HUMAN VACCINES & IMMUNOTHERAPEUTICS
2025, VOL. 21, NO. 1, 2467548
https://doi.org/10.1080/21645515.2025.2467548

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RESEARCH ARTICLE

Attitudes and beliefs regarding COVID-19 and COVID-19 Omicron booster vaccine among adults in the vaccine safety datalink, 2022–2023

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ABSTRACT

COVID-19 vaccination rates are decreasing despite vaccination being the most effective tool against severe disease from COVID-19. From October 1, 2022, to February 1, 2023, we conducted a cross-sectional study among adults in the Vaccine Safety Datalink about attitudes and beliefs regarding bivalent COVID-19 Omicron booster vaccine (hereafter referred to as COVID-19 bivalent vaccine) stratifying by vaccination status and race and ethnicity. Analysis was weighted for response and selection bias. The response rate was 27% (385/1430); 33% [95% CI: 21%–44%] of respondents were 'fully vaccinated' (had received COVID-19 bivalent vaccine), 54% [42%–67%] were partially vaccinated, and 13% [7%–19%] were unvaccinated. Fully vaccinated adults were more likely to consider COVID-19 bivalent vaccine 'very effective' (64%, [43%–86%]) at preventing hospitalization due to COVID-19 than partially (31%, [12%–50%]) or unvaccinated (2%, [0%–6%]) adults. Fully vaccinated adults were more likely to report COVID-19 bivalent vaccine was 'very safe' (83%, [69%–98%]) than partially (43%, [23%–63%]) or unvaccinated adults (2%, 0%–6%). Non-Hispanic White adults were more likely to report COVID-19 bivalent vaccine was 'very safe' (71%, [54%–87%]) than Non-Hispanic Black (36%, [21%–50%]) and Hispanic (26%, [7%–45%]) adults. A dose–response effect between vaccination status and perceptions of COVID-19 bivalent vaccine safety and effectiveness was observed, with fully vaccinated respondents having the most favorable attitudes. Racial and ethnic differences in perceived vaccine safety were also found. Improved communication about vaccine effectiveness and safety is key to improving low vaccination rates.

ARTICLE HISTORY
Received 5 November 2024
Revised 5 February 2025
Accepted 12 February 2025

KEYWORDS
Adult; COVID-19 vaccines; COVID-19/prevention and control; health knowledge, attitudes, practice; cross-sectional study; black or African American; Hispanic or Latino; white

Introduction

As of April 26, 2023, shortly before the end of the pandemic was declared and hospitals were no longer required to report about COVID-19 hospital admission, the number of confirmed and presumptive positive cases of COVID-19 disease reported in the U.S. was over 104 million with 1.1 million deaths reported among those cases.[1] Nearly all current COVID-19-related hospitalizations and deaths occur in people who are not fully vaccinated and have not received early treatment.[2] Vaccination has been shown to be the most effective tool against the spread of COVID-19, and all adults in the U.S. have been eligible for COVID-19 vaccination since April 2021.

The COVID-19 Omicron booster vaccine (hereafter referred to as COVID-19 bivalent vaccine) was recommended by the U.S. Centers for Disease Control and Prevention (CDC) in September 2022.[3] In September 2023, updated 2023–2024 COVID-19 vaccines were recommended by the CDC for use in the U.S.[4] As of January 2024, only 21.5% of U.S. adults had received an updated 2023–2024 COVID-19 vaccine, and thus, most of the U.S. population was not fully vaccinated.[5] Racial and ethnic differences in vaccination have been noted, with Non-Hispanic White adults having the highest coverage at 25.5%, followed by Non-Hispanic Black adults at 17.7%, and Hispanic adults at 13%.[6]

Understanding individuals' attitudes toward COVID-19 vaccination is critical to implementation efforts, and currently, the available literature has several limitations. Many studies have focused on attitudes prior to the vaccine rollout[7,8] or early in the pandemic,[9,10] providing information that is currently less relevant. Also, a lack of rigorous sampling methodology – using convenience samples,[8,11,12] Twitter polls,[13] Google trends,[14] and Amazon's Mechanical Turk Platform[15] - call into question the interpretability of the results.

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Supplemental data for this article can be accessed online at https://doi.org/10.1080/21645515.2025.2467548

To inform vaccination promotion strategies for the current and future iterations of COVID-19 vaccinations,[4] we assessed attitudes and beliefs regarding the COVID-19 bivalent vaccine among adults in the Vaccine Safety Datalink based on self-reported vaccination status and race and ethnicity.

