

**COVID-19 Vaccination Coverage by Social Vulnerability Index (SVI), Overall and by Theme,
United States --- December 2020 to November 2022**

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Introduction

Vaccines are the “foremost achievement of public health programs in the United States” [1]. Thus, equitable vaccine access is critical for protecting communities from a host of illnesses resulting in life-threatening health complications. Since the onset of the COVID-19 pandemic, racially and ethnically minoritized groups have faced significant barriers to vaccine uptake. Moreover, these groups experience higher rates of adverse health outcomes from COVID-19. Pre-existing disparities in education, employment, income, transportation, and housing, namely social determinants, can contribute to the racial and ethnic differences in COVID-19 vaccination uptake [2-4]. Even after the expansion of COVID-19 vaccine eligibility and availability in the spring of 2021 [5], certain racially and ethnically minoritized groups demonstrated lower vaccination coverage rates (percent who have received at least one dose) based on state-reported data during the summer of 2021 [6]. Social disadvantage is a fundamental cause of health disparities [7, 8]; therefore, examining social vulnerability of historically underserved communities is a key component of examining disparities in COVID-19 vaccine uptake. A community’s social vulnerability is “the degree to which a community exhibits certain social conditions, including high poverty, low percentage of vehicle access, or crowded households that may affect that community’s ability to prevent human suffering and financial loss in the event of disaster” [9].

A shift in public health practice from vaccine equality to vaccine equity [10] ensures every person has a fair and just chance for vaccination. Health equity approaches aim to provide all with a fair and just opportunity to attain their highest level of health through addressing injustices of the past and present, identifying and removing barriers to health and health care, and eliminating preventable health disparities [11, 12]. As a science, health equity goes beyond stating differences by race and ethnicity and explores underlying social determinants or drivers of health inequities by building an evidence base guiding action across program, surveillance, policy, communications, and scientific inquiry for action. The CDC/ATSDR Social Vulnerability Index (SVI) was developed as a place-based index, database, and mapping tool to assist public health officials with identifying and quantifying socially vulnerable communities [9]. Public health practitioners and community leaders have used SVI data (including themes and social factors such as socioeconomic status, characteristics of household members, and racial and ethnic minority status) [9] to identify communities at increased risk of exposure to COVID-19, those with reduced access to COVID-19 vaccinations, and areas where testing disparities exist to better focus resources and tailor outreach messages.

This health equity science approach adds to the body of knowledge regarding the examination of potential drivers of COVID-19 vaccination disparities using themes and factors of the SVI, such as socioeconomic status, housing, age, and race and ethnicity at a national level and over the course of the entire pandemic. The aim of this report is to provide a descriptive summary that can facilitate discussion on how to further identify, understand, and act on the social determinants that have influenced patterns of COVID-19 vaccinations when examined by SVI themes, such as socioeconomic status, household characteristics, racial and ethnic minority status, and housing type and transportation. This report analyzes COVID-19 vaccination coverage mapped to potential drivers of disparities for the four SVI themes and social factors. The approach builds on previous data presented on [CDC COVID Data Tracker](#), which depicts county-level social vulnerability (at the index level), age, and three separate metrics (e.g., percentage of residents with at least one dose, a completed primary series, and an updated (bivalent) booster dose) in a national map. CDC’s [Data Definitions for COVID-19 Vaccinations](#) are as follows:

- “People receiving at least one dose”: Represents the total number of people who received at least one dose of COVID-19 vaccine approved or authorized for use in the United States. This metric includes everyone who has received only one dose and those who received more than one dose.
- “People with a completed primary series”: Represents the total number of people who have received the second dose in a two-dose COVID-19 vaccine primary series or one dose of a single-dose COVID-19 vaccine primary series approved or authorized for use in the United States.
- “People receiving an updated (bivalent) booster dose”: Represents the number of people who received an updated (bivalent) booster dose. For population-based percentage metrics, CDC uses US Census estimates for the total populations within each specified demographic group regardless of prior vaccination status as denominators.

This report is intended for scientific and public health professionals, however, the information provided could be of use to other groups and the public.

