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# Minority Health Social Vulnerability Index and COVID-19 vaccination coverage – The United States, December 14, 2020–January 31, 2022



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## ARTICLE INFO

### Article history:

Received 20 April 2022

Received in revised form 25 January 2023

Accepted 8 February 2023

Available online 13 February 2023

### Keywords:

COVID-19 vaccines  
Vaccination coverage  
Vaccine uptake  
Social vulnerability  
Minority health

## ABSTRACT

**Introduction:** In 2021, HHS Office of Minority Health and CDC developed a composite measure of social vulnerability called the Minority Health Social Vulnerability Index (MHSVI) to assess the needs of communities most vulnerable to COVID-19. The MHSVI extends the CDC Social Vulnerability Index with two new themes on healthcare access and medical vulnerability. This analysis examines COVID-19 vaccination coverage by social vulnerability using the MHSVI.

**Methods:** County-level COVID-19 vaccine administration data among persons aged  $\geq 18$  years reported to CDC from 12/14/20 to 01/31/22 were analyzed. U.S. counties from 50 states and DC were categorized into tertiles of vulnerability (low, moderate, and high) for the composite MHSVI measure and each of the 34 indicators. Vaccination coverage ( $\geq 1$  dose, primary series completion, and receipt of a booster dose) was calculated by tertiles for the composite MHSVI measure and each indicator.

**Results:** Counties with lower per capita income, higher proportion of individuals with no high school diploma, living below poverty,  $\geq 65$  years of age, with a disability, and in mobile homes had lower vaccination uptake. However, counties with larger proportions of racial/ethnic minorities and individuals speaking English less than “very well” had higher coverage. Counties with fewer primary care physicians and greater medical vulnerabilities had lower  $\geq 1$  dose vaccination coverage. Furthermore, counties of high vulnerability had lower primary series completion and receipt of a booster dose. There were no clear patterns in COVID-19 vaccination coverage by tertiles for the composite measure.

**Conclusion:** Results from the new components in the MHSVI identify needs to prioritize persons in counties with greater medical vulnerabilities and limited access to health care, who are at greater risk for adverse COVID-19 outcomes. Findings suggest that using a composite measure to characterize social vulnerability might mask disparities in COVID-19 vaccination uptake that would have otherwise been observed using specific indicators.

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## 1. Introduction

In the United States, socially vulnerable communities have disproportionately higher COVID-19 incidence, hospitalization, and death [1–3]. Vaccination remains a key strategy in preventing a COVID-19 infection and its adverse health outcomes [4]. Although recent evidence suggests that racial/ethnic gaps in vaccination coverage have narrowed [5], socioeconomic disparities persist [6].

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Addressing inequitable vaccination access is imperative to reducing the disparities in COVID-19 burden. To improve vaccine equity, public health practitioners should first better understand the patterns in vaccination coverage across the spectrum of social vulnerability.

Previous studies have primarily examined COVID-19 vaccination disparities by social vulnerability characterized using the Centers for Disease Control and Prevention (CDC) Social Vulnerability Index (SVI) [6,7]. The CDC SVI is a composite measure of social vulnerability that was derived from 15 population-based social factors based on four themes: socioeconomic status (SES), household

composition and disability, minority status and language, and housing type and transportation [8]. In 2021, the U.S. Department of Health and Human Services Office of Minority Health partnered with CDC to develop the Minority Health Social Vulnerability Index (MHSVI) to assess the public health needs of communities most vulnerable to COVID-19 [9]. The MHSVI is an extension of the original CDC SVI that combines the previous four themes with two new themes on healthcare access and medical vulnerability. The purpose of this study is to assess COVID-19 vaccination coverage by social vulnerability using the MHSVI.

## 2. Methods

Data on COVID-19 vaccination came from jurisdictions, pharmacies, and federal entities that report to the CDC via immunization information systems, the Vaccine Administration Management System, or direct data submission [10]. Analyses included those  $\geq 18$  years of age with a valid county of residence in one of the 50 states or District of Columbia who received their first dose of either the Pfizer-BioNTech or Moderna COVID-19 vaccine or a single dose of the Janssen (Johnson & Johnson) COVID-19 vaccine from December 14, 2020–January 31, 2022. Eight counties in California with population size  $< 20,000$  were excluded because they have data-sharing restrictions on county-level information reported to CDC. One county from Alaska was not included due to unavailable vaccination data. Vaccine doses administered to persons residing in U.S. territories and freely associated states were also excluded as there were no available MHSVI metrics. County population denominators used to estimate vaccination coverage were obtained from the 2020 U.S. Census Bureau Bridged-Race Postcensal Population Estimates [11].

County-level data for measures on social vulnerability came from the 2021 MHSVI [9]. In brief, the MHSVI contains a total of 34 indicators, which include 13 original population-based social indicators from the 2018 CDC SVI, 11 indicators that were disaggregated from the original 2 indicators regarding racial/ethnic minority status and language, and 10 new indicators related to healthcare infrastructure and access and medical vulnerability. Percentile rankings ranging from 0 to 1 were created for all 3,142 U.S. counties based on the 34 social indicators, categorized into one of six themes: socioeconomic status, household composition and disability, racial/ethnic minority status and language, housing type and transportation, healthcare infrastructure and access, and medical vulnerability. The six themes were then summed and ranked to generate an overall MHSVI composite measure. Counties were categorized into tertiles (low, moderate, and high), with a higher tertile representing greater vulnerability, for the overall MHSVI composite measure, the six themes, and each of the 34 individual indicators. Receipt of the first dose of COVID-19 vaccine was matched by county of residence to one of three tertile categories of vulnerability. Ranges for tertile categories, definitions, and data sources for each indicator are shown in **Supplemental Table 1**.

### 2.1. Statistical analysis

Vaccination coverage, defined as percentage of residents aged  $\geq 18$  years who received  $\geq 1$  dose of a 2-dose COVID-19 primary vaccination series or a single dose of the Janssen COVID-19 vaccine, was calculated by tertiles for the overall MHSVI composite measure and each of the 34 indicators in the overall U.S. population. First dose vaccination coverage was further stratified by tertiles and jurisdiction for the MHSVI composite measure and each of the six themes using the counties rankings based on the United States overall. First dose counts may be overestimated if an individual received a second dose but was given a new identification

number or the first dose may have been received in another jurisdiction. In both cases the records would not be matched correctly to acknowledge the second dose and would be counted as a first dose. This may result in vaccine coverage  $> 100\%$  which may be misleading. To overcome this misrepresentation, the number of doses per county was capped at the county's population size minus one for a maximum vaccination coverage of 100%.

Primary series completion was also calculated and stratified by the MSHVI composite measure and each of the six themes' tertile categories. Primary series completion was defined as receiving either both doses of a 2-dose mRNA COVID-19 vaccination series (Pfizer-BioNTech or Moderna) or a single dose of the Janssen (Johnson & Johnson) vaccine. This included receipt of the same vaccine type for both mRNA doses or mismatched products for the first and second dose (e.g., Pfizer-BioNTech for the first dose and Moderna for the second dose, or vice versa).