Methods

Study setting

From October 1, 2022, to February 1, 2023, we surveyed individuals in the Vaccine Safety Datalink (VSD). VSD is a joint effort between CDC and a network of 13 integrated healthcare systems that conduct post-licensure monitoring of vaccine safety and coverage.[16] VSD patients' sociodemographic characteristics are consistent with those of the larger U.S. population, and they represent approximately 3% of the total U.S. population.[17] For this study, one site – Harvard Pilgrim – contributed scientific expertise; eight sites provided data: Denver Health, Kaiser Permanente Colorado, Marshfield Clinic, HealthPartners, Kaiser Permanente Washington, Kaiser Permanente Northwest, Kaiser Permanente Northern California, and Kaiser Permanente Southern California.

Study population

To be eligible to receive the survey, individuals had to be aged 18–89 y and have continuous health insurance enrollment during the survey period, except at Denver Health, where individuals had to have one primary care visit in the prior 18 months.[18] Using each of the eight data contributing sites health system's electronic health record, we identified English-speaking individuals and placed them in strata by race and ethnicity (Black vs. non-Black) and COVID-19 vaccination status (unvaccinated or ≥ 1 vaccine). We oversampled English-speaking Black, unvaccinated and non-Black, unvaccinated individuals in a 1.4–2.3:1 ratio. From the two VSD sites (Denver Health and Kaiser Permanente Southern California) with large Spanish-speaking populations, we identified Spanish-speaking individuals and placed them in strata by vaccination status. We oversampled Spanish-speaking unvaccinated individuals in a 2.1:1 ratio. We oversampled Black individuals and Spanish-speaking individuals to increase our ability to study attitudinal differences among racial and ethnic minority groups. We oversampled unvaccinated people, as prior vaccination surveys of pregnant women in the VSD have shown significantly lower response rates among unvaccinated people.[19] Individuals with possible data errors (e.g., simultaneous administration of multiple COVID-19 vaccines) and those on research 'do not contact' lists were excluded. Ultimately, this sampling strategy led to six mutually exclusive sampling strata whose sum was 1430 individuals. Study size calculations are described in a related project manuscript.[20]

Survey design

The survey is provided as an online appendix and was based on the Health Belief Model (HBM), which states that people's beliefs influence their health-related actions.[21] The HBM was chosen as it is a foundational framework in health behavior research.[22] We focused on the original four constructs of the HBM (perceived susceptibility, perceived severity, perceived benefits, perceived barriers) to keep the survey length reasonable and because perceived barriers and benefits have been shown to be the most common HBM constructs associated with COVID-19 vaccine hesitancy.[23] The survey tool was developed jointly with VSD sites and the CDC. It asked about COVID-19 vaccination status and attitudes about COVID-19 and the COVID-19 bivalent vaccine. In relation to the HBM, vaccine effectiveness was considered a perceived benefit and vaccine safety concerns a perceived attitudinal barrier. An additional question was asked about the perceived most trusted source of information for the COVID-19 bivalent vaccine. The survey was piloted at Denver Health in 10 English-speaking and 10 Spanish-speaking adults to ensure the questions were clear, understandable, and appropriate for the target audience. Each received a $25 gift card for their time, and feedback from the pilot testing was incorporated into the final survey instrument prior to the survey launch.

Survey administration

The survey was initially sent by mail approximately 1 month after the COVID-19 bivalent vaccine was officially recommended.[1] Up to 10 survey invitations were sent to survey non-respondents using a mixed-mode approach patterned on Dillman's Tailored Design Method.[24] Specifically, they received up to four mailed surveys with a postage-paid return envelope, five e-mails with a unique hyperlink to the online survey, and one telephone reminder call. Outreach halted after a participant's survey completion via mail, online or by telephone or if a person opted out. Survey administration was consistent across VSD sites, except one site required participants to receive a pre-survey letter with an opportunity to opt-out and prohibited contact by e-mail or phone. Research Electronic Capture (REDCap) software hosted the surveys online.[25] Respondents were compensated with a $25 gift card.

Statistical analysis

"Respondents" were defined as people who completed the first survey question: "Have you ever received a COVID-19 vaccine?" The Pearson chi-squared test was used to compare survey respondents to non-respondents on sociodemographic variables available via the EHR: age, race, ethnicity, language, sex, and vaccination status, considering $p < .05$ as significant. Because of when data was pulled from each site (1 month after the COVID-19 bivalent vaccine was recommended or 9/30/22–10/3/22), we had incomplete information about COVID-19 bivalent vaccine doses from the EHR. Therefore, for the purposes of comparing non-respondents to respondents, we used whether a person was unvaccinated or had received ≥ 1 COVID-19 vaccinations documented in the EHR; subsequent analyses used self-reported vaccination status, which included possible receipt of a COVID-19 bivalent booster. We calculated response rates by applying the American Association for Public Opinion Research's Response Rate Definition 6.[26] Among respondents, we

calculated sample and response probability weighted descriptive statistics for self-reported receipt of COVID-19 vaccination and sociodemographic variables. For attitudinal measures, we compared respondents by their self-reported vaccination status and by three mutually exclusive ethnicity, race, and language groups (Non-Hispanic White, Non-Hispanic Black, and Hispanic of any race).

