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SOCIODEMOGRAPHIC INEQUITIES IN COVID-19 VACCINATION AMONG ADULTS IN THE UNITED STATES, 2022

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- *Concept and design:* Guadamuz.
- *Acquisition, analysis, or interpretation of data:* Guadamuz.
- *Drafting of the manuscript:* Guadamuz.
- *Critical revision of the manuscript for important intellectual content:* Guadamuz.
- *Statistical analysis:* Guadamuz.

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KEY POINTS

Background

- Despite the availability of COVID-19 vaccines since December 2020, sociodemographic inequities in vaccination and preventable COVID-related deaths persist.
- While prior studies suggest that sociodemographic factors may influence COVID-19 vaccination, this research often used data that pre-dates federal guidance

recommending near-universal booster doses, measured, assessed area-level metrics, or focused on specific localities or subpopulations.

Findings

- This nationally representative study indicates that as of 2022, one-in-five US adults remain unvaccinated, and more than half have not received any recommended booster doses.
- Economically/socially marginalized populations – including Black and Latinx adults and those with structural barriers such as poverty, food insecurity, and poor healthcare access – were less likely to receive any booster doses.

ABSTRACT

Background: Despite the availability of COVID-19 vaccines since December 2020, sociodemographic inequities in vaccination and preventable COVID-related deaths persist. To inform efforts for equitable COVID-19 vaccination campaigns, a comprehensive national evaluation of existing inequities is necessary.

Objective: To examine sociodemographic inequities in COVID-19 vaccination receipt using data from the 2022 National Health Interview Survey (NHIS).

Methods: This secondary data analysis used cross-sectional, nationally-representative data from the 2022 NHIS to assess vaccination inequities among 27,126 adults. Separate Poisson regressions adjusted for clinical factors (*e.g.*, age, sex, high-risk health conditions) were used to evaluate vaccination inequities across sociographic factors (*e.g.*, race/ethnicity, poverty, health insurance).

Results: In 2022, 79.6% of adults received at ≥ 1 vaccine dose, 75.0% received ≥ 2 doses (“fully vaccinated”), 45.7% received ≥ 3 doses (≥ 1 booster), and 17.2% received ≥ 4 doses (≥ 2 boosters). Marked inequities were evident in COVID-19 vaccination across primary and booster doses, especially receipt of at least one booster dose (≥ 3 doses). Black (35.7%, prevalence ratio [PR] 0.78 [95% confidence interval {CI}:0.74-0.83]) and Latinx (35.5%, PR 0.82 [CI:0.78-0.86]) adults were less likely to receive ≥ 3 doses than Asian (66.5%, PR 1.41 [CI:1.35-1.48]) and White (48.8%) adults. Poverty (31.1% [PR 0.65 {CI: 0.61-0.69}] vs. 50.7%) and food insecurity (27.1% [PR 0.63 {CI:0.58-0.68}] vs. 47.3%) were negatively associated with receipt of ≥ 3 vaccine doses. Adults without usual source of care (24.9%, PR 0.61 [CI:0.57-0.65]) or health insurance (17.4%, PR 0.40 [CI:0.36-0.45]) had much lower rates of ≥ 3 doses than those with appropriate healthcare access (48.7% and 51.9%, respectively).

Conclusion: As of 2022, one-in-five US adults remain unvaccinated, and more than half have not received any recommended booster doses. Economically/socially marginalized populations – including Black and Latinx adults and those with structural barriers such as poverty, food insecurity, and poor healthcare access – were less likely to receive a booster. Addressing these vaccination inequities is crucial to achieve equitable COVID-19 protection and reduce preventable deaths among economically/socially marginalized populations.

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BACKGROUND

From 2020 to 2023, over one million United States adults have died from coronavirus disease 2019 (COVID-19).¹ Economically/socially marginalized populations – including minoritized racial and ethnic groups, immigrants, persons with low economic status, and those without adequate healthcare – have been disproportionately affected.^{2–5} In December 2020, the Food and Drug Administration issued the first emergency use authorization for a COVID-19 vaccine, which prevents and reduces the severity of infection.⁶ Since then the Centers for Disease Control and Prevention (CDC) has issued guidance recommending near-universal adult vaccination, including two initial monovalent doses (issued April 2021), a monovalent booster (November 2021), and a bivalent booster (November 2022).⁶ Yet, inequities – or avoidable, unnecessary, unfair, and unjust differences⁷ – in COVID-related deaths have persisted after the US adoption of COVID-19 vaccination.^{8–10}

While prior studies suggest that sociodemographic factors characterizing economic/social marginalization (*e.g.*, demographic, economic, and healthcare factors) may influence COVID-19 vaccination (and subsequent inequities in COVID-related mortality), substantial knowledge gaps remain. For example, studies examining racial and ethnic inequities in COVID-19 vaccination often used data that pre-dates federal guidance recommending booster doses for all adults, did not account for clinical factors that may influence vaccination receipt, measured intent (rather than vaccination receipt), and/or focused on specific localities or subpopulations (*e.g.*, certain occupations or health conditions).^{11–16}

Although the public health establishment acknowledged that immigrant populations, especially those without US citizenship, would endure substantial vaccination barriers,¹⁷ little is known about vaccination inequities across citizenship status once COVID-19 vaccines became available. Similarly, lesbian, gay, bisexual, transgender, and queer (LGBTQ+) communities face disproportionate healthcare barriers, discrimination, and other structural obstacles to vaccination.¹⁸ However, studies examining COVID-19 vaccination among these communities primarily focused on their intentions or early uptake during the first year of vaccine availability (during 2021).¹⁸⁻²⁰

Economic factors such as education, income, and food security are measures of structural healthcare barriers, as individuals with low economic status are less likely to have the necessary financial and logistical resources to obtain COVID-19 vaccinations. However, most studies examining economic inequities in COVID-19 vaccination relied on area- rather than individual-level economic measures and did not capture receipt of COVID-19 booster doses.^{11,21-26} Studies evaluating the association between inadequate healthcare access (*e.g.*, uninsured) and COVID-19 vaccination receipt have similar limitations.^{12,13,27-29}

Given the ongoing rollout of the fall/winter 2023-2024 updated bivalent COVID-19 vaccine (formulated to target current variants more closely, specifically Omicron variant XBB.1.5),³⁰ a national, comprehensive, and up-to-date evaluation of individual-level vaccination inequities is needed. This evaluation is crucial to inform policy interventions for achieving

equitable COVID-19 protection and minimize preventable COVID deaths, particularly among economically/socially marginalized populations.