Among those aged  $\geq 18$  years who had completed their primary COVID-19 vaccination series, the proportions eligible for a booster dose and with sufficient time to receive it, as well as the proportions of eligible persons who did and did not receive a booster dose, were calculated and stratified by tertile categories for each of the six themes of vulnerability. Eligible population for a booster dose was defined as persons aged  $\geq 18$  years who completed a primary COVID-19 vaccination series and were eligible to receive a booster or additional primary dose by the end of the analysis period, January 31, 2022. Individuals with sufficient time to complete the booster were defined as those who completed the primary series by August 31, 2021 (i.e.,  $\geq 5$  months earlier) for Pfizer-BioNTech and Moderna vaccines and 1 dose must have been received by December 1, 2021 (i.e.,  $\geq 2$  months earlier) for Janssen vaccine [12].

Vaccination coverage rate ratios and rate differences were estimated across analyses comparing those in the high vulnerability category to the moderate and low categories. Rate ratios were calculated by dividing the vaccination rates of the low and moderate categories by the high category while rate differences were calculated by subtracting the vaccination rates of the low and moderate categories from the high category. Rate ratios  $> 1$  and rate differences  $> 0$  represent greater vaccination coverage in moderate and high vulnerability counties whereas ratios  $< 1$  and difference  $< 0$  represent lower coverage.

Tests for statistical significance were not conducted because the data represent the U.S. population (minus eight counties in California) and were not based on population samples. All analyses were conducted using SAS software (version 9.4; SAS Institute). This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy (See e.g., 45C.F.R. part 46.102(1)(2), 21C.F.R. part 56; 42 U.S.C. §241(d); 5 U.S.C. §552a; 44 U.S.C. §3501 et seq).

## 3. Results

Between December 14, 2020–January 31, 2022, a total of 203,156,717 (79.2%) U.S. residents received  $\geq 1$  dose of a COVID-19 vaccine. Vaccination coverage by tertiles for the MHSVI composite measure and each indicator are shown in **Table 1**. Compared to high vulnerability counties for the overall MHSVI composite measure, vaccination coverage was 0.3 percentage points lower in the low vulnerability counties while the rate difference was 2.0 percentage points greater in moderate vulnerability counties. Rate ratios show similar coverage for both low to high and moderate to high comparisons (rate ratio = 1.0).

Counties of high vulnerability generally had lower vaccination coverage than those with moderate and low vulnerability across SES, household composition and disability, and medical vulnerability indicators. Among the SES indicators, counties with lower per

**TABLE 1**

COVID-19 vaccination coverage by minority health social vulnerability index (MHSVI) tertile classifications for each indicator among persons ≥ 18 years of age who received at least one vaccine dose (N = 192,253,905) – United States, December 14, 2020–January 31, 2022.

MHSVI Metrics	Vaccination Coverage No. (%)			Relative Differences in Vaccination Coverage (Ratio)		Rate Differences in Vaccination Coverage (%)	
	Low Social Vulnerability	Moderate Social Vulnerability	High Social Vulnerability	Low/High	Moderate/High	Low - High	Moderate - High
<b>Overall MHSVI</b>	25,784,643 (78.2)	73,378,210 (80.5)	103,993,864 (78.5)	1.0	1.0	−0.3 %	2.0 %
<b>Socioeconomic status</b>							
Poverty	80,166,432 (83.2)	85,064,423 (78.2)	37,925,862 (73.7)	1.1	1.1	9.5%	4.5%
Unemployment	42,516,254 (78.8)	95,280,667 (80.3)	65,359,796 (77.9)	1.0	1.0	0.9%	2.4%
Per capita income	144,487,365 (83.9)	40,007,685 (70.6)	18,661,667 (67.6)	1.2	1.0	16.3%	3.0%
No high school diploma	77,134,854 (81.2)	82,283,439 (78.6)	43,738,424 (77.0)	1.1	1.0	4.1%	1.5%
<b>Household composition and disability status</b>							
Age ≥ 65 years of age	145,524,535 (81.5)	38,599,345 (75.1)	19,032,837 (71.5)	1.1	1.1	10.0 %	3.6 %
Age ≤ 17 years of age	53,949,742 (80.8)	81,602,519 (81.8)	67,604,456 (75.1)	1.1	1.1	5.7 %	6.8 %
Disability	146,667,343 (83.3)	41,938,759 (72.5)	14,550,615 (64.0)	1.3	1.1	19.4 %	8.5 %
Single parent	45,835,124 (82.3)	66,744,386 (78.9)	90,577,207 (77.9)	1.1	1.0	4.4 %	1.0 %
<b>Racial/Ethnic minority status and language</b>							
<i>Minority Status:</i>							
American Indian/Alaska Native	57,946,011 (78.7)	93,775,490 (80.6)	51,435,216 (77.3)	1.0	1.0	1.4 %	3.3 %
Asian	9,968,319 (60.9)	22,446,379 (67.5)	170,742,019 (82.5)	0.7	0.8	−21.6 %	−15.1 %
African American	15,974,441 (70.9)	61,739,743 (78.6)	125,442,533 (80.7)	0.7	0.8	−9.8 %	−2.1 %
Native Hawaiian/Pacific Islander	103,569,626 (78.3)	§	99,587,091 (80.1)	1.0	§	−1.8 %	§
Hispanic or Latinx	18,856,839 (67.9)	47,031,352 (73.7)	137,268,526 (83.2)	0.8	0.9	−15.3 %	−9.5 %
Some Other Race	9,968,319 (60.9)	22,446,379 (67.5)	170,742,019 (82.5)	0.8	0.9	−15.1v%	−9.1 %
<i>Language - Speak English Less than "Very Well"</i>							
Spanish Speakers	7,242,915 (63.4)	21,166,095 (67.0)	174,747,707 (81.8)	0.8	0.8	−18.4 %	−14.8 %
Chinese Speakers	13,310,492 (62.3)	9,507,317 (65.6)	180,338,908 (81.7)	0.8	0.8	−19.5 %	−16.1v%
Vietnamese Speakers	20,141,077 (64.7)	4,606,149 (66.6)	178,409,491 (81.6)	0.8	0.8	−16.9 %	−15.0 %
Korean Speakers	21,304,344 (64.3)	4,087,444 (66.9)	177,764,929 (81.8)	0.8	0.8	−17.5 %	−14.9 %
Russian Speakers	29,993,312 (64.9)	§	173,163,405 (82.3)	0.8	§	−17.4 %	§
<b>Housing type and transportation</b>							
Multiunit housing	9,198,498 (61.3)	20,985,614 (65.9)	172,972,605 (82.5)	0.7	0.8	−21.2 %	−16.6 %
Mobile homes	153,179,385 (83.4)	33,770,777 (71.1)	16,206,555 (64.0)	1.3	1.1	19.3 %	7.1 %
Crowding	37,173,716 (75.9)	65,545,716 (75.9)	100,437,285 (82.8)	0.9	0.9	−6.9 %	−7.0 %
No vehicle	42,999,506 (74.9)	65,413,455 (77.5)	94,743,756 (82.6)	0.9	0.9	−7.6 %	−5.1 %
Group quarters	64,106,451 (77.3)	92,723,288 (82.3)	46,326,978 (76.0)	1.0	1.1	1.3 %	6.4 %
<b>Health Care Infrastructure &amp; Access</b>							
Hospitals	9,795,713 (64.9)	76,624,940 (75.8)	116,736,064 (83.2)	0.8	0.9	−18.3 %	−7.4 %
Urgent care clinics	136,748,119 (79.2)	43,882,471 (88.7)	22,526,127 (65.3)	1.2	1.4	14.0 %	23.5 %
Pharmacies	32,202,793 (76.1)	91,570,149 (79.7)	79,383,775 (79.9)	1.0	1.0	−3.7 %	−0.2 %
Primary Care Physicians	148,943,293 (83.5)	42,753,481 (71.9)	11,459,943 (61.5)	1.4	1.2	22.0%	10.4%
Health Insurance	76,237,111 (82.7)	79,659,690 (79.0)	47,259,916 (74.4)	1.1	1.1	8.3%	4.6%
<b>Medical Vulnerability</b>							
Cardiovascular Disease Death	107,616,500 (84.9)	72,901,658 (76.3)	22,638,559 (66.2)	1.3	1.2	18.7%	10.2%
Chronic Respiratory Disease	134,217,226 (85.2)	46,449,839 (72.5)	22,489,652 (64.5)	1.3	1.1	20.7%	8.0%
Obesity	134,220,748 (84.6)	46,111,338 (72.2)	22,824,631 (67.0)	1.3	1.1	17.7%	5.2%
Diabetes	93,412,417 (84.7)	83,945,431 (77.9)	25,798,869 (67.2)	1.3	1.2	17.4%	10.6%
Internet Access	157,354,560 (82.2)	35,139,028 (72.4)	10,663,129 (64.2)	1.3	1.1	18.0%	8.2%