Respondents were defined as fully vaccinated if they indicated they had received a COVID-19 bivalent vaccination, while partial vaccination was defined as having received at least one COVID-19 vaccination (i.e., ≥1 dose) and not boosted with the COVID-19 bivalent vaccination.

Missingness, meaning no response to a question, was given in the dataset was low (<5%), and unknown or missing categories were included in analyses. Since 'not sure' (don't know) responses are often conceptually meaningful,[27] we incorporated them into the analyses and did not treat them as a source of missing data. We also did not consider 'rather not say' responses as missing data. Attitudinal beliefs by vaccination status and race and ethnicity were compared for weighted tables using weighted logistic regression with the most extreme response (i.e., very likely, very effective, etc.) as the outcome.

Multivariable analysis incorporated the effects of age and either race/ethnicity or vaccination status. A finite population correction was used to reduce the variance of survey estimates due to sampling without replacement from a finite population and incorporated inverse probability weighting to account for sampling and response probability by VSD site, vaccination status, race (Black or non-Black), and language. Analyses were conducted using SAS version 9.4 and R version 4.3.3.[28] The Colorado Multiple Institutional Review Board (COMIRB) approved this study, and other participating site institutional review boards ceded oversight to COMIRB. We obtained a waiver of written consent, and participants could opt out by e-mail, in writing, or by telephone.

Results

The overall response rate was 27% (385/1430). Respondents and non-respondents did not statistically differ by ethnicity or by the proportion who preferred the English or Spanish language (Table 1). Females, older persons, vaccinated persons, and individuals whose EHR race was White were more likely to respond (Table 1). Racial differences were associated with a large amount of unknown race among the non-respondents. Table 2 shows weighted demographic characteristics for the 385 respondents; 7% [95% CI: 6%–8%], 40% [95% CI: 27%–53%], and 23% [95% CI: 12%–34%] of respondents were Non-Hispanic Black, Non-Hispanic White, and Hispanic ethnicity of any race (Hispanic), respectively. Thirty-three percent [95% CI: 21%–44%] of the respondents were considered 'fully vaccinated' because at the time of the survey they reported having received a COVID-19 bivalent vaccination; 54% [95% CI: 42%–67%] were partially vaccinated (i.e., vaccinated against COVID-19 but not yet boosted with a bivalent vaccine), and 13% [95%

Table 1. Unweighted demographic characteristics for respondents vs. non-respondents from the vaccine safety datalink,*November 2022 – February† 2023.

Characteristics and Levels		Non-Respondents, N = 1,045%)	Respondents, N = 385%)	p-value
Sex (EHR)				0.034
	Female	567 (54%)	233 (61%)	
	Male	478 (46%)	152 (39%)	
Age Group†† (EHR)				<.001
	18–29 y	237 (23%)	55 (14%)	
	30–49 y	424 (41%)	130 (34%)	
	50–64 y	251 (24%)	106 (28%)	
	65 y or older	133 (13%)	94 (24%)	
Race (EHR)				<.001
	Black	382 (37%)	124 (32%)	
	White	350 (33%)	150 (39%)	
	American Indian or Alaskan Native	1 (0.1%)	5 (1%)	
	Asian	20 (2%)	8 (2%)	
	Native Hawaiian or Pacific Islander	1 (0.1%)	1 (0.3%)	
	Multiracial	50 (5%)	30 (8%)	
	Other	6 (6%)	32 (8%)	
	Missing/Unknown	235 (22%)	35 (9%)	
Ethnicity (EHR)				0.728
	Hispanic	402 (38%)	152 (39%)	
	Non-Hispanic	643 (62%)	233 (61%)	
Language (EHR)				0.678
	English	707 (68%)	256 (66%)	
	Spanish	338 (32%)	129 (34%)	
COVID-19 Vaccination Status (EHR)				<.001
	Vaccinated	314 (30%)	197 (51%)	
	Unvaccinated	731 (70%)	188 (49%)	

Abbreviations: EHR, electronic health records.
*Vaccine Safety Datalink sites contributing data were geographically located in California, Colorado, Minnesota, Oregon, Washington, and Wisconsin.
†People with EHR-preferred language, ethnicity, and race data of (1) English preferred, Non-Hispanic ethnicity, Black race, and (2) Spanish preferred, Hispanic ethnicity, any race were oversampled. Frequencies in this table with values for both respondents and non-respondents are not weighted to account for sampling design.
††As of October 2022.