OBJECTIVE

The objective of this secondary data analysis is to examine sociodemographic inequities in primary and booster COVID-19 vaccination receipt using data from the 2022 National Health Interview Survey (NHIS).

METHODS

Study Sample

This secondary data analysis harnessed cross-sectional data from NHIS (obtained from the Integrated Public Use Microdata Series).³¹ NHIS is an interview survey that uses multistage probability survey design to select a nationally representative sample of the US population.³² NHIS is generally conducted face-to-face, but follow-ups to complete interviews may be conducted over the telephone.³² In 2022, half of all respondents were interviewed, at least partially, by phone.³² After excluding respondents who did not report their COVID-19 vaccination status (n=461), the analytic sample consisted of 27,126 NHIS respondents. NHIS represents approximately 250 million adults in 2022.^{31,32}

COVID-19 Vaccination

This secondary data analysis examines inequities in self-reported COVID-19 vaccination receipt. Based on Centers for Disease Control and Prevention (CDC) guidance, all US adults

were eligible to receive two initial monovalent COVID-19 vaccine doses (issued April 2021) and at least one booster dose (issued November 2021) by 2022.⁶ Therefore, vaccination receipt was categorized as receipt of ≥ 1 , ≥ 2 (“fully vaccinated”), or ≥ 3 (*i.e.*, ≥ 1 booster). As the CDC recommended a second booster dose for certain high-risk individuals in March 2022 and extended its recommendations to all adults using an updated bivalent vaccine in November 2022,⁶ receipt of ≥ 4 vaccine doses (*i.e.*, ≥ 2 boosters) was examined among respondents surveyed during October-December 2022.

Covariates

Clinical factors included interview quarter (January-March, April-June, July-September, October-December), age (18-39, 40-64, or ≥ 65 years), sex (female, male), and number of high-risk health conditions (0, 1, or ≥ 2). High-risk health condition refers respondents who report conditions that the CDC has conclusively linked to a higher risk of severe COVID-19 outcomes³³ (see **Supplement 1**). Demographic factors included Census region (Northeast, West, Midwest, and South), race and ethnicity (non-Latinx [NL] White [referred to as “White”], NL Black [referred to as “Black”], Latinx, or NL-Other), citizenship status (US-born citizen, naturalized citizen, or noncitizen), and sexual orientation (straight or queer). Queer sexual orientation refers to those who identify as “lesbian or gay”, “bisexual”, or “something else.” Economic factors included educational attainment ($\geq$ high school, high school, or $<$ high school), income-to-poverty ratio (per the federal poverty-level; $\geq 200\%$, $100\%-199\%$, $<100\%$), and food security (secure or insecure). Food insecure refers to respondents with a food security score (30-day, 10-item) greater than five.^{34,35} Healthcare

factors included self-reported access to a usual source of care (yes or no) and health insurance (private, public alone, or uninsured).

Statistical Analysis

Descriptive statistics (weighted counts and proportions) were used to estimate the COVID-19 vaccination receipt, overall and across sociodemographic factors. Differences were determined using Pearson χ^2 tests.

Poisson regressions with robust standard errors were used to examine associations.³⁶ Informed by the Institute of Medicine's definition of *healthcare inequities*, or differences not justified by clinical characteristics or patient preferences, clinical factors were considered potential confounders.^{37,38} Therefore, to examine the magnitude of COVID-19 vaccination inequities (≥ 1 , ≥ 2 , ≥ 3 , and ≥ 4 doses) across sociodemographic factors, separate models adjusted for clinical factors were used (similar approach described elsewhere).^{39,40} I focused on inequities in the receipt of ≥ 3 doses (or at least one booster dose) due to the availability of at least one year's worth of data since the CDC guidelines recommending near-universal adult receipt.³³

All analyses incorporate sample weights to adjust for differential probability of selection and nonresponse. Analyses were performed with R (version 4.3.1.).

IRB approval was not required, as this study used de-identified public data (45 CFR ×46.102[f]).

RESULTS

In 2022, 79.6% of adults received ≥ 1 vaccine dose, 75.0% received ≥ 2 doses, 45.7% received ≥ 3 doses, and 17.2% received ≥ 4 doses (**Table 1**). An estimated 51 million adults were not vaccinated against COVID-19 infection, 63 million were not fully vaccinated, and 136 million have not received any recommended booster doses.

As depicted in **Figure 1**, substantial vaccination inequities across sociodemographic factors (including demographic, economic, and healthcare characteristics) were evident in both primary (first two doses) and booster COVID-19 vaccine uptake (all subsequent doses).

Focusing on the receipt ≥ 3 doses (or at least one booster dose), clinical and sociodemographic factors were associated with receipt. Younger adults (30.9%, prevalence ratio {PR} 0.44 [95% confidence interval {CI}: 0.42-0.46]), men (43.5%, PR 0.92 [CI: 0.90-0.95]), and those with multiple high-risk health conditions (45.7%, PR 0.82 [CI: 0.79-0.85]) were less likely to receive ≥ 3 vaccine doses than older adults (68.0%), women (47.9%), and those without high-risk conditions (47.8%).

Several demographic characteristics were associated with receipt of ≥ 3 vaccine doses. For example, adults living in the South (38.0%, PR 0.71 [CI: 0.68-0.74]) and Midwest (46.0%, PR

0.86 [CI: 0.82-0.89]) were less likely to receive ≥ 3 vaccine doses than their counterparts in the West (51.6%, PR 0.96 [CI: 0.92-1.00]) and Northeast (54.2%, reference). Black (35.7%, PR 0.78 [CI: 0.74-0.83]) and Latinx (35.5%, PR 0.82 [CI: 0.78-0.86]) adults were less likely to receive ≥ 3 doses than Asian (66.5%, PR 1.41 [CI: 1.35-1.48]) and White (48.8%) adults. Noncitizens (36.2%, PR 0.85 [CI: 0.79-0.91]), but not naturalized citizens (56.4%, PR 1.14 [CI: 1.10-1.19]), were less likely to receive ≥ 3 doses than US-born citizens (45.8%, reference). Queer adults (52.9%, PR 1.48 [CI: 1.39-1.58]) were more likely to receive ≥ 3 doses than their straight counterparts (45.7%, reference).

