 10 states collected the information, thus potentially destabilizing the analysis.

Available data on known risk factors for COVID-19-related deaths are summarized in Table 3 and for COVID-19-related hospitalizations in Table 4. The following risk factors for COVID-19 mortality had higher relative risk among AI/AN persons compared to NHW persons: current smoker (2.3 RR, 95% CI: 1.9 - 2.7), diabetes mellitus (1.7 RR, 95% CI 1.7 - 1.8), former smoker (1.2 RR, 95% CI 1.1 - 1.4), working as a healthcare provider (1.8 RR, 95% CI 1.3 - 2.6), chronic liver disease (3.1 RR, 95% CI 2.7 - 3.6), severe obesity (1.9 RR, 95% CI 1.7 - 2.2), other chronic disease (1.3 RR, 95% CI 1.2 - 1.4), and unknown or not applicable risk factors (1.3 RR, 95% CI 1.2 - 1.3; Table 3).

Table 3: Risk Factors for Severe COVID-19 Outcomes among Those Who Died While Diagnosed with COVID-19 – 15 States**, January 1, 2020 – March 31, 2021

Risk Factors for Severe Outcomes from COVID-19	States reporting condition (N = 15)	AI/AN* N deaths (%)	NHW N deaths (%)	AI/AN:NHW Relative Risk (95% CI)
Any Risk Condition	15	2,988 (60.6 %)	34,521 (68.8 %)	0.88 (0.86- 0.90)
Cardiovascular Disease	15	1,114 (22.6 %)	15,308 (30.5 %)	0.74 (0.70- 0.78)
Current Smoker	14	153 (3.2 %)	648 (1.4 %)	2.30 (1.93- 2.74)
Diabetes Mellitus	15	1,732 (35.1 %)	10,237 (20.4 %)	1.72 (1.65- 1.79)
Former Smoker	13	315 (6.6 %)	2,432 (5.5 %)	1.21 (1.08- 1.35)
Works as a Healthcare Provider	12	35 (0.7 %)	181 (0.4 %)	1.80 (1.26- 2.59)
Hypertension	12	923 (26.0 %)	15,622 (33.3 %)	0.78 (0.74- 0.83)
Immunosuppressive Condition	15	254 (5.1 %)	2,928 (5.8 %)	0.88 (0.78- 1.00)
Chronic Liver disease	13	276 (5.9 %)	921 (1.9 %)	3.12 (2.74- 3.56)
Chronic Lung disease §	15	590 (12.0 %)	8,285 (16.5 %)	0.72 (0.67- 0.78)
No or Low Risk	13	159 (3.3 %)	1,476 (3.1 %)	1.05 (0.90- 1.24)
Severe Obesity (BMI >= 40)	10	249 (8.8 %)	1,896 (4.6 %)	1.92 (1.69- 2.18)
Other Chronic Disease	11	828 (29.2 %)	3,361 (22.6 %)	1.29 (1.21- 1.38)
Pregnant	14	#	#	#
Chronic Renal disease	15	745 (15.1 %)	7,224 (14.4 %)	1.05 (0.98- 1.12)
2 or More Risk Conditions	13	2,034 (44.6 %)	23,159 (50.0 %)	0.89 (0.86- 0.92)
Unknown/NA	13	1,640 (34.1 %)	12,716 (27.1 %)	1.26 (1.21- 1.32)

Notes: *AI/AN: American Indians/Alaska Natives; AI/AN includes Hispanic AI/AN, non-Hispanic and AI/AN individuals with unknown ethnicity; NHW: non-Hispanic White alone; ** 15 participating states include Alaska, Arizona, California, Maine, Minnesota, Mississippi, Montana, New Mexico, North Dakota, Oklahoma, Oregon,