Table 2. Weighted proportions of demographic characteristics for adult respondents from the vaccine safety datalink,*November 2022 – February 2023.

Characteristics and Levels		Overall Cohort, N = 385%, 95% CI)
COVID-19 Vaccination Status[†]		
	Unvaccinated	13 (7, 19)
	Partially vaccinated	54 (42, 67)
	Fully vaccinated	33 (21, 44)
Education		
	High School or less (includes GED)	21 (10, 33)
	Associate's degree	25 (14, 37)
	Bachelor's degree	30 (18, 43)
	Master's or Doctorate degree	18 (5, 32)
	Rather not say	5 (0, 12)
Income Level		
	$50,000 or less	22 (9, 36)
	$50,001–$75,000	21 (10, 33)
	$75,001–$100,000	10 (3, 18)
	$100,001 or more	26 (16, 37)
	Not sure	2 (1, 3)
	Rather not say	18 (7, 28)
Race and Ethnicity		
	Non-Hispanic, Black	7 (6, 8)
	Non-Hispanic, White	40 (27, 53)
	Hispanic, Any Race	23 (12, 34)
	Non-Hispanic, Other[††]	30 (17, 43)
Language		
	English	97 (96, 98)
	Spanish	3 (2, 5)
Sex		
	Female	58 (45, 71)
	Male	42 (29, 55)
Age Group[§]		
	18–29 y	15 (5, 26)
	30–49 y	23 (13, 32)
	50–64 y	30 (18, 42)
	65 y or older	32 (19, 45)

*Vaccine Safety Datalink sites contributing data were geographically located in California, Colorado, Minnesota, Oregon, Washington, and Wisconsin.
[†]Respondents were defined as fully vaccinated if they indicated they had received a COVID bivalent vaccination, while partial vaccination was defined as having received at least one COVID-19 vaccination (i.e., ≥1 dose) and not the COVID bivalent vaccination.
[††]The Non-Hispanic, Other group consists of Asian, Pacific Islander, Multiracial, and other.
[§]Age is based on the time of sampling, as of October 2022.

CI: 7%–19%] reported never being vaccinated against COVID-19.

Attitudes regarding COVID-19 and the COVID-19 bivalent vaccine by vaccination status

Figure 1 shows a diverging plot of weighted percentages for responses to questions regarding attitudes toward COVID-19 and the COVID-19 bivalent vaccine, stratified by vaccination status. In terms of perceived effectiveness at preventing hospitalization, fully vaccinated adults were more likely to report that the COVID-19 bivalent vaccine was 'very effective' [64%, 95% CI: 43%–86%] than those who were partially vaccinated [31%, 95% CI: 12%–50%] or unvaccinated [2%, 95% CI: 0%–6%] ($p < .030$ for all pairwise comparisons). Similarly, fully vaccinated adults were more likely to report that the COVID-19 bivalent was very effective at preventing death [82%, 95% CI: 67% –97%], than partially [32%, 95% CI: 13%–50%] or unvaccinated [0.3%, 95% CI: 0%–1%] ($p \leq .001$ for all pairwise comparisons). Over half of the unvaccinated group were 'unsure' about the COVID-19 bivalent vaccine preventing hospitalization or death. Regarding safety as a potential barrier to vaccination, fully vaccinated adults were more likely to report the COVID-19 bivalent vaccine was 'very safe' [83%, 95% CI: 69%–98%] than those who were partially vaccinated [43%, 95% CI: 23%–63%] or unvaccinated [2%, 95% CI: 0%–6%] ($p \leq .004$ for all pairwise comparisons). Concerning perceived susceptibility to COVID-19, the fully vaccinated and partially vaccinated groups were equally worried about getting sick with COVID-19 today (6% [95% CI: 1%–10%] vs. 14% [95% CI: 0%–28%] 'very worried,' $p = .134$); however, these groups were more worried about getting COVID-19 than the unvaccinated group (0.3% [95% CI: 0%–1%] 'very worried,' $p \leq .001$ comparing fully vaccinated and partially vaccinated to unvaccinated). In relation to perceived severity, fully vaccinated and partially vaccinated had similar responses regarding likelihood of COVID-19 harming them (4% [95% CI: 0%–8%] vs. 13% [95% CI: 0% –27%] 'Very likely,' $p = .115$), but were more concerned about COVID-19 harming them than the unvaccinated (0.6% [95% CI: 0%–1%] 'very likely,' $p \leq .001$ comparing fully or partially vaccinated to unvaccinated).