Methods

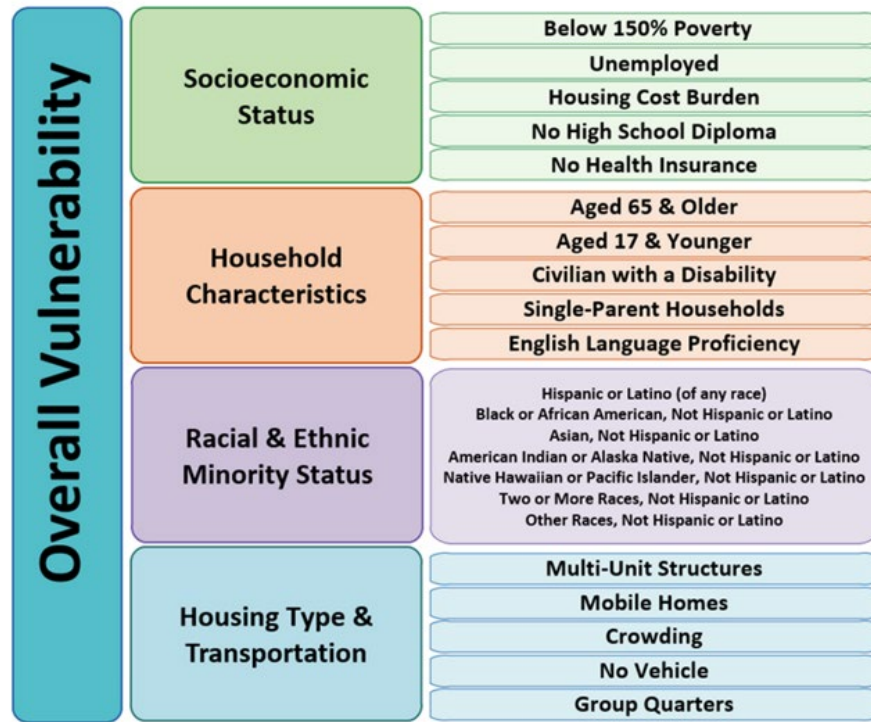
We assessed weekly vaccination coverage for persons who completed a primary series by SVI themes using COVID-19 vaccine administration data from the Tiberius platform (all vaccine partners including jurisdictional partner clinics, retail pharmacies, long-term care facilities, dialysis centers, Federal Emergency Management Agency sites, Health Resources and Services Administration sites, and other federal entity facilities) at the county level and 2020 SVI county-level ranks [13]. The 2020 SVI is grouped into four themes and social factors based on population-level factors by county (Figure 1):

- Socioeconomic Status: below 150% federal poverty level, unemployed, housing cost burden, no high school diploma, no health insurance;
- Household characteristics: people more likely to require assistance (financial, transportation, medical, and daily living) and rely on family and social networks during emergencies [14], such as those aged 65 or older, aged 17 or younger, civilian with a disability, single-parent households, English language proficiency;
- Racial and ethnic minority status: Hispanic or Latino (of any race); Black and African American, Not Hispanic or Latino; American Indian and Alaska Native, Not Hispanic or Latino; Asian, Not Hispanic or Latino; Native Hawaiian and Other Pacific Islander, Not Hispanic or Latino; Two or More Races, Not Hispanic or Latino; Other Races, Not Hispanic or Latino;
- Housing type and transportation: multi-unit structures, mobile homes, crowding, no vehicle, group quarters.

SVI percentile ranking values range from 0 to 1 for each of the four SVI themes, with higher values indicating greater vulnerability [15]. County-level percentile ranks for each theme were categorized into three (3) groups as follows: low (0-0.333), moderate (0.334-0.666), or high (0.667-1); where Low includes counties with low vulnerability scores and High includes counties with high vulnerability scores for each SVI theme. We merged vaccine data by matching on county Federal Information Processing System (FIPS) Code and then graphed by week (from the start of the COVID-19 vaccination rollout) to show primary series coverage by low, moderate, and high vulnerability tertiles for each SVI theme from December 2020 through November 2022. We calculated primary series vaccination coverage differences for each week by subtracting coverage between the high versus low vulnerability counties and between moderate versus low vulnerability counties.

Figure 1 The 2020 Social Vulnerability Index

American Community Survey (ACS), 2016-2020 (5-year) data for the following estimates:



SVI: Overall Vulnerability

Overall SVI vulnerability is a composite of four themes including socioeconomic status, household characteristics, racial and ethnic minority status, and housing type and transportation.