§ No counties in that MHSVI tertile category.

capita income and a higher proportion of individuals with no high school diploma, and/or individuals living below poverty had lower vaccination coverage. The largest rate difference among SES indicators was estimated for per capita income in which the coverage for counties with high vulnerability was 16.3 percentage points (rate ratio = 1.2) lower than those in low vulnerability. Regarding the household composition and disability status indicators, counties with a greater percentage of individuals ≥ 65 years of age, > 5 years of age with a disability, and/or living in single parent households had lower vaccination coverage. The greatest disparity for these indicators was estimated for county measure of the proportion of individuals > 5 years of age who report having a disability in which coverage of high vulnerability counties was 19.4 percentage points (rate ratio = 1.3) less than low vulnerability counties. For the medical vulnerability indicators, counties with higher rates of cardiovascular disease death, chronic respiratory diseases, obesity, diabetes, and/or greatest proportion of individuals with no internet

access had lower coverage estimates. The largest difference was found for the chronic respiratory diseases indicator with counties of high vulnerability having 20.7 percentage points (rate ratio = 1.3) lower coverage than counties in low vulnerability.

In contrast, among racial/ethnic minority status and language indicators, counties of higher vulnerability (i.e., greater proportion of racial/ethnic minority individuals and those that spoke English less than “very well”) had greater vaccination coverage except for the indicator measuring the proportion of American Indian/Alaska Native individuals where higher vulnerability counties had lower vaccination coverage. Regarding the indicators capturing racial/ethnic minority status, the largest difference was estimated for the indicator measuring the proportion of Asian individuals with vaccination coverage being 21.6 percentage points greater in high compared to low vulnerability counties. For the language indicators, there were large disparities estimated across all indicators when comparing low to high vulnerability

**TABLE 2**  
 COVID-19 vaccination coverage by minority health social vulnerability index tertile classification and jurisdiction among persons ≥ 18 years of age who received at least one vaccine dose by jurisdiction— United States, December 14, 2020–January 31, 2022.