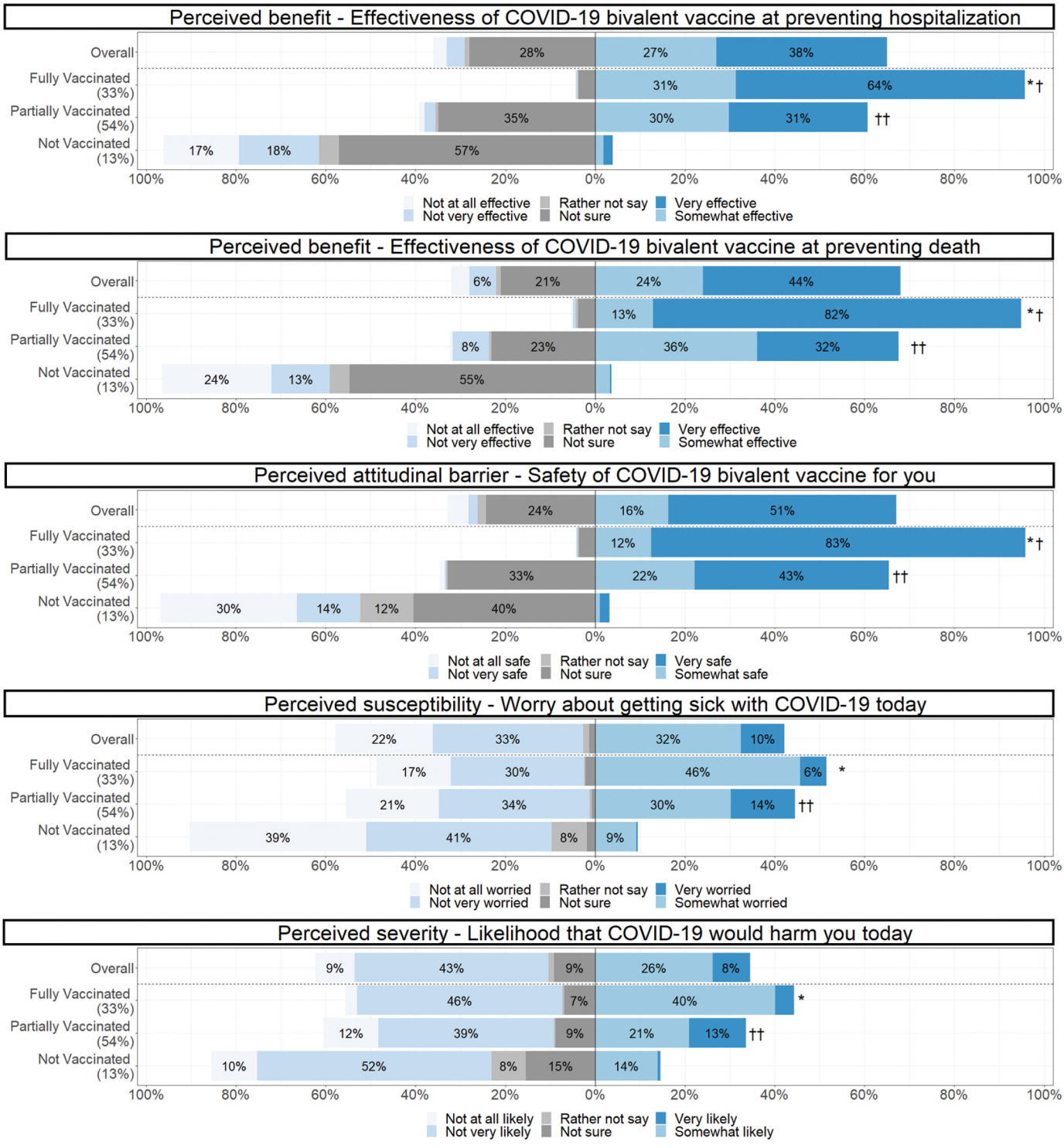

Figure 1. Patient attitudes regarding COVID-19 and the COVID-19 bivalent vaccine overall, by self-reported vaccination status. *Indicates a p-value < .010 for the "very" response category for fully vaccinated vs. not vaccinated. †P-value < .010 for the "very" response category for fully vaccinated vs. partially vaccinated. ††P-value < .010 for the "very" response category for partially vaccinated vs. not vaccinated

Attitudes regarding COVID-19 and the COVID-19 bivalent vaccine by race and ethnicity