Figure 2a

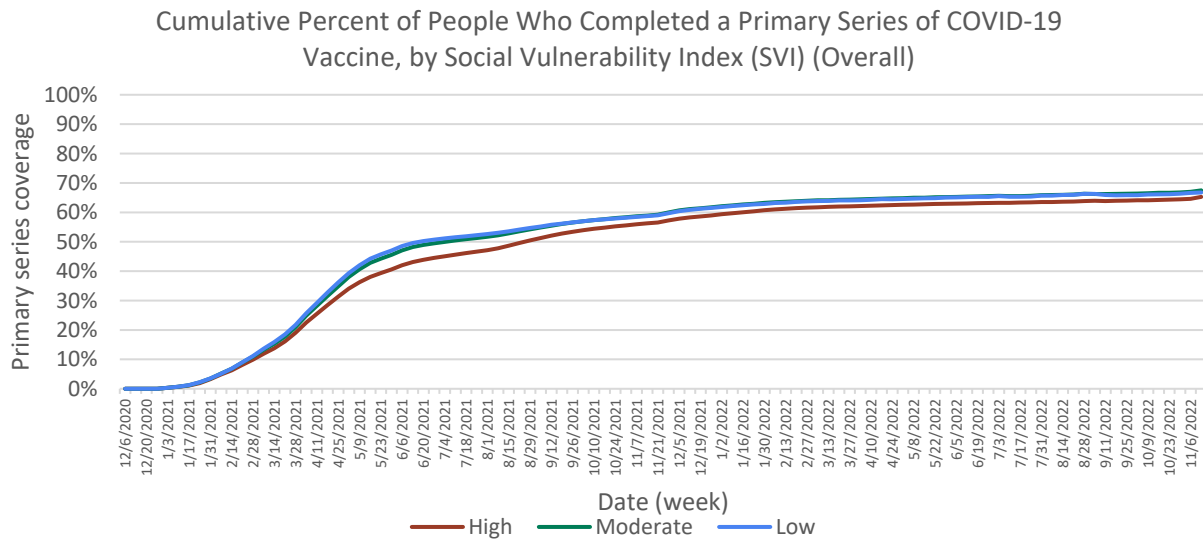
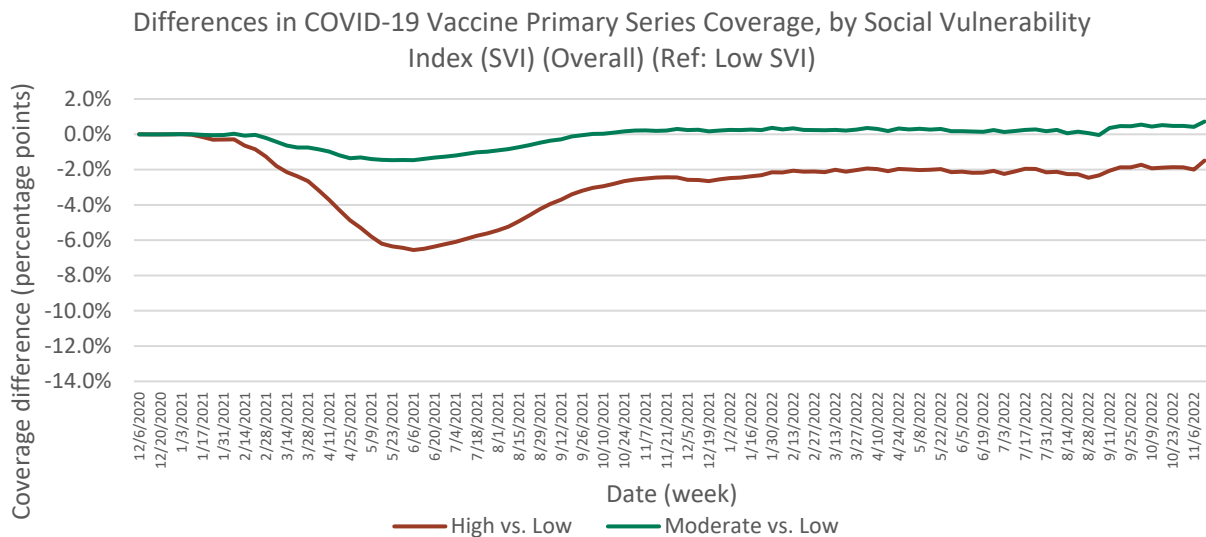


Figure 2b



During December 2020–November 2022, COVID-19 vaccine primary series completion was lower among persons living in counties with the highest overall SVI and higher among persons living in counties with the lowest overall SVI. However, differences varied over time and were generally relatively small (Fig 2a). Disparities in vaccination coverage widened between December 2020 and June 2021, as eligibility for the vaccine expanded to other demographic groups. The peak in disparity occurred the week of June 6, 2021, when persons living in counties with high overall

SVI had primary series completion that was 6.6 percentage points lower than those in counties with Low overall SVI (Fig 2b). Disparities in coverage by SVI began to narrow in mid-June 2021 and continued narrowing into 2022. By November 2022, completion of a COVID-19 vaccine primary series was slightly lower among persons living in counties with high overall SVI (65.3%), compared with persons living in counties with moderate (67.5%) or low (66.8%) overall SVI.

Socioeconomic Status Theme

Composite factors for the socioeconomic status theme include below 150% poverty level, unemployed, housing cost burden, no high school diploma, and no health insurance.