Jurisdiction	Overall MHSVI			Socioeconomic status			Household composition and disability status			Racial/Ethnic minority status and language			Housing type and transportation			Health care infrastructure and access			Medical Vulnerability			
	Low	Moderate	High	Low	Moderate	High	Low	Moderate	High	Low	Moderate	High	Low	Moderate	High	Low	Moderate	High	Low	Moderate	High	
Overall	25,784,643 (78.2)	73,378,210 (80.5)	103,993,864 (78.5)	85,387,653 (83.2)	84,758,244 (78.0)	33,010,820 (72.9)	124,519,929 (84.6)	54,742,726 (73.6)	23,894,062 (68.4)	7,149,422 (61.8)	15,792,509 (65.1)	180,214,786 (81.7)	33,434,187 (75.0)	67,479,162 (78.1)	102,243,368 (81.4)	103,348,097 (82.6)	85,233,295 (78.3)	14,575,325 (64.5)	143,593,169 (84.3)	42,788,823 (72.2)	16,774,725 (62.0)	
Alabama	86,038 (50.4)	72,614 (69.4)	1,745,593 (66.6)	468,652 (72.2)	917,523 (64.0)	1,168,070 (64.4)	12,583 (64.4)	912,527 (71.9)	829,135 (68.7)	162,139 (58.7)	478,616 (60.4)	1,913,490 (67.2)	417,068 (57.9)	1,388,971 (70.9)	748,206 (64.8)	1,855,948 (69.9)	346,566 (57.5)	351,731 (61.1)	217,342 (61.1)	805,545 (76.1)	1,531,358 (63.2)	
Alaska	3,681 (63.8)	122,736 (80.6)	280,404 (79.9)	329,897 (80.6)	51,511 (79.9)	25,413 (70.2)	351,909 (75.4)	45,251 (67.9)	9,661 (67.9)	4,659 (79.8)	43,293 (74.5)	358,869 (75.3)	42,402 (52.1)	2,866 (73.7)	381,553 (76.6)	33,761 (85.0)	257,536 (83.3)	115,524 (75.5)	366,233 (62.7)	22,433 (66.9)	18,155 (66.9)	
Arizona	§ 4,180 (61.1)	§ 4,359,724 (75.6)	§ 3,539,847 (75.6)	§ 824,057 (75.4)	§ 3,539,847 (75.4)	§ 824,057 (75.4)	§ 106,724 (75.4)	§ 3,457,153 (75.9)	§ 800,027 (75.9)	§ 90,235 (75.4)	§ 4,273,669 (75.4)	§ 162,091 (75.1)	§ 4,201,813 (75.1)	§ 108,174 (83.5)	§ 3,749,104 (77.7)	§ 506,626 (77.7)	§ 3,910,753 (75.2)	§ 419,912 (79.4)	§ 3,910,753 (75.2)	§ 419,912 (79.4)	§ 3,910,753 (75.2)	
Arkansas	38,342 (54.0)	660,136 (65.8)	777,750 (61.9)	210,813 (68.0)	698,059 (61.9)	567,356 (59.2)	350,081 (68.9)	223,214 (58.5)	902,933 (62.7)	278,272 (57.5)	969,905 (66.8)	342,823 (63.9)	495,693 (65.1)	637,712 (61.7)	696,088 (65.6)	613,438 (63.8)	166,702 (54.0)	150,844 (70.4)	600,965 (67.9)	724,419 (58.8)	24,419 (67.9)	
California	30,304 (78.7)	6,564,385 (91.3)	19,967,322 (85.8)	8,403,951 (92.3)	12,786,324 (89.3)	5,371,736 (76.0)	19,687,175 (88.9)	5,558,494 (76.9)	1,316,342 (77.7)	26,562,011 (87.1)	501,075 (85.2)	6,605,284 (88.0)	19,455,652 (90.7)	8,365,201 (90.7)	17,983,561 (85.5)	213,249 (85.5)	24,408,144 (88.3)	2,100,309 (85.5)	24,408,144 (88.3)	2,100,309 (85.5)	24,408,144 (88.3)	2,100,309 (85.5)
Colorado	1,244,960 (84.4)	931,274 (79.1)	1,542,869 (81.0)	3,057,458 (84.1)	519,030 (73.1)	142,615 (67.1)	3,074,814 (83.9)	499,104 (72.9)	145,185 (70.2)	21,841 (60.7)	286,003 (70.8)	3,411,259 (86.8)	2,129,619 (80.6)	743,713 (82.9)	1,531,408 (81.6)	2,083,341 (81.6)	104,354 (81.6)	3,550,446 (85.5)	154,773 (65.6)	13,884 (60.7)	13,884 (60.7)	
Connecticut	371,583 (91.2)	§ 399,442 (90.3)	§ 568,979 (88.9)	§ 1,981,831 (96.1)	§ 751,264 (96.8)	§ 103,174 (96.8)	§ 568,979 (88.9)	§ 103,174 (96.8)	§ 103,174 (96.8)	§ 103,174 (96.8)	§ 672,153 (85.9)	§ 568,979 (88.9)	§ 103,174 (88.9)	§ 568,979 (88.9)	§ 103,174 (88.9)	§ 568,979 (88.9)	§ 103,174 (88.9)	§ 568,979 (88.9)	§ 103,174 (88.9)	§ 103,174 (88.9)	§ 103,174 (88.9)	§ 103,174 (88.9)
D.C.	§ 583,224 (100.0)	§ 583,224 (100.0)	§ 583,224 (100.0)	§ 583,224 (100.0)	§ 583,224 (100.0)	§ 583,224 (100.0)	§ 583,224 (100.0)	§ 583,224 (100.0)	§ 583,224 (100.0)	§ 583,224 (100.0)	§ 583,224 (100.0)	§ 583,224 (100.0)	§ 583,224 (100.0)	§ 583,224 (100.0)	§ 583,224 (100.0)	§ 583,224 (100.0)	§ 583,224 (100.0)	§ 583,224 (100.0)	§ 583,224 (100.0)	§ 583,224 (100.0)	§ 583,224 (100.0)	§ 583,224 (100.0)
Florida	740,439 (85.5)	3,479,321 (80.6)	10,295,695 (83.7)	2,818,288 (81.9)	8,120,288 (82.0)	3,576,879 (86.4)	10,204,629 (86.8)	3,541,841 (77.1)	768,985 (67.8)	32,527 (59.7)	236,666 (61.0)	14,246,262 (83.6)	943,153 (76.7)	6,577,126 (82.8)	8,995,176 (84.2)	4,972,408 (79.9)	9,274,436 (85.9)	268,611 (58.9)	11,392,120 (86.7)	2,827,996 (73.8)	295,339 (57.3)	
Georgia	405,104 (67.4)	1,771,375 (65.5)	3,109,064 (63.4)	2,211,507 (70.1)	1,472,270 (64.8)	1,601,766 (57.6)	2,938,271 (64.8)	1,329,065 (60.8)	1,018,207 (53.0)	166,683 (66.4)	647,863 (66.4)	4,470,997 (65.7)	2,233,007 (57.5)	467,283 (64.7)	2,585,253 (65.7)	1,492,652 (66.0)	2,811,061 (66.0)	981,830 (71.2)	2,759,784 (56.3)	1,107,745 (57.9)	14,018,144 (58.5)	
Hawaii	113,284 (85.8)	917,250 (94.3)	§ 897,161 (94.3)	§ 133,373 (94.3)	§ 897,161 (94.3)	§ 133,373 (94.3)	§ 897,161 (94.3)	§ 133,373 (94.3)	§ 133,373 (94.3)	§ 50 (57.5)	§ 1,030,484 (92.7)	§ 295,929 (96.3)	§ 734,605 (92.7)	§ 1,030,484 (96.3)	§ 50 (57.5)	§ 1,030,484 (96.3)	§ 50 (57.5)	§ 1,030,484 (96.3)	§ 50 (57.5)	§ 1,030,484 (96.3)	§ 50 (57.5)	§ 1,030,484 (96.3)
Idaho	118,900 (59.7)	603,081 (60.3)	170,995 (69.3)	506,245 (69.3)	218,828 (58.7)	167,903 (61.5)	387,799 (60.6)	445,738 (60.6)	59,439 (53.6)	28,554 (59.3)	217,688 (58.8)	646,734 (60.8)	534,258 (60.8)	271,367 (60.8)	87,351 (61.6)	539,568 (64.9)	147,621 (64.9)	205,787 (59.7)	641,975 (58.1)	237,220 (55.8)	13,781 (55.8)	