Figure 2 shows a diverging plot of weighted percentages for responses to questions regarding attitudes toward COVID-19 and COVID-19 bivalent vaccine stratified by three racial and ethnic groups of interest. There were no statistically significant different responses in perceptions of whether the COVID-19 bivalent vaccine was 'very' effective at preventing hospitalization among Non-Hispanic Black (42% [95% CI: 27%–57%]), Non-Hispanic White (45% [95% CI: 23%–67%]), or Hispanic (41% [95% CI: 13%–69%]) adults, p = not significant (NS); or death among Non-Hispanic Black (35% [95% CI: 20%–50%]), Non-Hispanic White (55% [95% CI: 34%–76%]), or Hispanic (43% [95% CI: 15%–71%]) adults, p = NS. Non-Hispanic

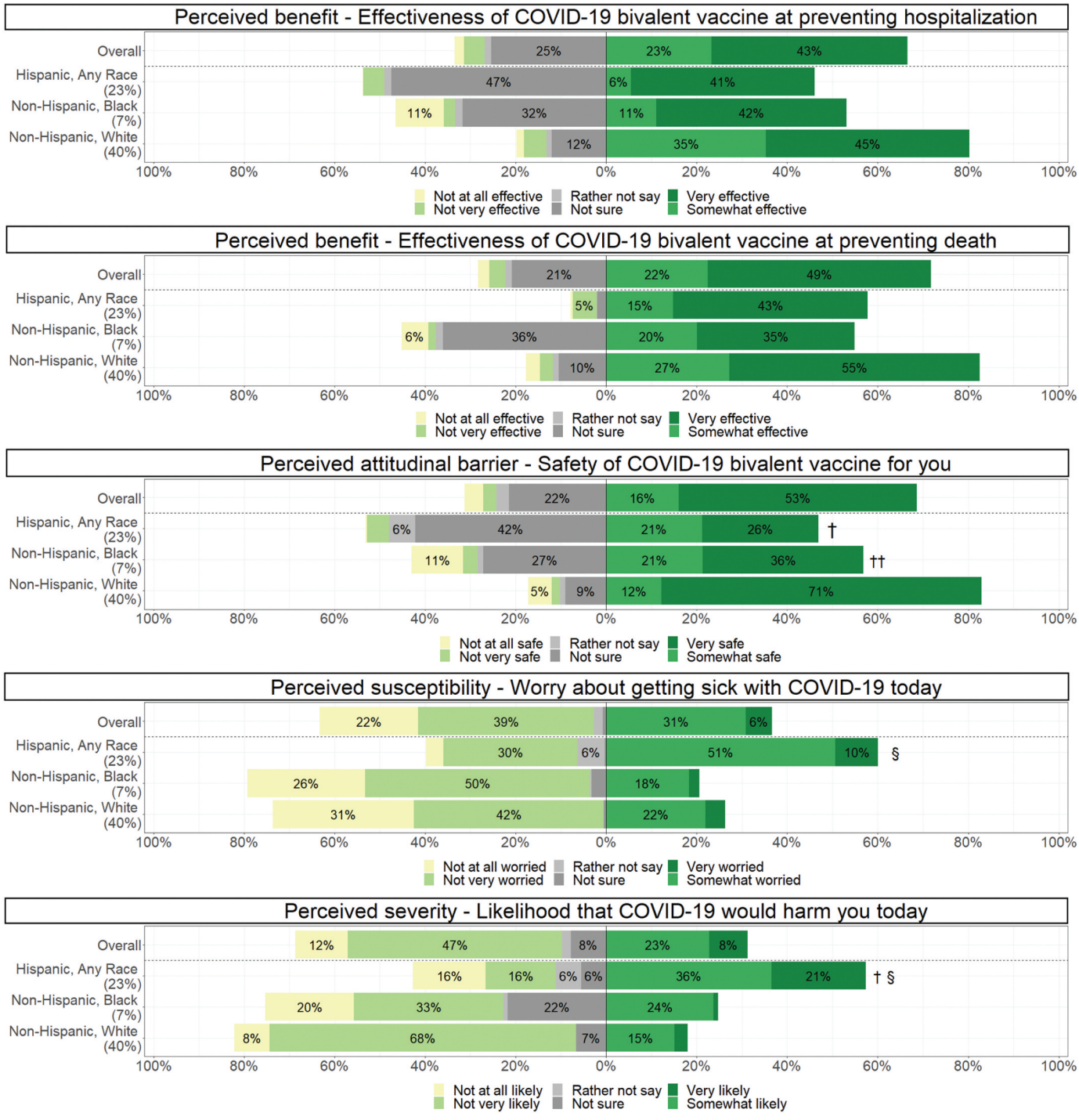

Figure 2. Patient attitudes regarding COVID-19 and the COVID-19 bivalent vaccine overall, by three race and ethnicity groups*. *The figure and overall count exclude those that were not in the three largest race and ethnicity groups. The race of those excluded includes Asian, Pacific Islander, Multiracial, and other. †Indicates a p-value <.010 for the "very" response category for Hispanic, any Race vs. Non-Hispanic, White. ††P-value <.010 for the "very" response category for Non-Hispanic Black vs. Non-Hispanic, White. §P-value < .010 for the "very" response category for Hispanic, any Race vs. Non-Hispanic, Black.

Whites were more likely to report the COVID-19 bivalent vaccine was 'very safe' (71%, [95% CI: 54%–87%]) than Non-Hispanic Black (36%, [95% CI: 21%–50%]) and Hispanic adults (26%, [95% CI: 7%–45%]) ($p \leq .006$ for both comparisons). Hispanic adults were more likely to report being 'very' worried about getting sick with COVID-19 (10%, [95% CI: 4% –15%]) than Non-Hispanic Black (2%, 95% CI: 0%–4%; $p = .011$) adults. Additionally, Hispanic adults more often reported COVID-19 would 'very likely' harm them (21%, [95% CI: 0%–47%]) than Non-Hispanic Black (1%, [95% CI: 0%–2%]) or Non-Hispanic White (3%, [95% CI: 0%–6%]) adults ($p \leq .008$ for both comparisons).

Multivariable analysis

We further evaluated associations between vaccination status and attitudes regarding COVID-19 and COVID-19 bivalent vaccine, controlling for age, race, and ethnicity. When controlling for these covariates, fully vaccinated and unvaccinated adults no longer had significantly different responses in relation to COVID-19 being 'very likely' to harm them ($p = .210$). We also further considered associations between race and ethnicity and attitudes regarding COVID-19 and COVID-19 bivalent vaccine controlling for vaccination status and age; no differences from the unadjusted analysis were found.

Most trusted source for information about COVID-19 bivalent vaccine