South Dakota, Utah, Washington, and Wyoming. Not all states collected surveillance information for all items. Most provided information reported in response to a general query about whether the ill or deceased person had underlying health conditions but did not systematically ask about specific comorbidities.
§ Asthma/emphysema/chronic obstructive pulmonary disease (COPD). Risk Factors for Severe Outcomes from COVID-19 with < 10 States collecting surveillance information for that category: Autoimmune condition (N = 5), Disability (N = 9), Other underlying conditions (N = 6), Psychological/Psychiatric Condition (N = 8), Substance Abuse (N = 5); # Suppressed numbers for conditions with N < 10

The following risk factors for COVID-19-related hospitalizations had higher relative risk among AI/AN persons compared to NHW persons: current smoker (1.5 RR, 95% CI 1.4 - 1.6), diabetes mellitus (1.6 RR, 95% CI 1.6 - 1.7), healthcare provider (1.2 RR, 95% CI 1.1 - 1.3), chronic liver disease (2.3 RR, 95% CI 2.1 - 2.5), severe obesity (1.3 RR, 95% CI 1.3 - 1.4), and unknown or not applicable risk factors (1.2 RR, 95% CI 1.2 - 1.3; Table 4).

Among COVID-19-related deaths, the following risk factors had lower relative risk among AI/AN persons compared to NHW persons: cardiovascular disease (e.g., heart failure, stroke, etc.; RR 0.7, 95% CI 0.7 - 0.8), hypertension (RR 0.8, 95% CI 0.7 - 0.8), and chronic lung disease (RR 0.7, 95% CI 0.7 - 0.8). Overall, AI/AN persons dying from COVID-19 appeared less likely to have any of the risk conditions (0.9 RR, 95% CI 0.8 - 0.9), or two or more risk conditions (RR 0.9, 95% CI 0.8 - 0.9; Table 3) compared to NHW persons. For COVID-19-related hospitalizations, the following risk factors had lower relative risk among AI/AN persons compared to NHW persons: cardiovascular disease (RR 0.7, 95% CI 0.8 - 0.9), disability (RR 0.7, 95% CI 0.6 - 0.8), hypertension (RR 0.8, 95% CI 0.7 - 0.83), immunosuppressive condition (RR 0.8, 95% CI 0.7 - 0.9), chronic lung disease (RR 0.7, 95% CI 0.7 - 0.8), and other chronic disease (RR 0.7, 95% CI 0.7 - 0.8). AI/AN persons hospitalized with COVID-19 also appeared less likely to have any risk conditions (0.9 RR, 95% CI 0.8 - 0.9), or two or more risk conditions (RR 0.9, 95% CI 0.8 - 0.9; Table 4) compared to NHW persons.

Table 4: Risk Factors for Severe COVID-19 Outcomes among Those Who Were Hospitalized While Diagnosed with COVID-19 – 15 States**, January 1, 2020 – March 31, 2021

Risk Factors for Severe Outcomes from COVID-19	States reporting condition (N = 15)	AI/AN* N hospitalized (%)	NHW N hospitalized (%)	AI/AN:NHW Relative Risk (95% CI)
Any Risk Condition	14	8,419 (52.1 %)	69,328 (58.2 %)	0.90 (0.88- 0.91)
Cardiovascular Disease	15	2,665 (16.4 %)	24,836 (19.6 %)	0.84 (0.81- 0.87)
Current Smoker	14	652 (4.0 %)	3,264 (2.7 %)	1.47 (1.36- 1.60)
Diabetes Mellitus	15	4,764 (29.3 %)	22,998 (18.1 %)	1.61 (1.57- 1.66)
Disability	10	280 (6.4 %)	6,852 (9.2 %)	0.70 (0.62- 0.78)
Former Smoker	12	1,179 (10.8 %)	9,154 (10.5 %)	1.03 (0.97- 1.09)
Works as Healthcare Provider	13	319 (2.0 %)	1,921 (1.7 %)	1.18 (1.05- 1.33)
Hypertension	12	2,449 (22.0 %)	31,501 (27.5 %)	0.80 (0.77- 0.83)
Immunosuppressive Condition	15	609 (3.8 %)	5,701 (4.6 %)	0.81 (0.74- 0.88)
Chronic Liver disease	14	624 (4.0 %)	2,150 (1.8 %)	2.26 (2.07- 2.47)
Chronic Lung disease§	15	1,819 (11.2 %)	18,560 (15.1 %)	0.74 (0.71- 0.78)
No or Low Risk	13	1,295 (8.2 %)	9,542 (8.3 %)	0.99 (0.94- 1.05)
Severe Obesity (BMI >= 40)	10	876 (9.9 %)	7,555 (7.4 %)	1.33 (1.25- 1.43)
Other Chronic Disease	13	2,392 (16.4 %)	16,186 (22.3 %)	0.73 (0.71- 0.76)
Pregnant	14	160 (1.0 %)	1,123 (0.9 %)	1.08 (0.92- 1.27)
Chronic Renal Disease	15	1,457 (9.0 %)	10,663 (8.7 %)	1.03 (0.98- 1.09)
2 or More Risk Conditions	13	5,320 (34.8 %)	44,500 (39.3 %)	0.88 (0.86- 0.91)
Unknown/NA	13	6,716 (42.6 %)	39,458 (34.2 %)	1.24 (1.22- 1.27)