Illinois	1,406,966 (80.4)	2,141,937 (79.6)	4,621,664 (86.1)	2,551,487 (84.9)	5,456,970 (88.5)	162,110 (60.0)	6,750,953 (86.3)	938,774 (67.1)	480,840 (65.2)	373,840 (62.8)	460,666 (85.7)	7,336,061 (82.2)	2,207,270 (78.9)	1,780,794 (85.9)	4,182,503 (79.6)	1,777,196 (79.6)	6,167,506 (85.4)	225,865 (87.1)	6,553,144 (85.4)	1,503,210 (62.8)	114,213 (62.8)	
Indiana	894,020 (73.5)	859,583 (62.9)	1,800,448 (69.1)	1,141,891 (73.5)	1,702,747 (67.8)	709,413 (67.8)	1,269,623 (67.0)	1,588,947 (60.5)	695,481 (60.5)	449,387 (60.5)	599,839 (71.6)	2,504,825 (82.4)	1,240,019 (65.1)	890,489 (72.0)	1,419,543 (72.0)	1,238,531 (68.9)	1,932,742 (68.9)	382,778 (57.6)	741,772 (67.7)	2,076,558 (63.5)	735,721 (63.5)	
Iowa	806,610 (68.9)	884,850 (78.9)	104,524 (71.8)	1,430,829 (66.6)	356,619 (75.1)	8,536 (67.7)	1,159,185 (69.1)	470,464 (69.1)	166,335 (68.3)	366,737 (68.3)	310,971 (68.3)	1,118,276 (69.6)	493,508 (75.8)	1,017,271 (73.6)	285,205 (75.4)	1,521,972 (75.4)	178,456 (68.1)	95,556 (75.9)	1,321,949 (69.0)	328,329 (66.4)	145,706 (66.4)	
Kansas	719,682 (82.5)	346,761 (76.5)	615,538 (80.7)	972,649 (68.8)	516,960 (80.7)	147,372 (75.9)	730,879 (81.3)	695,016 (73.9)	256,086 (63.7)	170,655 (63.7)	249,067 (80.9)	1,262,259 (82.0)	755,751 (71.9)	440,453 (78.2)	485,777 (80.8)	842,908 (74.9)	749,722 (80.8)	89,351 (72.6)	670,301 (72.6)	801,327 (68.0)	210,353 (68.0)	
Kentucky	427,309 (70.6)	1,095,766 (68.2)	918,463 (72.7)	398,806 (76.5)	1,283,330 (72.7)	759,402 (60.8)	565,056 (79.3)	1,027,693 (64.8)	848,789 (62.9)	711,525 (66.7)	462,375 (76.8)	1,267,638 (66.7)	396,332 (67.1)	696,625 (73.2)	1,375,581 (73.2)	1,733,111 (66.1)	405,665 (61.3)	302,762 (61.3)	384,134 (61.3)	1,244,901 (75.5)	812,503 (61.6)	
Louisiana	13,988 (76.0)	564,005 (65.8)	1,844,691 (68.6)	178,225 (73.8)	967,918 (65.6)	1,276,541 (73.1)	448,454 (71.6)	1,077,939 (63.1)	896,291 (63.1)	177,141 (63.1)	398,770 (71.2)	1,846,773 (69.5)	269,574 (71.3)	598,577 (81.3)	1,554,533 (71.1)	1,706,384 (62.3)	350,233 (60.7)	366,067 (60.7)	304,239 (62.3)	1,109,547 (76.2)	1,008,898 (60.5)	
Maine	636,228 (94.8)	365,453 (84.8)	§ 623,522 (95.7)	§ 133,660 (84.9)	§ 64,499 (97.2)	§ 449,391 (86.5)	§ 64,499 (86.5)	§ 449,391 (86.5)	§ 64,499 (86.5)	§ 41,476 (88.4)	§ 284,796 (93.2)	§ 675,409 (93.2)	§ 258,114 (85.6)	§ 432,255 (85.6)	§ 311,312 (86.1)	§ 773,166 (86.1)	§ 173,138 (89.3)	§ 55,377 (89.3)	§ 565,843 (84.3)	§ 435,838 (84.3)	§ 435,838 (84.3)	§ 435,838 (84.3)
Maryland	687,455 (90.0)	2,287,669 (85.3)	1,264,255 (85.3)	2,956,330 (92.0)	847,825 (79.5)	435,224 (79.5)	3,664,664 (90.8)	537,595 (79.6)	37,120 (64.8)	15,319 (82.3)	92,357 (90.1)	4,131,703 (90.1)	1,047,865 (92.7)	1,945,585 (85.6)	2,459,929 (90.8)	3,373,303 (77.5)	814,953 (89.8)	51,123 (77.5)	2,694,598 (86.7)	1,365,454 (86.7)	179,327 (72.2)	
Massachusetts	690,031 (76.0)	3,382,877 (93.8)	§ 3,680,764 (90.6)	§ 1,349,262 (91.1)	§ 4,629,537 (85.2)	§ 400,489 (85.2)	§ 4,629,537 (85.2)	§ 400,489 (85.2)	§ 400,489 (85.2)	§ 1,274 (89.9)	§ 5,028,752 (90.8)	§ 23,888 (91.2)	§ 1,451,584 (91.2)	§ 3,554,554 (90.6)	§ 5,030,026 (90.6)	§ 5,030,026 (90.6)	§ 5,030,026 (90.6)	§ 5,030,026 (90.6)	§ 5,030,026 (90.6)	§ 5,030,026 (90.6)	§ 5,030,026 (90.6)	§ 5,030,026 (90.6)
Michigan	1,512,502 (75.8)	2,256,577 (68.7)	1,717,817 (67.1)	2,714,971 (74.6)	1,421,872 (65.6)	1,350,053 (66.4)	3,077,549 (73.3)	756,918 (66.3)	1,652,429 (62.8)	265,583 (65.6)	838,107 (71.4)	4,383,206 (82.0)	2,083,489 (69.0)	2,222,762 (68.5)	1,180,645 (71.6)	4,492,260 (84.9)	849,915 (64.0)	144,721 (74.4)	2,815,963 (74.4)	2,147,752 (67.2)	523,181 (60.9)	
Minnesota	1,337,563 (72.7)	2,005,188 (80.8)	25,731 (76.2)	3,214,308 (77.7)	147,535 (70.6)	6,639 (63.0)	2,866,126 (66.0)	334,455 (66.0)	167,901 (68.5)	228,619 (68.5)	545,880 (80.5)	2,593,983 (80.5)	1,189,364 (73.4)	414,161 (81.3)	1,764,957 (80.0)	2,436,602 (71.0)	714,883 (71.0)	216,997 (77.7)	3,287,222 (64.4)	81,260 (77.7)	64,451 (64.4)	
Mississippi	68,827 (79.5)	581,169 (65.0)	887,876 (68.7)	247,844 (72.3)	189,348 (65.4)	1,100,680 (67.0)	226,339 (67.0)	420,454 (65.5)	891,079 (64.2)	371,816 (66.0)	477,725 (70.9)	688,331 (68.4)	342,155 (64.1)	370,314 (69.0)	825,403 (64.3)	808,511 (64.3)	438,856 (64.3)	290,505 (64.8)	481,752 (64.8)	1,056,120 (66.1)	661.1 (66.1)	
Missouri	574,282 (70.2)	1,540,650 (67.1)	1,126,666 (67.1)	1,441,792 (76.4)	1,219,574 (63.8)	580,232 (59.1)	1,818,354 (65.1)	973,647 (54.4)	449,597 (52.8)	364,447 (53.4)	436,007 (74.2)	2,441,144 (81.7)	1,517,794 (64.3)	935,609 (68.4)	788,195 (72.4)	1,910,809 (74.5)	745,334 (65.0)	585,455 (59.1)	1,265,370 (77.1)	1,238,276 (73.2)	737,952 (63.5)	
Montana	359,177 (64.3)	194,921 (71.8)	21,178 (99.7)	436,462 (66.9)	79,184 (64.8)	59,630 (71.8)	388,157 (69.2)	143,540 (61.0)	43,579 (65.0)	91,971 (65.0)	188,773 (71.5)	294,532 (82.5)	124,817 (72.3)	187,597 (71.7)	262,862 (67.8)	469,417 (63.7)	63,045 (63.7)	42,814 (63.1)	458,518 (61.1)	86,858 (63.1)	29,900 (99.8)	
Nebraska	303,827 (57.6)	268,822 (66.2)	401,487 (75.9)	875,998 (88.5)	81,449 (88.5)	16,689 (88.5)	780,140 (51.3)	95,945 (47.9)	98,051 (51.3)	106,812 (47.9)	118,294 (74.2)	749,030 (59.2)	276,071 (69.6)	456,978 (69.6)	241,087 (69.6)	828,829 (93.2)	93,220 (50.3)	52,087 (50.3)	764,930 (51.6)	201,204 (51.6)	8,002 (58.6)	
Nevada	30,936 (60.8)	50,500 (63.8)	1,822,006 (78.9)	52,738 (94.8)	1,821,931 (58.4)	2																