Lower economic status and healthcare barriers were adversely associated with receipt of ≥ 3 vaccine doses. For example, adults without a high school diploma (31.5%, PR 0.65 [CI: 0.62-0.68]) were less likely to receive ≥ 3 vaccine doses than those with more than a high school education (53.2%, reference). Adults who endured poverty (31.1%, PR 0.65 [CI: 0.61-0.69]) or food insecurity (27.1%, PR 0.63 [CI: 0.58-0.68]) were also less likely to receive ≥ 3 vaccine doses than their counterparts who did not experience such barriers (50.7% and 47.3%, respectively). Finally, adults without a usual source of care (24.9%, PR 0.61 [CI: 0.57-0.65]) or health insurance (17.4%, PR 0.40 [CI: 0.36-0.45]) had much lower rates of ≥ 3 doses than those with appropriate healthcare access (48.7% and 51.9%, respectively).

DISCUSSION

As of 2022, an estimated 51 million US adults had not been vaccinated against COVID-19, and 136 million had not received a recommended booster dose. Economically/socially

marginalized populations, including Black and Latinx adults and those with structural barriers such as poverty, food insecurity, and poor healthcare access, were also less likely to receive a booster doses. These findings provide valuable insights for efforts designed to reduce inequities in COVID-19 vaccination and reduce the disproportionately high burden of COVID-19 related mortality among economically/socially marginalized populations.²⁻⁵

Potentially effective strategies range from targeted educational campaigns aimed at mitigating vaccine hesitancy to concrete policies addressing logistical barriers to vaccination access.⁴¹ For instance, individuals living in poverty may face financial constraints hindering their ability to travel for vaccine administration or experience inflexible work schedules that complicate scheduling appointments. To address such challenges, expanding vaccination availability at geographically accessible and convenient settings, such as pharmacies, schools, and workplaces, could be instrumental.⁴¹ Additionally, broader health equity initiatives, such as enhancing food assistance programs, could positively influence COVID-19 prevention. Studies indicate that access to federal food assistance programs correlates with improved access to medications,⁴² and this study suggests that addressing food insecurity may also promote COVID-19 vaccine uptake.

This study also sheds light on vaccination challenges experienced by immigrants, who endured disproportionately severe health and economic consequences during the COVID-19 pandemic.^{43,44} For instance, emerging data suggests that immigrants, 55% of whom are noncitizens,⁴⁵ have a COVID-19 mortality rate twice that of US-born individuals.³ Notably,

this study is the first to investigate the relationship between citizenship status and COVID-19 vaccination uptake, finding that noncitizens are less likely to receive booster doses than US-born citizens. Immigrants – especially noncitizens – encounter distinct obstacles to vaccination, including language barriers and apprehension about engaging with the healthcare system.^{46,47} For instance, the CDC Bridge Access Program offers uninsured individuals free COVID-19 vaccinations through partnerships with major pharmacy chains.⁴⁸ However, early in the pandemic, these pharmacies demanded photo identification and/or social security numbers to administer COVID-19 tests (see **Supplement 2**). Despite not being mandated by federal regulations, many also pharmacies require this information to administer COVID-19 vaccines,⁴⁹ hindering the vaccination of many noncitizens who may not possess or be hesitant to provide such details due to their immigration status.

As nearly 90% of adult vaccinations in the US are administered in pharmacies,⁵⁰ this study – which found stark sociodemographic inequities in COVID-19 vaccination – has important implications for pharmacy practice. For example, the increasing number of closures in Black and Latinx neighborhoods,⁵¹ which aggravate the persistent problem of pharmacy deserts in these neighborhoods,⁵² may perpetuate racial and ethnic inequities in COVID-19 vaccination receipt. Pharmacies located in Black and Latinx neighborhoods are also less likely to offer immunization services.⁵³ Therefore, to encourage pharmacies to provide vaccinations – especially to patients experiencing persistent barriers to COVID-19 vaccination – federal, state, and private payers should consider appropriate reimbursement for pharmacist-administered care.⁵⁴ Pharmacists may have a role in informing patients

about their vaccination offerings and programs to offset the associated costs. For example, most private and public insurers reimburse for COVID-19 vaccinations without cost-sharing and the federal government is funding vaccinations for uninsured patients at select chain pharmacies,⁴⁸ resulting in COVID-19 vaccinations being freely available to nearly all adults in the US.

Despite near-universal and cost-free coverage of COVID-19 vaccines, this study also revealed that publicly insured and uninsured adults were less likely to receive a booster dose. Therefore, it is important to assess whether other healthcare barriers – especially pharmacy networks – influence vaccination rates. For example, more restrictive Medicaid managed care plans may not provide in-network coverage for conveniently located pharmacies providing COVID-19 vaccines.⁵⁵ This can be a substantial hurdle to vaccination, especially in neighborhoods with limited healthcare and pharmacy choices.⁵³ Additionally, chain pharmacies offering free COVID-19 vaccinations to uninsured patients may be concentrated in more affluent neighborhoods,⁵² rendering them inaccessible to those most in need.

Limitations

Our study acknowledges several limitations. First, our measure of COVID-19 vaccination relies on self-reporting. Although respondents may overestimate vaccination, the ability to assess all vaccinations, including those not captured in insurance claims, is a study strength that outweighs this limitation. Second, our measure of high-risk health conditions

encompasses many common conditions associated with worse COVID-19 outcomes but does not capture all such conditions. Third, we lacked information on where patients received their vaccinations or the type of provider administering the vaccine – information that would have been valuable for further exploring the role of pharmacy systems in vaccine administration. Finally, missing data and unmeasured confounders may influence the observed inequities. For example, we were unable to assess transportation, time, language, or other logistical barriers that have been hypothesized to influence COVID-19 vaccine uptake.

Conclusion

As of 2022, one-in-five US adults remain unvaccinated, and more than half have not received any recommended booster doses. Economically/socially marginalized populations, including Black and Latinx adults and those with structural barriers such as poverty, food insecurity, and lacking citizenship or healthcare, were less likely to receive a booster. Addressing these inequities – including within pharmacy systems – is crucial to achieve equitable COVID-19 protection and reduce preventable deaths among economically/socially marginalized populations.