Notes: *AI/AN: American Indians/Alaska Natives; AI/AN Includes Hispanic AI/AN, non-Hispanic and AI/AN individuals with unknown ethnicity; NHW: non-Hispanic White alone; ** 15 participating states include Alaska, Arizona, California, Maine, Minnesota, Mississippi, Montana, New Mexico, North Dakota, Oklahoma, Oregon, South Dakota, Utah, Washington, and Wyoming. Not all states collected surveillance information for all items. Most provided information reported in response to a general query about whether the ill or deceased person had underlying health conditions but did not systematically ask about specific comorbidities. § Asthma/emphysema/chronic obstructive pulmonary disease (COPD). Risk Factors for Severe Outcomes from COVID-19 with < 10 States collecting surveillance information for that category: Autoimmune condition (N = 6), Other underlying conditions (N = 4), Psychological/Psychiatric Condition (N = 7), Substance Abuse (N = 5)

DISCUSSION

This study, completed before the Delta and Omicron periods of the COVID-19 pandemic, confirms a greater risk for COVID-19-related mortality and hospitalization among AI/AN persons compared to NHW persons across all age and sex groups. The age-adjusted mortality incidence ratio was higher than that found by this workgroup in a prior study and contributes to other literature demonstrating a disproportionate impact of COVID-19 on AI/AN persons (Acosta et al., 2021; Ahmad et al., 2022; Arrazola et al., 2021; Biggs et al., 2021; Hatcher et al., 2020; Hathaway, 2021; Rossen et al., 2021; Ward et al., 2022; Whiteman et al., 2021; Yuan et al., 2022). States and Tribal Epidemiology Centers (TEC) have conducted data quality improvement initiatives since the prior study by Arrazola et al. (2021); however, the extent to which the increased mortality incidence ratio reflects the resulting improved ascertainment of deaths among AI/AN persons compared to actual differences in mortality over time could not be determined.

Consistent with other analyses, the workgroup included AI/AN persons who identified as multiple races and ethnicities, which increased identification of hospitalized AI/AN cases by 13.6% and increased case identification of AI/AN deaths by 11.7% (Arrazola et al., 2021; Hatcher et al., 2020; Joshi & Warren-Mears, 2019). A TEC-performed linkage with the COVID-19 database of one state involved in the study increased identification of COVID-19 cases recognized as AI/AN by 22% post-linkage (Northwest Tribal Epidemiology Center, unpublished data)—an approach supported by previous studies (Dougherty et al., 2019; Espey et al., 2014; Jim et al., 2014; Puukka et al., 2005). Supporting case data linkages would minimize racial misclassification and provide a clearer picture of disease burden among AI/AN communities. Efforts to improve race and ethnicity ascertainment at the time of healthcare encounter or initial contact with public health can also reduce racial misclassification (Oregon Health Authority, 2021).