TABLE 2 (continued)

Jurisdiction	Overall MHSVI			Socioeconomic status			Household composition and disability status			Racial/ethnic minority status and language			Housing type and transportation			Health care infrastructure and access			Medical Vulnerability			
	Low	Moderate	High	Low	Moderate	High	Low	Moderate	High	Low	Moderate	High	Low	Moderate	High	Low	Moderate	High	Low	Moderate	High	
Oregon	37,882 (81.7)	1,117,365 (82.8)	1,614,238 (81.3)	1,504,505 (88.9)	1,102,137 (76.1)	162,843 (67.4)	1,793,068 (87.7)	292,279 (74.7)	684,138 (72.4)	1,785 (67.6)	965,75 (71.4)	2,671,125 (82.4)	134,321 (80.6)	913,101 (82.1)	1,722,063 (81.9)	1,144,878 (80.4)	95,392 (83.9)	2,394,855 (84.1)	2,394,855 (80.4)	359,857 (69.9)	1,226,374 (67.4)	14,773 (77.4)
Pennsylvania	2,501,901 (87.3)	3,288,611 (78.9)	2,728,536 (87.2)	4,852,819 (86.8)	2,428,287 (73.1)	1,237,942 (99.3)	4,876,513 (86.0)	3,416,505 (82.4)	216,030 (65.6)	142,300 (59.6)	1,005,602 (69.6)	7,371,146 (86.9)	804,493 (79.0)	4,424,170 (83.7)	3,110,385 (85.7)	6,118,937 (88.4)	1,987,377 (75.5)	5,304,483 (86.7)	5,304,483 (80.2)	3,041,749 (80.2)	1,728,16 (68.3)	
Rhode Island	318,983 (91.7)	742,193 (81.7)	2,112,173 (67.4)	865,220 (76.6)	1,356,183 (87.2)	632,963 (87.2)	1,188,133 (89.0)	979,476 (89.0)	685,757 (85.1)	100,203 (66.3)	368,039 (64.1)	2,386,124 (70.7)	93,792 (71.4)	1,171,089 (70.3)	1,552,271 (69.0)	470,659 (72.1)	831,436 (64.0)	470,659 (64.0)	570,397 (67.4)	1,226,374 (67.4)	657,595 (74.4)	
South Carolina	275,907 (75.7)	238,862 (84.8)	24,021 (86.3)	465,033 (79.8)	39,125 (78.1)	34,632 (84.4)	332,960 (81.0)	166,243 (78.1)	39,387 (78.4)	157,393 (75.8)	141,501 (83.7)	239,896 (75.9)	129,779 (73.3)	296,669 (84.9)	382,692 (74.9)	91,623 (80.5)	64,475 (75.9)	454,079 (80.5)	454,079 (80.5)	58,914 (85.7)	25,797 (85.7)	
Tennessee	208,062 (74.2)	1,841,790 (65.4)	1,629,313 (71.5)	841,270 (70.6)	2,139,717 (72.8)	698,178 (72.8)	1,573,047 (73.9)	1,278,549 (67.1)	827,569 (61.7)	389,818 (55.6)	64,274 (61.9)	2,635,073 (72.9)	965,012 (68.0)	1,463,444 (63.9)	1,250,709 (75.2)	1,900,269 (68.2)	1,383,905 (58.0)	394,991 (58.0)	728,193 (58.0)	1,936,627 (57.5)	1,014,345 (57.5)	
Texas	449,617 (61.9)	3,657,846 (72.2)	11,622,700 (69.9)	3,981,249 (73.3)	9,030,385 (68.7)	4,403,428 (72.3)	4,403,428 (68.7)	8,474,361 (70.5)	2,152,574 (68.7)	44,059 (44.7)	14,571,533 (52.0)	14,571,533 (52.0)	2,337,459 (73.8)	5,280,675 (68.8)	1,810,029 (70.5)	1,549,283 (74.7)	10,435,407 (65.5)	11,490,137 (71.7)	11,490,137 (64.6)	2,807,252 (64.6)	1,132,774 (51.2)	
Utah	130,581 (76.5)	1,576,194 (80.5)	148,869 (78.0)	1,637,777 (81.5)	196,353 (71.0)	21,514 (62.3)	1,572,532 (81.5)	273,232 (71.9)	9,880 (82.5)	10,590 (67.9)	153,741 (74.6)	1,691,313 (80.6)	358,337 (79.7)	1,468,877 (80.3)	28,430 (67.3)	817,685 (86.5)	932,426 (76.0)	1,816,908 (80.3)	1,816,908 (76.0)	38,736 (66.8)		
Vermont	458,600 (89.9)	1,019,837 (77.8)	1,219,422 (70.6)	436,929 (90.4)	2,167 (80.9)	666,013 (81.4)	339,899 (90.7)	74,429 (87.1)	44,272 (87.7)	98,675 (85.5)	164,380 (89.9)	195,535 (92.3)	109,640 (85.8)	147,634 (92.3)	20,126 (90.9)	378,152 (90.9)	71,374 (85.8)	361,503 (91.1)	361,503 (85.7)	97,097 (85.7)	538,307 (85.7)	
Virginia	50,171 (81.2)	3,146,263 (87.3)	1,842,541 (81.4)	3,590,002 (81.4)	688,207 (75.7)	317,851 (77.7)	666,013 (81.4)	671,650 (68.3)	285,867 (68.2)	302,785 (64.2)	59,831 (78.6)	4,216,532 (78.6)	3,352,801 (79.8)	465,657 (69.4)	1,306,690 (70.2)	1,526,403 (79.3)	2,770,677 (66.5)	3,426,434 (66.5)	3,426,434 (68.0)	1,154,407 (68.0)	495,517 (66.4)	
Washington	50,171 (81.2)	3,146,263 (87.3)	1,842,541 (81.4)	3,590,002 (81.4)	688,207 (75.7)	317,851 (77.7)	666,013 (81.4)	671,650 (68.3)	285,867 (68.2)	302,785 (64.2)	59,831 (78.6)	4,216,532 (78.6)	3,352,801 (79.8)	465,657 (69.4)	1,306,690 (70.2)	1,526,403 (79.3)	2,770,677 (66.5)	3,426,434 (66.5)	3,426,434 (68.0)	1,154,407 (68.0)	495,517 (66.4)	
West Virginia	254,972 (67.1)	672,763 (82.3)	88,647 (71.4)	108,322 (77.2)	527,775 (72.6)	380,285 (72.8)	213,070 (67.7)	386,333 (69.0)	416,979 (73.0)	454,134 (67.7)	183,015 (71.4)	379,233 (75.6)	221,109 (69.5)	419,857 (72.8)	375,416 (70.4)	607,250 (72.8)	361,727 (67.5)	98,425 (68.8)	98,425 (73.2)	129,916 (68.8)	788,041 (71.3)	
Wisconsin	2,242,757 (76.5)	465,073 (73.3)	800,990 (79.5)	2,551,707 (76.4)	954,178 (77.6)	2,935 (96.7)	1,198,535 (76.7)	1,198,535 (76.9)	55,211 (72.2)	161,329 (66.5)	792,904 (69.6)	2,554,587 (80.0)	1,043,793 (75.6)	1,802,119 (76.7)	662,908 (78.5)	2,430,946 (69.1)	81,015 (67.6)	2,526,846 (67.6)	2,526,846 (71.3)	979,039 (76.8)	2,895 (96.7)	
Wyoming	137,520 (60.1)	129,550 (68.6)	137,520 (68.6)	218,269 (63.2)	70,624 (67.8)		172,427 (63.4)	87,387 (63.0)	28,879 (75.7)	73,718 (58.7)	37,910 (57.7)	177,265 (68.7)	47,773 (54.5)	172,418 (67.9)	68,702 (65.7)	127,158 (65.7)	158,593 (66.0)	158,593 (66.0)	130,390 (62.3)			

§ No counties in that MHSVI tertile category.

counties (rate difference range: -19.5 percentage point difference to -16.9 percentage point difference) with the greatest difference found for the number of Spanish speakers who spoke English less than “very well” (rate difference = -19.5 percentage point difference; rate ratio = 0.8).