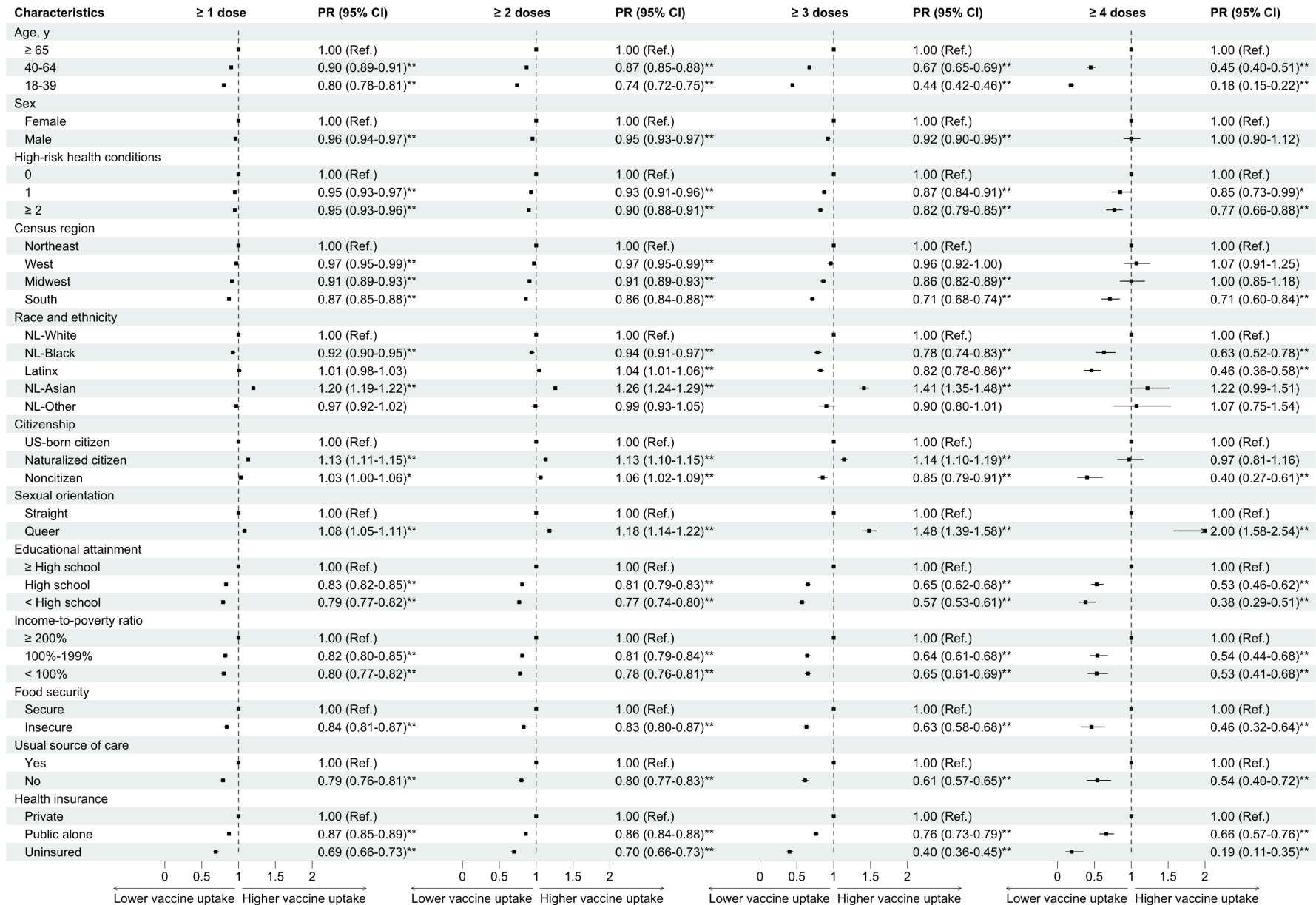
Table 1. COVID-19 Vaccination Across Clinical, Demographic, Economic, and Healthcare Factors Among Adults in the US, 2022