The CDC was the most trusted source of information for fully vaccinated individuals (55%, [95% CI: 32%–77%]), while those who were partially vaccinated tended to trust either the CDC (36%, [95% CI: 16%–56%]) or their doctor/healthcare provider (38%, [95% CI: 19%–58%]). Approximately 30% (95% CI: 9%–51%) of unvaccinated respondents answered they 'don't trust anyone.' Family and friends were the most trusted source for Hispanic adults (35%, [95% CI: 4%–66%]), while Non-Hispanic Black adults tended to trust their doctor or healthcare provider (40%, [95% CI: 24%–56%]) and Non-Hispanic White adults tended to trust their doctor or healthcare provider (42%, [95% CI: 20%–64%]) followed closely by the CDC (37%, [95% CI: 15%–58%]).

Discussion

To our knowledge, this is one of the few studies[29,30] to assess attitudes about the COVID-19 bivalent vaccine among U.S. adults and the only one to include persons who had not received any COVID-19 vaccines. In this rigorous evaluation of attitudes regarding COVID-19 and the COVID-19 bivalent vaccine in a large, mostly insured population, we found a dose–response effect between vaccination status and beliefs, with fully vaccinated individuals having the most favorable attitudes.

Clear differences in the perceived effectiveness of COVID-19 bivalent vaccines between fully and partially vaccinated adults and that over 50% of unvaccinated adults were unsure about the vaccine's effectiveness in preventing hospitalization and death suggests that specific communication about vaccine effectiveness must be improved. When considering prevention of SARS-CoV-2 infections, the COVID-19 bivalent vaccines have reduced relative effectiveness in adults versus the monovalent COVID-19 vaccines (37% to 56% effective); importantly, effectiveness declines with increasing age due to a reduced ability to mount neutralizing antibodies associated with aging and declines incrementally with prior receipt of monovalent COVID-19 and booster vaccines.[31,32] By comparison, the vaccines' effectiveness at preventing hospitalization has been shown to be as high as 84% and 73% in persons who were previously unvaccinated or who had received at least two monovalent-only mRNA vaccine doses, respectively[33]; and the vaccines' effectiveness at preventing death is over 80% in both persons previously unvaccinated and those who had received at least two doses of any monovalent vaccine.[34] Some evidence suggests that COVID-19 vaccination can prevent long COVID,[35–37] or signs, symptoms, and conditions that continue or develop after acute COVID-19 infection.[38] Ultimately, vaccine effectiveness is a difficult concept to convey to the public, as many different factors influence effectiveness, including host, pathogen-specific, outcome-specific, and vaccine-related factors. While vaccination is less efficacious at preventing infection, it is very effective at preventing more severe outcomes (specifically, hospitalization and death), and communications focused on the vaccines' effectiveness against these severe outcomes may encourage some partially or unvaccinated individuals to get vaccinated against COVID-19.