Patterns for housing type and transportation, and healthcare infrastructure and access were mixed. For housing type and transportation, there was lower vaccination coverage in higher vulnerability counties for indicators related to living in mobile homes and group quarters whereas the opposite was found for multiunit housing, crowding, and households with no vehicle available. The largest differences were found for mobile homes (rate difference = 19.3 percentage point difference; rate ratio = 1.3) and multiunit housing (rate difference = -21.2 percentage point difference; rate ratio = 0.7) when comparing low to high vulnerability. Among healthcare infrastructure and access, there was lower vaccination coverage in higher vulnerability counties for indicators related to rates of urgent care clinics and primary care physicians, and proportion of those with health insurance, whereas the opposite was found for rates of hospitals and pharmacies. The widest disparities were found for rate of urgent care clinics comparing moderate to high vulnerability (rate difference = 23.5 percentage point difference rate ratio = 1.4) and for rate of primary care physicians comparing low to high vulnerability (rate difference = 22.0 percentage point difference; rate ratio = 1.4).

Results for analyses stratified by tertiles of vulnerability for the overall MHSVI measure and each of the six themes across jurisdictions are shown in Table 2. Among the 42 jurisdictions in which a low-to-high comparison could be made for the overall MHSVI composite measure, 16 jurisdictions had lower vaccination coverage in counties with high vulnerability. Additionally, 22 out of 44 jurisdictions in which a moderate-to-high vulnerability comparison could be conducted for the overall MHSVI composite measure, had lower vaccination coverage in counties with high vulnerability. Across jurisdictions, counties of high vulnerability generally had lower vaccination coverage than counties with low or moderate vulnerability related to socioeconomic status, household composition and disability status, healthcare access and infrastructure, and medical vulnerability. For housing type and transportation, vaccination coverage was similar by tertile categories of vulnerability across jurisdictions. Across all jurisdictions, counties with high racial/ethnic minority status and language vulnerability had higher vaccination coverage than low and moderate vulnerability counties.

Overall, 179,953,306 (70.1) completed their primary vaccination series. Among those eligible who had sufficient time to receive a booster dose (n = 142,380,107), 73,667,084 (51.7 %) received their booster dose. Stratifying by tertiles of the overall MHSVI measure, counties of high vulnerability had lower primary vaccination series completion compared to moderate (rate difference = 3.1 percentage point difference; rate ratio = 1.0) and low vulnerability (rate difference = 1.6 percentage point difference; rate ratio = 1.0) counties. There were similar findings for receipt of a booster dose comparing high vulnerability counties to moderate (rate difference = 5.5 percentage point difference; rate ratio = 1.1) and low vulnerability (rate difference = 7.6 percentage point difference; rate ratio = 1.2) counties.

Across the six themes, counties with high socioeconomic status, household composition and disability, healthcare access, and medical vulnerability had lower primary vaccination series completion and receipt of a booster dose than counties with low and moderate vulnerability (Table 3). In contrast, primary series completion was higher among counties with high vulnerability related to racial/ethnic minority status and language and housing type and transportation. Receipt of a booster dose was similar across tertiles of vulnerability related to racial/ethnic minority status and language

**Table 3**  
 COVID-19 vaccine series completion\* and receipt of booster dose among those ≥18 years of age by Minority Health Social Vulnerability Index tertile classifications – December 14, 2020–January 31, 2022.

	Overall [N (%)]	Minority Health Social Vulnerability Index classification [N (%)]			Rate Ratios in Vaccination Coverage (Ratio)		Rate Differences in Vaccination Coverage (%)	
		Low Vulnerability	Medium Vulnerability	High Vulnerability	Low/High	Moderate/High	Low - High	Moderate - High
<b>Overall MHSVI</b>								
<b>Completed series*</b>	179,953,306 (70.1)	23,234,595 (70.5)	65,544,380 (71.9)	91,174,331 (68.8)	1.0	1.0	1.6%	3.1%
<b>Eligible for booster dose<sup>†</sup></b>	142,380,107	20,215,812	53,080,393	69,083,902				
Received booster dose	73,667,084 (51.7)	11,361,422 (56.2)	28,731,112 (54.1)	33,574,550 (48.6)	1.2	1.1	7.6%	5.5%
Did not receive booster dose	68,713,023 (48.3)	8,854,390 (43.8)	24,349,281 (45.9)	35,509,352 (51.4)	1.0	0.9	-7.6%	-5.5%
<b>Socioeconomic status</b>								
<b>Completed series*</b>	179,953,306 (70.1)	76,408,607 (74.4)	74,682,945 (68.8)	28,861,754 (63.8)	1.2	1.1	10.7%	5.0%
<b>Eligible for booster dose<sup>†</sup></b>	142,380,107	62,727,622	57,654,212	21,998,273				
Received booster dose	73,667,084 (51.7)	34,773,578 (55.4)	29,100,969 (50.5)	9,792,537 (44.5)	1.2	1.1	10.9%	6.0%
Did not receive booster dose	68,713,023 (48.3)	27,954,044 (44.6)	28,553,243 (49.5)	12,205,736 (55.5)	0.8	0.9	-10.9%	-6.0%
<b>Household composition and disability status</b>								
<b>Completed series*</b>	179,953,306 (70.1)	110,639,778 (75.1)	48,204,540 (64.8)	21,108,988 (60.5)	1.2	1.1	14.7%	4.3%
<b>Eligible for booster dose<sup>†</sup></b>	142,380,107	92,009,467	34,494,629	15,876,011				
Received booster dose	73,667,084 (51.7)	49,129,688 (53.4)	17,071,431 (49.5)	7,465,965 (47.0)	1.1	1.1	6.4%	2.5%
Did not receive booster dose	68,713,023 (48.3)	42,879,779 (46.6)	17,423,198 (50.5)	8,410,046 (53.0)	0.9	1.0	-6.4%	-2.5%
<b>Racial/Ethnic minority status and language</b>								
<b>Completed series*</b>	179,953,306 (70.1)	6,484,439 (56.0)	14,190,495 (58.5)	159,278,372 (72.2)	0.8	0.8	-16.1%	-13.7%
<b>Eligible for booster dose<sup>†</sup></b>	142,380,107	5,374,194	11,174,242	125,831,671				
Received booster dose	73,667,084 (51.7)	2,771,230 (51.6)	5,747,079 (51.4)	65,148,775 (51.8)	1.0	1.0	-0.2%	-0.3%
Did not receive booster dose	68,713,023 (48.3)	2,602,964 (48.4)	5,427,163 (48.6)	60,682,896 (48.2)	1.0	1.0	0.2%	0.3%
<b>Housing type and transportation</b>								
<b>Completed series*</b>	179,953,306 (70.1)	30,132,562 (67.6)	59,829,902 (69.2)	89,990,842 (71.7)	0.9	1.0	-4.1%	-2.5%
<b>Eligible for booster dose<sup>†</sup></b>	142,380,107	21,946,339	48,506,066	71,927,702				
Received booster dose	73,667,084 (51.7)	11,713,057 (53.4)	25,433,777 (52.4)	36,520,250 (50.8)	1.1	1.0	2.6%	1.7%
Did not receive booster dose	68,713,023 (48.3)	10,233,282 (46.6)	23,072,289 (47.6)	35,407,452 (49.2)	0.9	1.0	-2.6%	-1.7%
<b>Health Care Infrastructure &amp; Access</b>								
<b>Completed series*</b>	179,953,306 (70.1)	91,865,447 (73.4)	75,150,203 (69.1)	12,937,656 (57.3)	1.3	1.2	16.1%	11.8%
<b>Eligible for booster dose<sup>†</sup></b>	142,380,107	79,493,218	55,208,384	7,678,505				
Received booster dose	73,667,084 (51.7)	42,641,266 (53.6)	27,437,513 (49.7)	3,588,305 (46.7)	1.1	1.1	6.9%	3.0%
Did not receive booster dose	68,713,023 (48.3)	36,851,952 (46.4)	27,770,871 (50.3)	4,090,200 (53.3)	0.9	0.9	-6.9%	-3.0%
<b>Medical Vulnerability</b>								
<b>Completed series*</b>	179,953,306 (70.1)	127,622,006 (75.0)	37,615,979 (63.5)	14,715,321 (54.4)	1.4	1.2	20.5%	9.1%
<b>Eligible for booster dose<sup>†</sup></b>	142,380,107	101,659,131	29,508,512	11,212,464				
Received booster dose	73,667,084 (51.7)	54,168,692 (53.3)	14,353,854 (48.6)	5,144,538 (45.9)	1.2	1.1	7.4%	2.8%
Did not receive booster dose	68,713,023 (48.3)	47,490,439 (46.7)	15,154,658 (51.4)	6,067,926 (54.1)	0.9	0.9	-7.4%	-2.8%