Figure 3a

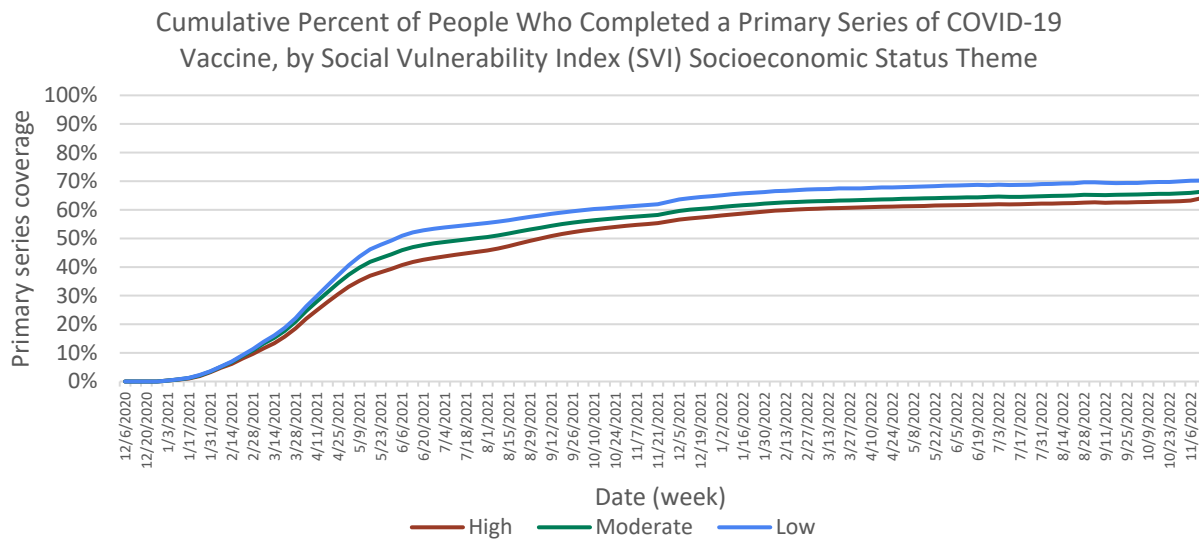
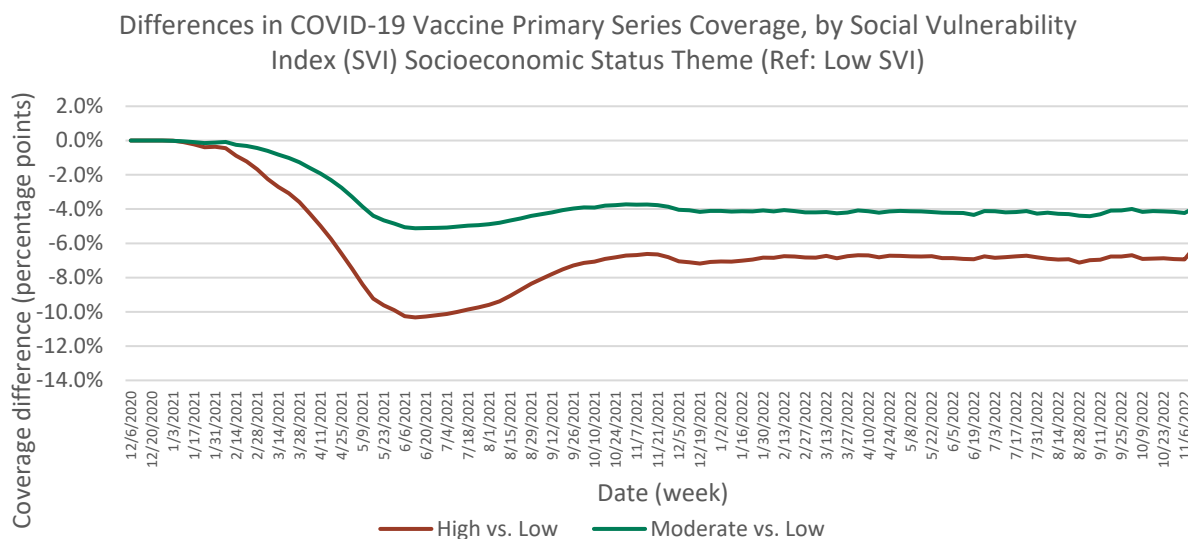


Figure 3b



During December 2020–November 2022, COVID-19 vaccine primary series completion was consistently lower among persons living in counties with the highest socioeconomic status SVI, and higher among persons living in counties with the lowest socioeconomic status SVI (Figure 3a). Disparities in vaccination coverage between high, moderate, and low socioeconomic status SVI widened between December 2020 and June 2021 (Figure 3b). Disparities peaked in mid-June 2021 when persons living in counties with high and moderate socioeconomic status SVI had primary series completion that was 10.3 and 5.1 percentage points lower, respectively, than those in counties with low socioeconomic status SVI. By November 2022, coverage disparities had narrowed, but completion of a COVID-19 vaccine primary series was still somewhat lower among persons living in counties with high (64.0%) or moderate (66.3%) socioeconomic status SVI compared with persons living in counties with low (70.2%) socioeconomic status SVI.

Household Characteristics Theme

Composite factors for the household characteristics theme include those aged 65 years and older, aged 17 years and younger, civilian with a disability, single-parent households, and English language proficiency.