The high percentage of AI/AN COVID-19 deaths taking place in high-SVI counties is noteworthy (1292 out of 3692 [27.5%] AI/AN deaths vs. 6360 out of 67778 [9.4%] NHW deaths; Table 2). The absence of a statistically significant difference in COVID-19-related mortality and hospitalization risk between AI/AN and NHW people when stratified by SVI status suggests that one potential driver of COVID-19 outcome disparities may be the greater proportion of AI/AN persons living in high SVI areas. Given that residents of high SVI areas, regardless of race, had higher incidence of severe COVID-19 outcomes (Table 2), the incidence ratios observed in Table 1 could result in part from the greater proportion of AI/AN persons residing in high SVI counties (18.8% AI/AN vs 6.7% NHW). This is consistent with recent work by Hathaway (2021) who found heightened social vulnerability across multiple domains among rural Tribal communities and notes the likely connection between social determinants of health and AI/AN burden of COVID-19 disease. Islam et al. (2021) reported that counties with greater social vulnerability and higher proportions of minority residents also had higher COVID-19 incidence. Similarly, Wong et al. (2021) and Rodriguez-Lonebear et al. (2020) noted that neighborhood conditions such as lower socio-economic status and higher percentages of households experiencing crowding were associated with higher rates of COVID-19 infection among AI/AN persons.

The disproportionate burden of COVID-19-related hospitalization and death in AI/AN communities demonstrates the need for more investment and support of systems to improve disease mitigation and prevention efforts. Per capita healthcare expenditures by the Indian Health Service were $4,078 in 2019, compared to 2019 U.S. national per capita healthcare expenditures of $11,582 (United States Indian Health Service, 2020). Additional investments could include improved access to testing, vaccination, early monoclonal antibody therapy, and other treatments

when they are available; improved ventilation of homes and other congregate facilities; and integration of cultural knowledge and expertise into disease prevention efforts. These efforts would also fall under the trust responsibility of the federal government to support Tribal sovereignty and ensure the well-being and prosperity of federally recognized tribes under treaty law (Administration for Native Americans & United States Department of Health & Human Services, n.d.). Culturally responsive outreach within AI/AN communities about the safety and efficacy of COVID-19 vaccines could also help reduce the COVID-19 burden. Though AI/AN communities initially had the highest COVID-19 vaccine uptake among any cultural or ethnic group (Hill & Artiga, 2021), data from the May – June 2021 American COVID-19 Vaccine Poll found that 40% of responding AI/AN persons reported hesitancy in receiving a COVID-19 vaccination (Sanchez & Foxworth, 2021).

This study also assessed associations between underlying COVID-19 risk factors and COVID-19-related hospitalization and death; however, the direction of the associations was not consistent. This study found that being a current smoker or having diabetes, chronic liver disease, or obesity was more common among AI/AN persons than NHW persons for COVID-19 hospitalizations and deaths. Additionally, in this dataset, AI/AN persons were also significantly less likely than NHW persons to have hypertension, cardiovascular disease, or other chronic lung conditions like asthma or emphysema (Tables 3 & 4). Some studies have found similar variances in the presence of risk factors for severe COVID-19 outcomes, though others have found these risk factors to be more prevalent in AI/AN persons relative to NHW persons (Acosta et al., 2021; Denny et al., 2011). The inconsistencies in this study could partly reflect inadequate data quality as illustrated by the large percentages of missing/unknown data (up to 46% in some categories), volunteer bias from the states that submitted information, or differences in racial definitions from previously published literature on risk factors (e.g., using AI/AN alone vs. in combination with any other race & ethnicity). They may also result from historical and ongoing policies and practices that contribute to disparities in healthcare access, poverty, and other social determinants of health in AI/AN communities (Hicks et al., 2022).