\* Persons who received a single dose of Johnson & Johnson or both doses of an mRNA vaccine. This includes those who received the same vaccine type for both mRNA doses, as well as those who received mismatched products for the first and second dose (e.g., Pfizer-BioNTech for first dose and Moderna for the second dose, or vice versa). Eight counties in California with population size <20,000 were excluded because they have data-sharing restrictions on county-level information reported to CDC. One county from Alaska was not included due to unavailable vaccination data. Vaccine doses administered to persons residing in U.S. territories and freely associated states were also excluded as there were no available MHSVI metrics.

<sup>†</sup> Eligible population is defined as persons aged ≥18 years who completed a primary COVID-19 vaccination series and were eligible to receive a booster or additional primary dose by the end of the analysis period, January 31, 2022. For Pfizer-BioNTech and Moderna, the primary series must have been completed by August 31, 2021 (≥5 months earlier); for Janssen (Johnson & Johnson) recipients, 1 dose must have been received by December 1, 2021 (≥2 months earlier).

and was lower among counties with high compared to low (rate difference = 2.6 percentage point difference; rate ratio = 1.1) and moderate (rate difference = 1.7 percentage point difference; rate ratio = 1.0) vulnerability for housing type and transportation.

#### 4. Discussion

Although there were no clear patterns in first dose COVID-19 vaccination coverage by tertiles for the MHSVI composite measure, notable differences were found for individual indicators. Counties with a higher proportion of individuals below poverty, per capita income, individuals with no high school diploma, individuals  $\geq$  65 years of age, with a disability, and living in single parent households, mobile homes, and group quarters had lower vaccination uptake. However, counties with a higher proportion of racial/ethnic minority individuals and individuals who speak English less than “very well,” had higher coverage. Among the new indicators in the MHSVI, counties with fewer primary care physicians, a higher proportion of those uninsured, and greater medical vulnerabilities had both lower first dose vaccination coverage. Furthermore, counties with high vulnerability based on the overall composite measure, socioeconomic status, household composition and disability, healthcare access, and medical vulnerability had lower primary series completion and receipt of a booster dose.

Previous studies examining first dose COVID-19 vaccination coverage by SVI in the United States have also found socioeconomic disparities [6,7]. Altogether, the findings from this study and previous research highlight the persistence and importance of addressing socioeconomic related factors to improve vaccination coverage. Before the COVID-19 pandemic, vaccine uptake was lower and hesitancy was higher for some routine vaccination (e.g., influenza, shingles, and human papilloma virus) in lower SES communities, which may be driving the current vaccine hesitancy and the lower COVID-19 vaccination coverage among these communities [12–17]. Additionally, individuals from lower SES communities had less access to healthcare prior to the pandemic, which may be an issue for those seeking to get vaccinated. Furthermore, prior studies have found similar patterns across household composition and disability status indicators [6,7]. These disparities may involve similar factors underlying SES disparities, since many of the household composition and disability measures are correlated with the SES indicators.

During the early roll-out of COVID-19 vaccines, racial/ethnic disparities in vaccination were well-documented with racial/ethnic minority groups having lower vaccination coverage [18]. More recent findings suggest that racial/ethnic disparities in COVID-19 vaccination have been narrowing [18]. One factor that may have played a role is the ongoing efforts put forth by CDC, local and state health departments, and other community partners, to decrease vaccine hesitancy and improve access to vaccination among racial/ethnic minority communities. Moreover, greater vaccination coverage in counties with a higher proportion of individuals speaking English less than “very well” may be attributed to adults in immigrant families having greater intention to get vaccinated than those in non-immigrant families [19]. The greater willingness to get vaccinated among adults in immigrant families may be due to greater concern of being exposed to the virus at their job and potentially exposing their families to the virus [19].

Findings on lower vaccination coverage in counties with fewer primary care physicians, a greater proportion of individuals uninsured, and more medical vulnerabilities highlight the need to improve vaccination coverage among this group given that they are at higher risk for adverse COVID-19 outcomes [20]. Research suggests that primary care providers are the most trusted source of information about COVID-19 among adults [21]. In addition,

previous studies suggest high vaccine hesitancy (e.g., concerns about vaccine safety) among adults with comorbid conditions [22,23]. Thus, removing barriers to healthcare access and having primary care providers encourage vaccination to decrease vaccine hesitancy, especially among those with comorbid conditions, are critical to achieving vaccine equity, reducing disparities, and decreasing COVID-19-related illness and death in the United States.

##### 4.1. Limitations

Results from this study should be interpreted in the context of five limitations. First, eight counties in California with a population <20,000, one county in Alaska, and persons residing in U.S. territories and freely associated states were excluded, which may have biased the coverage estimates. Second, individuals who received a booster dose in a different jurisdiction from that of their primary series, or who for other reasons were not able to be linked back to their primary series, may have led to underestimation of booster doses. Third, this study was not able to assess factors at a more granular level to determine specific pathways driving these disparities. Fourth, the indicators cannot adequately account for the multiplicative nature of vulnerability which may be important given that some indices may play a larger role in shaping vaccination coverage. Finally, the data for the MHSVI indicators were cross-sectional in nature and do not account for changes over time. Moreover, the data came from sources dating back to 2018 and older and may not be representative of the counties in 2022.

#### 5. Conclusions

Consistent with previous findings using CDC SVI, these results demonstrate the importance of improving vaccine uptake in communities with vulnerabilities related to socioeconomic status, household composition, and disability. Results from the new components in the MHSVI provide further insight and identify interventions for persons living in counties with greater medical vulnerabilities and limited access to health care, who are at greater risk for adverse COVID-19 outcomes. Findings from this analysis suggest that using a composite measure to characterize social vulnerability might mask disparities in COVID-19 vaccination uptake that would have otherwise been observed using specific indicators.

##### Data availability

The data that has been used is confidential.

##### Declaration of Competing Interest

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

##### Acknowledgements

COVID-19 Vaccine Task Force; U.S. Department of Defense; immunization program managers, immunization information system managers, and other staff members of the immunization programs in the 64 jurisdictions and five federal entities who provided these data.

##### Appendix A. Supplementary material

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.vaccine.2023.02.022>.



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