Figure 4a

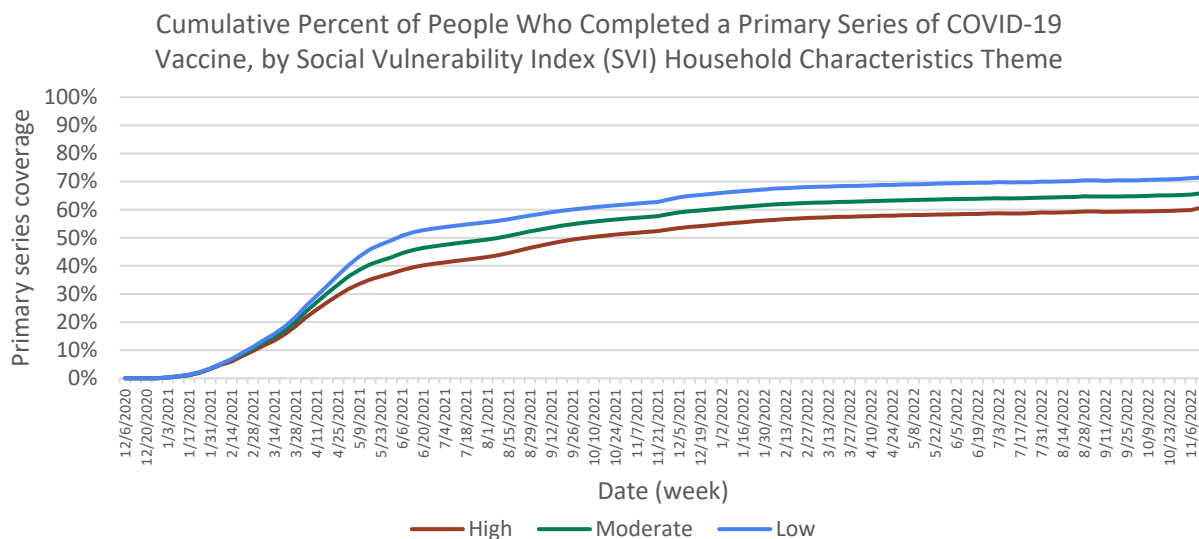
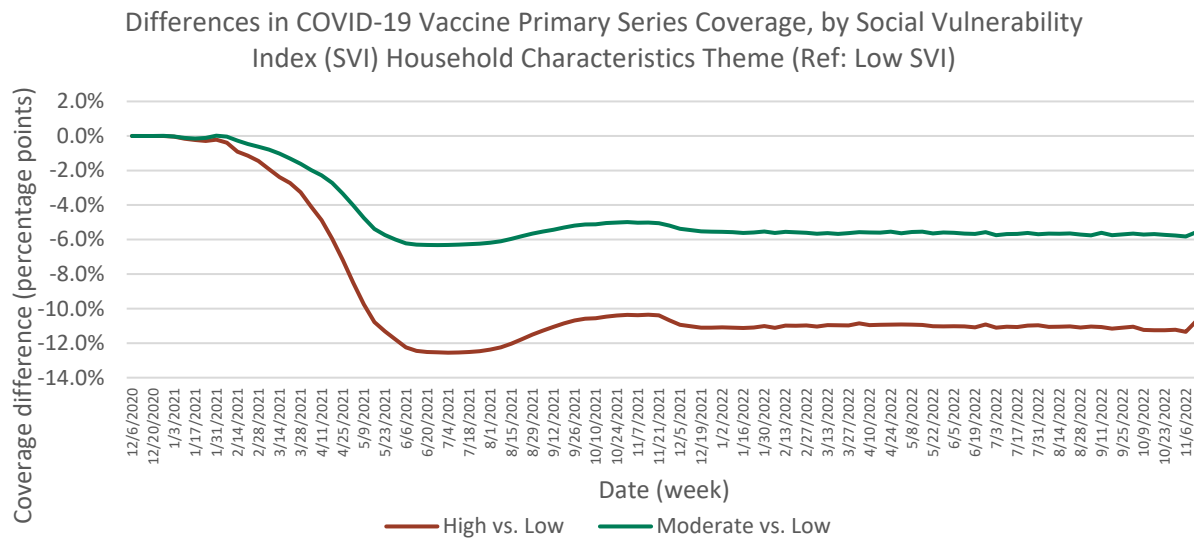


Figure 4b



During December 2020–November 2022, COVID-19 vaccine primary series completion was consistently lower among persons living in counties with the highest household characteristics SVI, and higher among persons living in counties with the lowest household characteristics SVI (Figure 4a). The magnitude of disparities grew between December 2020 and June/July 2021 (Figure 4b). At the peak, persons living in counties with high household characteristics SVI had primary series completion that was 12.6 percentage points lower than those in counties with Low household characteristics SVI (week of July 4, 2021). After Summer 2021, disparities narrowed slightly, but as of November 2022, persons in counties with high and moderate household characteristics SVI still had lower series completion (60.7% and 65.8%, respectively) than those in counties with Low household characteristics SVI (71.4%) (Figure 4a).

Racial and Ethnic Minority Status Theme

Composite factors for the racial and ethnic minority status theme include Hispanic or Latino (of any race); Black and African American, Not Hispanic or Latino; American Indian and Alaska Native, Not Hispanic or Latino; Asian, Not Hispanic or Latino; Native Hawaiian and Other Pacific Islander, Not Hispanic or Latino; Two or More Races, Not Hispanic or Latino, and Other Races, Not Hispanic or Latino.