Systematic data collection of race and ethnicity and risk factor data was lacking across participating states. Some states collected data from the case report alone while others provided additional details from case interviews or select chart reviews. Separate work by CSTE with state and local public health agencies found that most surveyed jurisdictions reported difficulties collecting complete race and ethnicity data for COVID-19 case surveillance data (n = 39 of 45 agencies, 87%: Beaulieu, 2022). Beaulieu (2022) found these gaps resulted from reporters not providing the data, patient hesitance to indicate their race & ethnicity, and limited resources at public health agencies. Specific initiatives leading to systematic collection of this information by states would greatly improve data quality. These could include evaluating current data collection procedures; defining race and ethnicity as required data fields and allowing multiple values; convening community representatives to understand the historical context and concerns around giving race and ethnicity information; and bolstering resources at public agencies to better support data management systems, among others (Beaulieu, 2022). The work of Hennessy et al., (2016) who used systematic medical chart review to assess the role of pre-existing medical conditions and other factors in driving higher 2009 H1N1 influenza mortality risk among AI/AN persons, provides a good example of what could be accomplished. While this study illustrates higher risk for severe COVID-19 outcomes among AI/AN persons compared to NHW persons, the lack of

systematic collection of risk factors like occupation limits the use of data to inform targeted public health action.

Limitations

This study had several notable limitations. There was non-ignorable missingness throughout the data that should be accounted for when considering these findings. Race and ethnicity information were missing or incomplete from 42.7% of COVID-19 cases, 24.7% of hospitalizations, and 10.1% of deaths in the sample. This missingness may represent volunteer bias from the states that responded to the invitation from CSTE and had enough data on AI/AN persons to not trigger suppression guidelines. Unfortunately, due to the way states reported data for this study, a sensitivity analysis of the missing data was not possible. Only aggregate numbers of COVID-19 case records with missing or incomplete race data were reported by the states. The outcomes of those cases with missing or incomplete race and ethnicity information were not reported. The workgroup initially explored using federal datasets to conduct this analysis—which would have included information from all states—but insurmountable data quality and completeness issues arose. This experience suggests a need for better coordination between Tribal, state, and federal public health partners to produce complete datasets that are more representative of AI/AN health nationwide.

As with any multi-state analysis, the data quality, collection methods, and completeness varied across the 16 participating states. For example, in some states, periods of high case volume may have contributed to the incompleteness of data due to overstretched staff capacity preventing the systematic collection of demographic or case-related descriptive data. Cases, hospitalizations, and deaths may have been undercounted due to racial misclassification resulting in underestimates of the effects on AI/AN communities. Studies like Labgold et al. (2021) and others reported that when missing racial data in COVID-19 cases were corrected, observed racial disparities increased (Joshi & Warren-Mears, 2019). Thus, despite the data quality issues, the estimates in this study likely underestimate the relative burden of COVID-19-related hospitalizations and deaths for AI/AN persons (Stokes et al., 2021).

Patterns of post-mortem testing also varied by state. Data for comorbid conditions were particularly susceptible to inconsistent and incomplete collection. In at least two reporting states, information was not consistently collected once cases were hospitalized. Inconsistent data collection methodology among states also resulted in challenges analyzing data related to underlying health conditions. Most states relied on self-reports to collect information on underlying conditions and did not systematically assess for the presence or absence of specific comorbidities. These limitations limited the comparisons made between prevalence of underlying conditions by race and precluded assessment of the possible role of underlying conditions in contributing to the observed elevated risk of severe COVID-19-related outcomes.

Furthermore, data collection methods did not allow evaluation of changes in hospitalization and mortality incidence over time, preventing the workgroup from detecting differences by pandemic waves, season, and the introduction of the vaccine. The grouping of all cases, hospitalizations, and deaths that occurred to people ages 50 years and older into a single age group was also affected by the data collection methods of this study. This decision was based on the age-based definition of Elder used by many of the study authors' agencies; however, this age grouping may obscure variations in experience among older AI/AN people (Denny et al., 2011; Joshi &

Warren-Mears, 2019; Kahn et al., 2016). Thus, the resulting findings may not fully reflect the COVID-19-related health burdens for all AI/AN communities.