	Total, ^a % (95% CI)	COVID-19 Vaccine Doses, ^a % (95% CI)			
		≥ 1	≥ 2 ^b	≥ 3 ^c	≥ 4 ^d
US population, No.	250,516,459	199,350,064	187,894,445	114,572,825	N/A
Total, No.	27,126	22,237	21,103	13,832	1,457
Overall	100.0	79.6 (79.0-80.2)	75.0 (74.4-75.6)	45.7 (45.0-46.4)	17.2 (16.2-18.2)
Clinical factors ^e					
Age, y					
≥ 65	22.2 (21.7-22.7)	89.8 (89.1-90.6)	87.3 (86.4-88.1)	68.0 (66.9-69.1)	35.1 (32.9-37.4)
40-64	42.2 (41.5-42.9)	80.8 (79.9-81.6)	76.4 (75.4-77.3)	46.5 (45.5-47.6)	16.2 (14.8-17.8)
18-39	35.6 (34.8-36.3)	71.8 (70.5-72.9)	65.7 (64.4-67.0)	30.9 (29.7-32.1)	6.8 (5.7-8.2)
Sex					
Female	51.3 (50.6-52.0)	81.2 (80.4-82.0)	77.1 (76.2-77.9)	47.9 (46.9-48.8)	17.5 (16.2-18.9)
Male	48.7 (48.0-49.4)	77.8 (76.9-78.7)	72.8 (71.8-73.8)	43.5 (42.4-44.5)	16.8 (15.5-18.3)
High-risk health conditions ^f					
0	24.2 (23.6-24.8)	82.9 (81.7-84.1)	77.9 (76.6-79.2)	47.8 (46.4-49.3)	17.1 (15.1-19.3)
1	30.8 (30.1-31.4)	78.7 (77.6-79.8)	74.2 (73.1-75.4)	44.1 (42.8-45.3)	16.3 (14.7-18.1)
≥ 2	45.1 (44.4-45.8)	78.4 (77.5-79.2)	74.0 (73.0-74.9)	45.7 (44.7-46.8)	17.8 (16.4-19.3)
Demographic factors					
Census region					
Northeast	17.6 (17.1-18.2)	86.1 (84.8-87.3)	81.8 (80.3-83.2)	54.2 (52.5-56.0)	19.3 (16.9-22.0)
West	23.7 (23.1-24.3)	83.8 (82.6-84.8)	79.1 (77.8-80.3)	51.6 (50.2-53.0)	19.5 (17.5-21.7)
Midwest	20.7 (20.2-21.3)	78.5 (77.2-79.7)	74.0 (72.6-75.3)	46.0 (44.6-47.5)	19.3 (17.3-21.5)
South	38.0 (37.3-38.7)	74.5 (73.5-75.6)	69.9 (68.8-71.0)	38.0 (36.9-39.1)	13.6 (12.2-15.1)
Race and ethnicity					
NL-White	62.3 (61.6-63.0)	79.3 (78.5-80.0)	74.8 (74.0-75.6)	48.8 (47.9-49.7)	20.5 (19.2-21.8)
NL-Black	11.7 (11.2-12.2)	73.3 (71.2-75.2)	68.3 (66.2-70.4)	35.7 (33.7-37.7)	11.3 (9.2-13.8)
Latinx	17.2 (16.7-17.8)	79.7 (78.2-81.2)	74.4 (72.7-75.9)	35.5 (33.8-37.2)	7.4 (5.9-9.2)
NL-Asian	6.0 (5.7-6.4)	95.5 (94.2-96.6)	94.0 (92.6-95.2)	66.5 (63.7-69.1)	23.3 (18.9-28.5)
NL-Other	2.8 (2.5-3.0)	76.7 (72.6-80.3)	69.7 (65.3-73.7)	37.7 (33.5-42.1)	16.0 (10.9-22.9)
Citizenship ^g					
US-born citizen	81.7 (81.2-82.3)	78.3 (77.6-79.0)	73.7 (72.9-74.4)	45.8 (45.0-46.5)	18.2 (17.1-19.4)
Naturalized citizen	10.1 (9.7-10.6)	88.6 (87.0-90.0)	85.6 (83.9-87.2)	56.4 (54.1-58.6)	20.0 (16.8-23.6)
Noncitizen	8.1 (7.7-8.6)	80.7 (78.3-82.8)	76.1 (73.6-78.4)	36.2 (33.7-38.8)	6.1 (4.1-9.1)
Sexual orientation					
Straight	94.4 (94.1-94.8)	79.2 (78.5-79.8)	74.7 (74.0-75.4)	45.7 (44.9-46.4)	17.5 (16.5-18.5)
Queer ^h	5.6 (5.2-5.9)	85.3 (82.8-87.5)	80.3 (77.5-82.8)	52.9 (49.6-56.1)	19.4 (15.2-24.4)
Economic factors					
Educational attainment					
≥ High school	62.1 (61.4-62.8)	85.4 (84.8-86.0)	81.3 (80.6-82.0)	53.2 (52.4-54.1)	21.2 (19.9-22.5)
High school	27.1 (26.5-27.8)	71.1 (69.8-72.4)	65.4 (64.0-66.8)	34.4 (33.2-35.7)	11.6 (10.1-13.3)
< High school	10.8 (10.3-11.3)	67.7 (65.3-69.9)	63.3 (60.9-65.6)	31.5 (29.3-33.7)	9.1 (6.8-12.0)
Income-to-poverty ratio ⁱ					
≥ 200%	76.3 (75.7-76.9)	83.7 (83.0-84.3)	79.4 (78.7-80.0)	50.7 (49.9-51.5)	19.8 (18.6-21.0)
100%-199%	13.6 (13.1-14.1)	68.8 (66.9-70.7)	63.7 (61.7-65.7)	32.0 (30.3-33.9)	10.7 (8.6-13.2)
< 100%	10.2 (9.7-10.6)	66.6 (64.4-68.8)	60.9 (58.6-63.1)	31.1 (29.1-33.3)	9.6 (7.5-12.3)
Food security					
Secure	92.3 (91.9-92.7)	80.6 (80.0-81.2)	76.1 (75.5-76.8)	47.3 (46.6-48.0)	18.1 (17.1-19.2)
Insecure ^j	7.7 (7.3-8.1)	67.6 (65.1-70.0)	61.2 (58.6-63.7)	27.1 (24.9-29.4)	6.4 (4.6-9)
Healthcare factors					
Usual source of care					
Yes	87.7 (87.2-88.2)	81.7 (81.1-82.3)	77.4 (76.7-78.0)	48.7 (47.9-49.4)	18.6 (17.5-19.6)
No	12.3 (11.8-12.8)	64.3 (62.2-66.4)	58.0 (55.8-60.1)	24.9 (23.2-26.6)	6.9 (5.2-9.2)
Health insurance					
Private	68.8 (68.2-69.5)	84.5 (83.9-85.1)	80.4 (79.7-81.1)	51.9 (51.1-52.7)	20.4 (19.2-21.7)
Public alone	21.9 (21.3-22.4)	73.4 (72.0-74.8)	68.2 (66.8-69.6)	38.9 (37.4-40.3)	13.4 (11.7-15.3)
Uninsured	9.3 (8.9-9.8)	58.7 (56.1-61.2)	52.7 (50.1-55.3)	17.4 (15.6-19.4)	2.6 (1.4-4.7)

Abbreviations: COVID-19 = coronavirus disease 2019; CI = confidence interval; N/A = non-applicable; NL = non-Latinx; No. = number; US = United States; y = years.

Notes: **a** Estimates were weighted. All differences (as assessed with χ^2 tests) in COVID-19 vaccination were statistically significant ($p < .01$) except for differences in the receipt of ≥ 4 doses by sex ($p = .49$), high-risk health conditions ($p = .45$), and sexual orientation ($p = .40$). **b** Adults who are “fully vaccinated”. **c** Adults who received at least one vaccine booster. **d** Adults who received at least two vaccine boosters. Assessed among adults interviewed from October to December 2022 ($n = 6743$). **e** Interview quarter was also considered a clinical factor because COVID-19 vaccination may vary based on timing of clinical guidelines. Approximately 25% of respondents were interviewed in each quarter of 2022. **f** Adults who self-report having conditions that the Centers for Disease Control and Prevention has conclusively linked to a higher risk of severe COVID-19 outcomes ([see Supplement 1](#)). **g** Conceptualized using county of birth and citizenship status acquired via birth or naturalization. **h** Self-reported sexual orientation as “lesbian or gay”, “bisexual”, or “something else.” **i** Based on the federal poverty-level. **j** 30-day, 10-item food security score ≥ 5.

Figure 1. Prevalence Ratios Demonstrating Sociodemographic Inequities in COVID-19 Vaccination, 2022



Abbreviations: COVID-19 = coronavirus disease 2019; CI = confidence interval; NL = non-Latinx; PR = prevalence ratio; Ref. = reference; US = United States.

Notes: All regressions were weighted. Informed by the Institute of Medicine definition of health care inequities, or differences not justified by clinical characteristics or patient preferences, clinical factors were considered potential confounders. Therefore, to examine inequities, separate models adjusted for clinical factors were used. Adults with ≥ 2 vaccine doses are considered “fully vaccinated”. Adults with ≥ 3 doses received at least one vaccine booster. Adults with ≥ 4 doses received at least two vaccine boosters (assessed among adults interviewed from October to December 2022).