Figure 5a

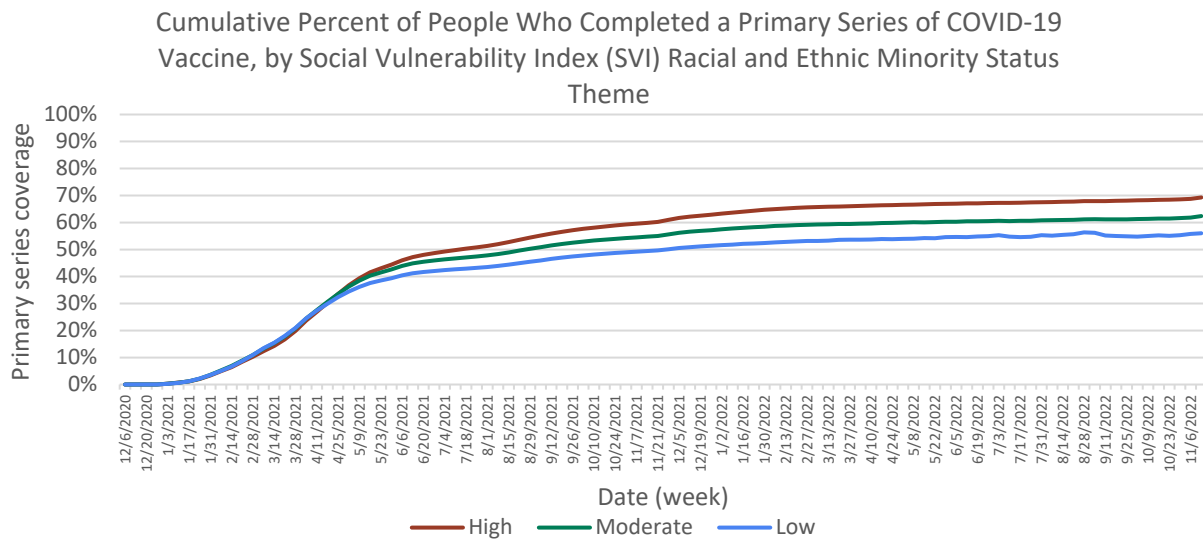
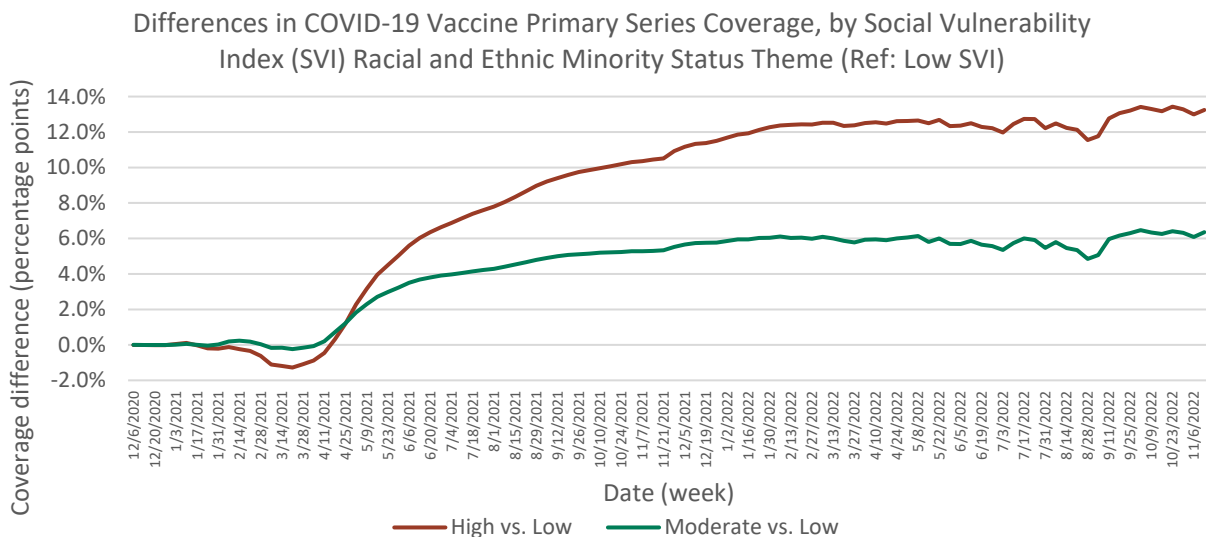


Figure 5b



In late 2020 and early 2021, when availability of the COVID-19 vaccine was limited, vaccine primary series completion was slightly higher among persons living in counties with the lowest racial and ethnic minority status SVI (Figure 5a). Starting in mid-April 2021, as eligibility for the COVID-19 vaccine expanded, vaccination coverage increased in counties with moderate and high racial and ethnic minority status SVI and surpassed lower SVI counties (Figure 5b). Unlike the patterns seen in other SVI themes, the magnitude of disparities by the racial and ethnic minority status theme widened over time. This might indicate that persons in some racial and ethnic minority groups who were not vaccinated early on were able to access vaccine as time went on, thus increasing their vaccination coverage over time.

Housing Type and Transportation Theme

Composite factors for the housing type and transportation theme include multi-unit structures, mobile homes, crowding, no vehicle, and group quarters.