There were also limitations in the SVI analyses; due to limitations in data collection, the workgroup was unable to adjust for the effect of age at the county level, which likely greatly underestimates the relative burden of COVID-19 deaths and hospitalizations in AI/AN populations compared to NHW populations. This may also explain some of the differences in rates between Tables 1 and 2; age-adjustment increased the incidence for AI/AN persons (a generally younger population) and decreased the incidence for NHW persons (generally older). During the study period, younger individuals and children were thought to be at lesser risk for severe COVID-19 outcomes (Centers for Disease Control and Prevention, 2022). Over a quarter of the AI/AN population (27.5%) is under 18 years old, compared to 18.6% of the NHW population (Office of Minority Health & Department of Health & Human Services, 2022). Data from two states were excluded in the SVI analysis as the cell counts fell below the suppression thresholds adopted by those states. This limits the generalizability of the findings around county SVI status.

Additionally, certain risk factors and parts of the SVI are related to AI/AN culture and the development of more culturally appropriate measures could provide information more reflective of the experience of AI/AN communities. For example, smoking as a risk factor made no distinction between traditional vs. commercial tobacco use. In the SVI, traditional and subsistence occupations like hunting are associated with "lower socioeconomic status" and living in multigenerational households is associated with "crowded housing". Circumstances that can bring strength and resiliency to AI/AN communities are instead viewed as vulnerabilities. Lastly, SVI as a county-level composite score does not distinguish vulnerability experienced by a Tribal community separately from the experience of the county, nor does the SVI capture the totality of risk factors vulnerable communities might face. Environmental risk factors like exposure to extractive industries, water pollution, and the impacts of climate change have substantial effects on social determinants of health like access to traditional foods and reliable housing. The SVI does not collect these data.

CONCLUSION

This study documented a higher COVD-19-related mortality risk among AI/AN communities as well as an elevated risk of COVID-19-related hospitalization compared to NHW persons during the pre-Delta and Omicron period of the COVID-19 pandemic. These findings suggest that this disproportionate burden may be influenced in part by higher proportional residence of AI/AN people in regions affected by low income, high unemployment, and often crowded living conditions. These challenges are frequently compounded by the need to travel extremely long and expensive distances for health care, which is frequently under-funded, resulting in lower rates of access to services and prohibitive barriers to care (Ward et al., 2022). For example, for many Alaskan rural residents, accessing a hospital requires a lengthy plane ride.

In the short term, these disparities should be addressed by increasing access for AI/AN communities to medical countermeasures such as monoclonal antibody therapy, effective antivirals when available, and vaccines to ameliorate or prevent COVID-19 disease. In the longer term, a good faith effort by the federal government to fully meet its trust responsibilities to members of federally recognized Tribes could provide the resources needed to support improved employment opportunities, infrastructure, income, and health (Administration for Native

Americans & United States Department of Health & Human Services, n.d.). These could include sustained and emergency funding, trained personnel, and access to public health data. Tribal health facilities and urban Indian health programs play critical roles in supporting AI/AN health and could be valuable sources of complete and accurate data.

This analysis highlights the need for a more systematic approach to data collection and data sharing across states, federal agencies, and Tribes that acknowledges and upholds Tribal data sovereignty. Historically, Tribes have not been included as partners in promoting health and developing public health data systems. As sovereign governments and by federal law, Tribes have a right to establish and maintain public health data structures for the health and well-being of their people (Indian Health Care Improvement Act, 1976; Patient Protection and Affordable Care Act, as Amended by Health Care and Education Reconciliation Act, 2010). In addition to improved and required standards of race and ethnicity data, partnerships and equitable investments in Tribes and urban Indian health organizations are essential for more accurate data and improved AI/AN health. This study found a clear and disproportionate health burden on AI/AN persons despite the limitations and challenges of aggregate state surveillance data. Fully understanding the magnitude of the disproportionate burden of COVID-19 on AI/AN persons will require systematic, coordinated collection of AI/AN health data by Tribes, federal agencies, TECs, and states to address data quality challenges and expand the scope of data collection to all states.

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