REFERENCES

1. Centers for Disease Control and Prevention. COVID Data Tracker. Published February 10, 2024. Accessed February 22, 2024. <https://covid.cdc.gov/covid-data-tracker>
2. Andrasfay T, Goldman N. Reductions in 2020 US life expectancy due to COVID-19 and the disproportionate impact on the Black and Latino populations. *Proc Natl Acad Sci*. 2021;118(5):e2014746118. doi:10.1073/pnas.2014746118
3. Horner KM, Wrigley-Field E, Leider JP. A First Look: Disparities in COVID-19 Mortality Among US-Born and Foreign-Born Minnesota Residents. *Popul Res Policy Rev*. 2022;41(2):465-478. doi:10.1007/s11113-021-09668-1
4. Pathak EB, Menard JM, Garcia RB, Salemi JL. Joint Effects of Socioeconomic Position, Race/Ethnicity, and Gender on COVID-19 Mortality among Working-Age Adults in the United States. *Int J Environ Res Public Health*. 2022;19(9):5479. doi:10.3390/ijerph19095479
5. Campbell T, Galvani AP, Friedman G, Fitzpatrick MC. Exacerbation of COVID-19 mortality by the fragmented United States healthcare system: A retrospective observational study. *Lancet Reg Health - Am*. 2022;12:100264. doi:10.1016/j.lana.2022.100264
6. US Department of Health and Human Services. COVID-19 Vaccines. HHS.gov. Published September 13, 2023. Accessed October 13, 2023. <https://www.hhs.gov/coronavirus/covid-19-vaccines/index.html>
7. Whitehead M. The concepts and principles of equity and health. *Int J Health Serv Plan Adm Eval*. 1992;22(3):429-445. doi:10.2190/986L-LHQ6-2VTE-YRRN
8. Berry KM, Stokes AC, Morris KJ, Raquib RV, Wrigley-Field E. Disparities in All-Cause Mortality Beyond the Acute Phase of the COVID-19 Pandemic in the US. *JAMA Netw Open*. 2024;7(2):e2356869. doi:10.1001/jamanetworkopen.2023.56869
9. Lundberg DJ, Wrigley-Field E, Cho A, et al. COVID-19 Mortality by Race and Ethnicity in US Metropolitan and Nonmetropolitan Areas, March 2020 to February 2022. *JAMA Netw Open*. 2023;6(5):e2311098. doi:10.1001/jamanetworkopen.2023.11098
10. Riley AR, Kiang MV, Chen YH, Bibbins-Domingo K, Glymour MM. Recent Shifts in Racial/Ethnic Disparities in COVID-19 Mortality in the Vaccination Period in California. *J Gen Intern Med*. 2022;37(7):1818-1820. doi:10.1007/s11606-021-07380-6
11. Kim D. Associations of race/ethnicity and socioeconomic factors with vaccination among US adults during the COVID-19 pandemic, January to March 2021. *Prev Med Rep*. 2023;31:102021. doi:10.1016/j.pmedr.2022.102021

12. Na L, Banks S, Wang PP. Racial and ethnic disparities in COVID-19 vaccine uptake: A mediation framework. *Vaccine*. 2023;41(14):2404-2411. doi:10.1016/j.vaccine.2023.02.079
13. Williams AM, Clayton HB, Singleton JA. Racial and Ethnic Disparities in COVID-19 Vaccination Coverage: The Contribution of Socioeconomic and Demographic Factors. *Am J Prev Med*. 2022;62(4):473-482. doi:10.1016/j.amepre.2021.10.008
14. National Center for Immunization and Respiratory Diseases. *COVID-19 Vaccination Coverage and Intent for Vaccination, Adults 18 Years and Older, United States.*; 2023. Accessed February 23, 2024. <https://www.cdc.gov/vaccines/imz-managers/coverage/covidvaxview/interactive/adult-coverage-vaccination.html>
15. Bell J. Influenza and Up-to-Date COVID-19 Vaccination Coverage Among Health Care Personnel — National Healthcare Safety Network, United States, 2022–23 Influenza Season. *MMWR Morb Mortal Wkly Rep*. 2023;72. doi:10.15585/mmwr.mm7245a5
16. Haanschoten E. Disparities in COVID-19 Vaccination Status Among Long-Term Care Facility Residents — United States, October 31, 2022–May 7, 2023. *MMWR Morb Mortal Wkly Rep*. 2023;72. doi:10.15585/mmwr.mm7240a4
17. Clark EH, Fredricks K, Woc-Colburn L, Bottazzi ME, Weatherhead J. Preparing for SARS-CoV-2 Vaccines in US Immigrant Communities: Strategies for Allocation, Distribution, and Communication. *Am J Public Health*. 2021;111(4):577-581. doi:10.2105/AJPH.2020.306047
18. Low A, Wright C, Platt J, et al. COVID-19 Vaccine Uptake and Factors Associated With Being Unvaccinated Among Lesbian, Gay, Bisexual, Transgender, Queer, and Other Sexual Identities (LGBTQ+) New Yorkers. *Open Forum Infect Dis*. 2022;9(7):ofac260. doi:10.1093/ofid/ofac260
19. McNaghten AD, Brewer NT, Hung MC, et al. COVID-19 Vaccination Coverage and Vaccine Confidence by Sexual Orientation and Gender Identity - United States, August 29-October 30, 2021. *MMWR Morb Mortal Wkly Rep*. 2022;71(5):171-176. doi:10.15585/mmwr.mm7105a3
20. Adzrago D, Ormiston CK, Sulley S, Williams F. Associations between the Self-Reported Likelihood of Receiving the COVID-19 Vaccine, Likelihood of Contracting COVID-19, Discrimination, and Anxiety/Depression by Sexual Orientation. *Vaccines*. 2023;11(3):582. doi:10.3390/vaccines11030582
21. Crane MA, Faden RR, Romley JA. Disparities In County COVID-19 Vaccination Rates Linked To Disadvantage And Hesitancy. *Health Aff (Millwood)*. 2021;40(11):1792-1796. doi:10.1377/hlthaff.2021.01092