Figure 6a

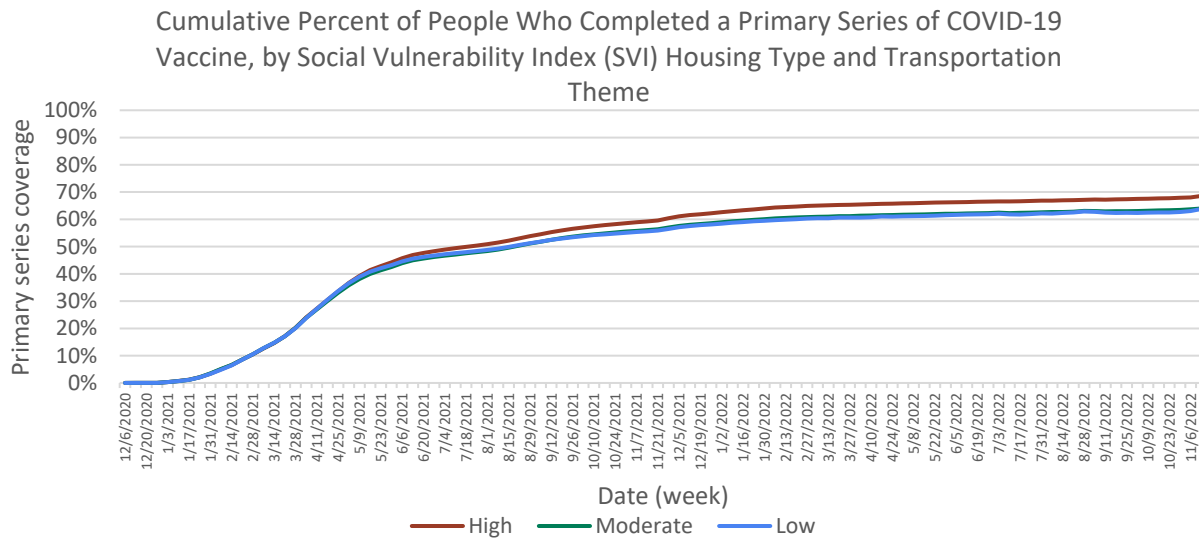
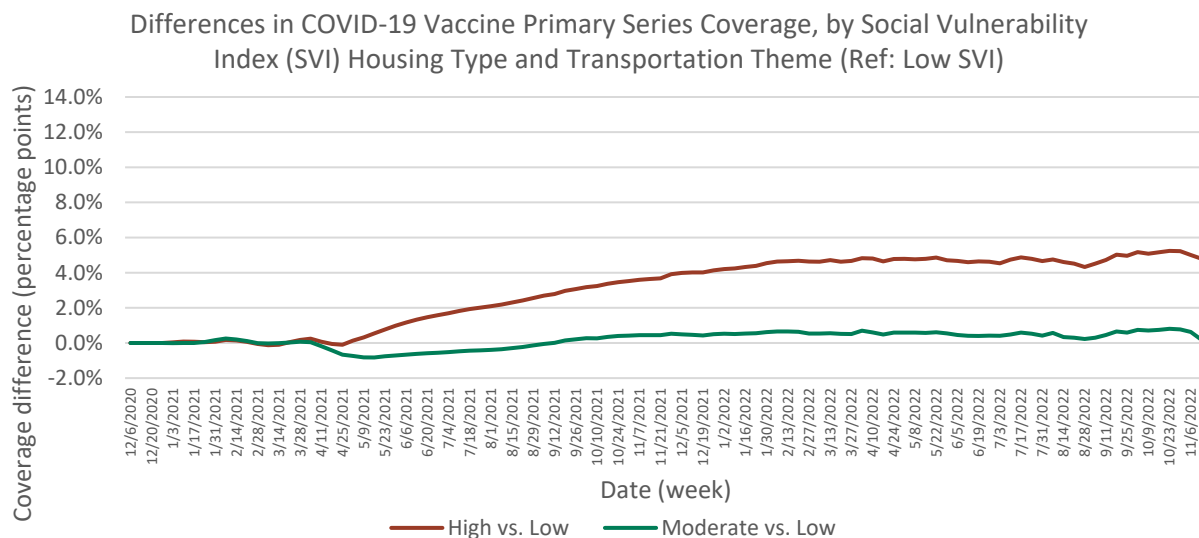


Figure 6b



During December 2020-November 2022, COVID-19 vaccine primary series completion was higher among persons living in counties with the highest housing type and transportation SVI, and lower among persons living in counties with moderate and low housing type and transportation SVI (Figure 6a). Like the pattern seen for the racial and ethnic minority status theme, the magnitude of disparities by the housing type and transportation theme widened over time (Figure 6b).

Discussion

Throughout the course of the pandemic, high social vulnerability across SVI themes were seen as potential drivers for COVID-19 vaccination coverage. First, trends in vaccination coverage among counties with high socioeconomic status and household characteristics vulnerability were similar (e.g., lower coverage among counties with the highest vulnerability), with widening disparities between December 2020 and June/July 2021. Lower vaccine primary series coverage for counties with high vulnerability due to those themes was expected, considering how individual components may interact and influence access to vaccines (e.g., poverty level/unemployment and no insurance, no high school diploma, extremes of age (aged 65 and older, aged 17 and younger) and English (language proficiency) [16]. Alternatively, primary series completion was higher in counties with high racial and ethnic minority status and housing type and transportation vulnerability. It is possible that the expansion of eligibility for the COVID-19 vaccination in April 2021 played a role in higher uptake of the vaccine in specific communities. However, state reported data depicted gaps in certain ethnically and racially minoritized groups receiving at least one dose of vaccination by the summer [6]. In addition, the magnitude of disparities between high versus moderate vulnerability levels for both themes widened after the expansion of vaccine eligibility in April 2021. Further research is warranted to explore SVI themes, social factors, and other phenomena such as vaccination campaigns in understanding trends in completion of a primary vaccination series, especially in light of the eligibility expansion of the COVID-19 vaccination.

Agenda for Future Research

Additional analyses of these data are needed to better understand current trends from the results.

There are many questions to consider:

- What is driving observed differences among persons living in high SVI versus low SVI counties?
- Why is high SVI associated with higher vaccination coverage for two themes (race and ethnicity; housing type and transportation); whereas low SVI is associated with higher vaccination coverage for the other themes (socioeconomic status and household characteristics)?
- What specific social factors within themes (e.g., race and ethnic minority groups and housing type and transportation) and geographical factors (urbanicity) contribute to higher vaccination coverage (primary series completion) over time?
- Are observed results different for the individual subcomponents of the larger SVI themes?
- Do results differ based on when vaccine was made available during the stratified COVID-19 vaccine rollout? Is it possible that the expansion of vaccination eligibility could provide opportunities for communities who could not access the vaccine during the earlier phases as time went on?
- How have efforts by the Department of Health and Human Services, including CDC, to increase vaccination access to vulnerable populations influenced the observed results?
- What is the correlation between vaccine primary series coverage and morbidity and mortality within the context of SVI?
- How can these data be used to tailor interventions pertaining to social determinants of health?
- How can SVI data be used to tailor local efforts to improve vaccine uptake?
- How do increases (e.g., increased by 10%) in the overall SVI affect vaccination rates?