22. Goto R, Kawachi I, Kondo N, Inoue K. Contribution of vaccinations to reducing socioeconomic disparities in COVID-19 deaths across U.S. counties. *Ann Epidemiol*. 2023;86:65-71.e3. doi:10.1016/j.annepidem.2023.07.003
23. Clouston SAP, Hanes DW, Link BG. Social inequalities and the early provision and dispersal of COVID-19 vaccinations in the United States: A population trends study. *Vaccine*. 2023;41(36):5322-5329. doi:10.1016/j.vaccine.2023.07.022
24. Agarwal R, Dugas M, Ramaprasad J, Luo J, Li G, Gao GG. Socioeconomic privilege and political ideology are associated with racial disparity in COVID-19 vaccination. *Proc Natl Acad Sci U S A*. 2021;118(33):e2107873118. doi:10.1073/pnas.2107873118
25. Masterson JM. Disparities in COVID-19 Disease Incidence by Income and Vaccination Coverage — 81 Communities, Los Angeles, California, July 2020–September 2021. *MMWR Morb Mortal Wkly Rep*. 2023;72. doi:10.15585/mmwr.mm7226a5
26. Nguyen KH. Prior COVID-19 Infection, Mental Health, Food and Financial Insecurity, and Association With COVID-19 Vaccination Coverage and Intent Among College-Aged Young Adults, US, 2021. *Prev Chronic Dis*. 2021;18. doi:10.5888/pcd18.210260
27. Ku L. The Association of Social Factors and Health Insurance Coverage with COVID-19 Vaccinations and Hesitancy, July 2021. *J Gen Intern Med*. 2022;37(2):409-414. doi:10.1007/s11606-021-07213-6
28. Cuadros DF, Gutierrez JD, Moreno CM, et al. Impact of healthcare capacity disparities on the COVID-19 vaccination coverage in the United States: A cross-sectional study. *Lancet Reg Health Am*. 2023;18:100409. doi:10.1016/j.lana.2022.100409
29. Ohlsen EC, Yankey D, Pezzi C, et al. Coronavirus Disease 2019 (COVID-19) Vaccination Coverage, Intentions, Attitudes, and Barriers by Race/Ethnicity, Language of Interview, and Nativity—National Immunization Survey Adult COVID Module, 22 April 2021–29 January 2022. *Clin Infect Dis*. 2022;75(Supplement_2):S182-S192. doi:10.1093/cid/ciac508
30. Regan JJ. Use of Updated COVID-19 Vaccines 2023–2024 Formula for Persons Aged ≥6 Months: Recommendations of the Advisory Committee on Immunization Practices — United States, September 2023. *MMWR Morb Mortal Wkly Rep*. 2023;72. doi:10.15585/mmwr.mm7242e1
31. Blewett LA, Rivera Drew JA, King ML, Williams KCW, Del Ponte N, Convey P. IPUMS Health Surveys: National Health Interview Survey, Version 7.2 [dataset]. IPUMS. Published 2022. <https://doi.org/10.18128/D070.V7.2>
32. National Center for Health Statistics. About the National Health Interview Survey. Published March 3, 2022. Accessed June 20, 2022. https://www.cdc.gov/nchs/nhis/about_nhis.htm

33. Centers for Disease Control and Prevention. Underlying Medical Conditions Associated with Higher Risk for Severe COVID-19: Information for Healthcare Professionals. Centers for Disease Control and Prevention. Published February 1, 2023. Accessed November 20, 2023. <https://www.cdc.gov/coronavirus/2019-ncov/hcp/clinical-care/underlyingconditions.html>
34. United States Department of Agriculture. U.S. Adult Food Security Survey Module. Published 2012. <https://www.ers.usda.gov/media/8279/ad2012.pdf>
35. Institute of Medicine. *Research Opportunities Concerning the Causes and Consequences of Child Food Insecurity and Hunger: Workshop Summary*. The National Academies Press; 2013. doi:10.17226/18504
36. Tamhane AR, Westfall AO, Burkholder GA, Cutter GR. Prevalence Odds Ratio versus Prevalence Ratio: Choice Comes with Consequences. *Stat Med*. 2016;35(30):5730-5735. doi:10.1002/sim.7059
37. Institute of Medicine (US) Committee on Understanding and Eliminating Racial and Ethnic Disparities in Health Care. *Unequal Treatment: Confronting Racial and Ethnic Disparities in Health Care*. (Smedley BD, Stith AY, Nelson AR, eds.). National Academies Press (US); 2003. Accessed November 2, 2023. <http://www.ncbi.nlm.nih.gov/books/NBK220358/>
38. Lê Cook B, McGuire TG, Zaslavsky AM. Measuring racial/ethnic disparities in health care: methods and practical issues. *Health Serv Res*. 2012;47(3 Pt 2):1232-1254. doi:10.1111/j.1475-6773.2012.01387.x
39. Guadamuz JS, Wang X, Royce TJ, Calip GS. Sociodemographic Inequities in Telemedicine Use Among US Patients Initiating Treatment in Community Cancer Centers During the Ongoing COVID-19 Pandemic, 2020-2022. *JCO Oncol Pract*. Published online September 25, 2023:OP.23.00144. doi:10.1200/OP.23.00144
40. Guadamuz JS, Wang X, Ryals CA, et al. Socioeconomic status and inequities in treatment initiation and survival among patients with cancer, 2011-2022. *JNCI Cancer Spectr*. 2023;7(5):pkad058. doi:10.1093/jncics/pkad058
41. Safo SA. Exploring Barriers and Facilitators to COVID-19 Vaccine Uptake Among Black and Latinx Communities. *JAMA Netw Open*. 2021;4(10):e2129675. doi:10.1001/jamanetworkopen.2021.29675
42. Srinivasan M, Pooler JA. Cost-Related Medication Nonadherence for Older Adults Participating in SNAP, 2013-2015. *Am J Public Health*. 2018;108(2):224-230. doi:10.2105/AJPH.2017.304176

43. Đoàn LN, Chong SK, Misra S, Kwon SC, Yi SS. Immigrant Communities and COVID-19: Strengthening the Public Health Response. *Am J Public Health*. 2021;111(Suppl 3):S224-S231. doi:10.2105/AJPH.2021.306433
44. Siddiq H, Teklehaimanot S, Williams J. An Observational Study Quantifying the Disproportionate Impact of COVID-19 Among Immigrant Adults, 2021 California Health Interview Survey. *Public Health Rep Wash DC* 1974. Published online November 29, 2023;333549231208485. doi:10.1177/00333549231208485
45. Budiman A, Pew Research Center. Key findings about U.S. immigrants. Pew Research Center. Published 2020. Accessed August 20, 2023. <https://www.pewresearch.org/short-reads/2020/08/20/key-findings-about-u-s-immigrants/>
46. Quadri NS, Knowlton G, Vazquez Benitez G, et al. Evaluation of Preferred Language and Timing of COVID-19 Vaccine Uptake and Disease Outcomes. *JAMA Netw Open*. 2023;6(4):e237877. doi:10.1001/jamanetworkopen.2023.7877
47. Guadamuz JS, Kapoor K, Lazo M, et al. Understanding Immigration as a Social Determinant of Health: Cardiovascular Disease in Hispanics/Latinos and South Asians in the United States. *Curr Atheroscler Rep*. 2021;23(6):25. doi:10.1007/s11883-021-00920-9
48. KFF. Insurance Coverage of Updated COVID-19 Vaccines. Published September 22, 2023. Accessed December 19, 2023. <https://www.kff.org/infographic/insurance-coverage-of-updated-covid-19-vaccines-a-cheat-sheet/>
49. Jameel CC Maryam. False Barriers: These Things Should Not Prevent You From Getting a COVID Vaccine. ProPublica. Published April 1, 2021. Accessed December 20, 2023. <https://www.propublica.org/article/false-barriers-these-things-should-not-prevent-you-from-getting-a-covid-vaccine>
50. IQVIA. Trends in Vaccine Administration in the United States. Published 2023. Accessed December 11, 2023. <https://www.iqvia.com/insights/the-iqvia-institute/reports-and-publications/reports/trends-in-vaccine-administration-in-the-united-states>
51. Guadamuz JS, Alexander GC, Zenk SN, Qato DM. Assessment of Pharmacy Closures in the United States From 2009 Through 2015. *JAMA Intern Med*. 2020;180(1):157-160. doi:10.1001/jamainternmed.2019.4588
52. Guadamuz JS, Wilder JR, Mouslim MC, Zenk SN, Alexander GC, Qato DM. Fewer Pharmacies in Black and Hispanic/Latino Neighborhoods Compared with White or Diverse Neighborhoods, 2007–15. *Health Aff (Millwood)*. 2021;40(5):802-811. doi:10.1377/hlthaff.2020.01699

53. Guadamuz JS, Alexander GC, Zenk SN, Kanter GP, Wilder JR, Qato DM. Access to Pharmacies and Pharmacy Services in New York City, Los Angeles, Chicago, and Houston, 2015-2020. *J Am Pharm Assoc.* 2021;61(6):e32-e41. doi:10.1016/j.japh.2021.07.009
54. DeMaagd G, Pugh A. Pharmacists' Expanding Role in Immunization Practices. *US Pharm.* 2023;48(10):34-38.
55. Bendicksen L, Kesselheim AS. Anticipated efficiencies, real costs: Medicaid managed care organizations and the pharmacy benefit. *J Manag Care Spec Pharm.* 2022;28(3):354-361. doi:10.18553/jmcp.2022.28.3.354

TABLES

Table 1. COVID-19 Vaccination Across Clinical, Demographic, Economic, and Health Care Factors Among Adults in the US, 2022

FIGURES

Figure 1. Prevalence Ratios Demonstrating Sociodemographic Inequities in COVID-19 Vaccination, 2022

ONLINE APPENDIX MATERIAL

Supplement 1. Conditions Linked to Higher Risk of Severe COVID-19 Outcomes

Supplement 2. Examples of Photo Identification and Social Security Number Requirements for COVID-19 Testing and Vaccination at Large Retail Chains Early in the COVID-19 Pandemic

ONLINE SUPPLEMENTAL MATERIALS

Supplement 1. Conditions Linked to Higher Risk of Severe COVID-19 Outcomes

In this study, high-risk health conditions associated with higher risk of severe COVID-19 outcomes included self-reported:

- Cancer
- Asthma
- Chronic obstructive lung disease
- Diabetes (type 1, type 2, and gestational)
- Coronary heart disease (including myocardial infarction)
- Dementia
- Obesity (body mass index ≥ 30)
- Smoking (current or previous)
- Pregnancy (currently or live birth within the last 12 months)
- Physical inactivity (did not meet 2018 guidelines for aerobic activity)
- Primary immunodeficiencies
- Use of corticosteroids or other immunosuppressive medications
- Disabilities
 - Cognitive impairment
 - Visual impairment/ blindness
 - Deafness/hearing loss
 - Limitations of self-care or activities of daily living
 - Multiple disability
 - Epilepsy
 - Traumatic brain injury
 - Wheelchair use

Certain high-risk health conditions identified by CDC guidance could not be determined using NHIS data (e.g., HIV/AIDS). Therefore, this variable may underestimate the number of individuals at high risk for severe COVID-19 outcomes. For a complete list of high-risk health conditions, please reference CDC guidance.¹

Abbreviations: CDC = Centers for Disease Control and Prevention; COVID-19 = coronavirus disease 2019; HIV/AIDS = human immunodeficiency virus/acquired immunodeficiency syndrome; NHIS = National Health Interview Survey.

Supplement 2. Examples of Photo Identification and Social Security Number Requirements for COVID-19 Testing and Vaccination at Large Retail Chains Early in the COVID-19 Pandemic ²



COVID-19 testing



I do not have medical insurance, Medicare, Medicaid or any commercial or government-funded health benefit plan. I acknowledge that I must answer this question truthfully in order to have the cost of my test covered by the U.S. Department of Health and Human Services (HHS) Uninsured Program. If I have active insurance and fail to provide that information, I may be charged the price of the test.

Please provide a valid Social Security number OR a driver's license/state ID number, which is used for the HHS Uninsured Program administration.

**Schedule your
COVID-19
vaccination today.**

For your appointment, please arrive 15 minutes early and bring the following:

- Your appointment confirmation email
- Your COVID-19 Vaccination Authorization Code (if applicable)
- Your state ID, valid driver's license or other government-issued ID
- Your medical, pharmacy benefit or medicare insurance card
- Download, print and complete the [vaccination consent form](#). If you don't bring t

Supplemental References

1. Centers for Disease Control and Prevention. Underlying Medical Conditions Associated with Higher Risk for Severe COVID-19: Information for Healthcare Professionals. Centers for Disease Control and Prevention. Published February 1, 2023. Accessed November 20, 2023.
<https://www.cdc.gov/coronavirus/2019-ncov/hcp/clinical-care/underlyingconditions.html>
2. Author snapshots of COVID-19 testing and vaccination scheduling requirements for CVS (www.cvs.com) and Walgreens (www.walgreens.com) (obtained December 2021).