- Could additional analytic methods (e.g., spatial lag regression and mixed methods) be utilized to further understand the SVI and COVID-19 outcomes (e.g., potential spatial relationships)?

Analyses must consider additional approaches to analyze vaccine equity: incorporate a rationale for methodological choices, account for diversity within social status groups (of SES, sex, race and ethnicity), and consider communication needs of stakeholders [17]. In addition, future research must consider mixed-method approaches to determine vaccination coverage, where qualitative data analysis provides context associated with those impacted by social determinants of health and informs equity-focused interventions and related efforts [18].

Limitations

We acknowledge several limitations of the analysis that could impact our findings. First, this approach was an ecological analysis where the unit of observation was at the county level. Thus, we could not make inferences regarding vaccination coverage with a primary series at the individual, state, or regional level. Second, this analysis did not examine differences in vaccination primary series coverage by geography (urban and rural) and within individual ethnic and minority communities, which may mask differences in coverage and affect results.

Third, this analysis did not include metrics around the impact of local or statewide vaccination campaigns over time. Finally, updates in SVI themes between 2018 to 2020, including the addition of “housing cost burden” to the socioeconomic status theme and “English language proficiency” was moved from the Racial and Ethnic Minority Status theme to the Household Characteristics theme. These changes between themes could impact trend interpretation. Also, other variables that address social determinants are not included in the index. For example, household characteristics theme did not incorporate occupation of household members (requirements for continued or existing employment which may have influenced the trends that were observed with vaccination coverage differences.

Conclusions

We expected that high levels of vulnerability would link to lower proportions of vaccination primary series coverage among most, if not all, SVI themes [5]. However, the trends for counties with high levels of vulnerability for racial and ethnic minority status, along with housing and transportation, had high vaccination coverage. It is possible that the expansion of vaccine eligibility in April 2021, combined with hyperlocal efforts, including those from trusted messengers within communities, allowed for increased outreach and education to those disproportionately affected (e.g., racial and ethnic minority groups, persons multi-unit dwellings, group quarters, in carceral settings, etc.) in accessing vaccinations and treatment. Additionally, individual components of the SVI may also interact with one another, or affect overall vulnerability rankings within themes, thus influencing vaccination coverage interpretation.

Public Health Implications

Persistent gaps in vaccination primary series coverage for counties with high socioeconomic and household characteristics vulnerability are concerning even after the expansion of eligibility for the COVID-19 vaccination. These findings lend themselves to further examination of vaccine confidence and actions to increase uptake. The literature acknowledges population-level structural, behavioral, and informational barriers that prevent access to vaccines and healthcare [20-23]. Achieving COVID-19 vaccine equity across populations at increased risk for exposure and adverse outcomes is an attainable goal but requires commitment to interventions and strategies that result in measurable improvements in population health and health care. For example, a recent report found that adults reporting experiences of racial and ethnic discrimination in health care settings had a significantly higher prevalence of being unvaccinated against COVID-19 overall. [24]. Multi-sectoral strategic activities have been proposed for public health partners to address social determinants [25].

Public health practitioners should further research vaccination coverage using an intersectional perspective to understand other social and contextual factors that may drive inequities [16, 24]. Policies and research that ignore inequities, including their sources and intersections, will perpetuate them and inevitably slow public health's passage out of this pandemic and into a more equitable and just future [24]. Recognizing the intersectionality of the social determinants of health in predisposing systemically marginalized populations to inequitable health outcomes is critical to changing the course of this pandemic [16]. A focus solely on biological explanations of disease is narrow and has been damaging to science and people. Labeling populations as 'vulnerable' without understanding the reasons for the increased risk in outcomes causes further stigmatization and discrimination.

As additional research contributes to our understanding of differences in acute COVID-19 disease, outcomes and post-COVID conditions, such as a preventable health disparity, researchers and health professionals must understand the potential effects of disease burden and long-term health outcomes on communities with higher levels of social vulnerability [16]. The public health field must continue to push for advancements in equity-centered practice and research by addressing interactions and limitations among social systems and the environment. The intersectionality of social determinants of health that public health practitioners must contend with vulnerability related to vaccination uptake including income, unemployment, education/literacy, health insurance, age, disability, single-parent households, and language proficiency [16].

For example, research has documented that lower education/literacy level is associated with lower vaccination rates (including lower parental education in the case of intent to vaccinate children) [16]. Populations with lower socioeconomic status and, especially no access to healthcare insurance, and out-of-pocket costs can result in differing levels of access to preventative measures including vaccines. Community-based programs and governmental partners may partner and invest in a combination of community-based vaccination interventions beyond local or state funding cycles, along with initiatives that improve access to healthcare (community navigators, etc.) [16]. Public health officials should continue providing and promoting educational materials across various literacy levels, recruiting family and community members as trusted messengers for vaccines, and translators at clinics and events during outreach [16]. Finally, existing partnerships between communities and government can employ

implementation and translation science strategies that recognize the voices and expertise of community partners and create an infrastructure that supports evidence from the “ground up”.

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