This study also highlights important differences in perceived safety of the COVID-19 bivalent vaccine by vaccination status and by race and ethnicity, which may be contributing to lower vaccination rates in Non-Hispanic Black and Hispanic adults compared to Non-Hispanic White adults.[6] Hundreds of millions of people in the United States have received COVID-19 vaccinations under the most intense vaccine safety monitoring in U.S. history,[4] and while systemic and local reactions are commonly reported, serious adverse reactions are rare.[39–43] Close monitoring detected individuals who received the Johnson & Johnson/Janssen COVID-19 vaccination had higher incidences of Guillain Barre Syndrome than individuals who received mRNA COVID-19 vaccinations.[44,45] This information, along with Johnson & Johnson/Janssen COVID-19 vaccination being associated with thrombosis and thrombocytopenia syndrome, led the Advisory Committee on Immunization Practices (ACIP) to preferentially recommend mRNA COVID-19 vaccinations over the Johnson & Johnson/Janssen vaccination, resulting in the Johnson & Johnson/Janssen vaccination coming off the market in the U.S. in January 2022.[46] A safety signal for the COVID-19 bivalent vaccines and ischemic strokes in individuals aged 65 and older was presented to ACIP in April 2023,[47] although it was not corroborated by other monitoring systems and has since attenuated.[4] Communication to vaccine-hesitant individuals about safety should include information about the huge volume of COVID-19 vaccinations that have been administered, the close safety monitoring by the CDC, the U.S. Food and Drug Administration, and other federal agencies that is ongoing, the rarity of serious adverse events noted and the willingness of authorities to act when they occur.

Another important finding from this study is the differential perception of susceptibility and harm from COVID-19 in the three racial and ethnic groups of interest we examined. Despite the literature highlighting both Non-Hispanic Black and Hispanic adults being disproportionately affected by COVID-19 infections,[48–52] Hispanic adults in this study were more likely to perceive a high degree of susceptibility to and harm from a COVID-19 infection than Non-Hispanic Black adults. It is unclear why Non-Hispanic Black adults did not share the same sentiments despite being disproportionately affected. Based on published studies, the causes could be a lack of awareness of the disproportional adverse impact of COVID-19 on the Non-Hispanic Black community or

underestimating the impact due to mistrust in the medical establishment.[53,54] Of note, on a national level, Hispanic adults currently have the lowest vaccination rates.[6] Traditionally, a physician's recommendation is considered very influential in convincing patients to receive vaccinations[55,56] and we found this for Non-Hispanic Black and Non-Hispanic White adults in this study; however, family and friends were considered the most trusted source for information about COVID-19 vaccination for Hispanic adults. This work would suggest that community messaging may be an important avenue for promoting vaccination among Hispanic adults. Unlike unvaccinated adults in this study who were not only skeptical about the vaccine but also not concerned about getting an infection, Hispanic adults may be more open to vaccination with better communication as they perceive being susceptible to infection.

Despite implementing a sound survey methodology, these findings are subject to several limitations. Males, younger individuals, and people from racial and ethnic groups other than Non-Hispanic White and Non-Hispanic Black adults are underrepresented in these findings. The low response rate may limit the generalizability of the results. However, it remains a respectable response rate in the context of declining response rates related to the COVID-19 pandemic.[57,58] We did not inquire about all aspects of the HBM (e.g., cues to action and self-efficacy) or the reliance on social media as a source of information regarding vaccination. We did not evaluate attitudes based on SARS-CoV-2 infection history, which would have been helpful since infection rates were very different in certain racial and ethnic groups. Finally, this survey focused on the COVID-19 bivalent vaccine, and COVID-19 vaccination recommendations have since evolved to recommend an Omicron monovalent booster vaccine for the 2023–2024 season.

Ultimately, this study provides information for clinicians and public health workers seeking to improve COVID-19 booster vaccination rates in diverse groups. Estimates indicate that the U.S. COVID-19 vaccination program has prevented more than 18.5 million additional hospitalizations and 3.2 million additional deaths.[59] In efforts to promote COVID-19 vaccination, we suggest vaccination advocates focus on vaccine effectiveness against severe outcomes, remind adults of vaccine safety and monitoring systems, and pursue community-engaged approaches that are sensitive to concerns that predominate in specific racial, ethnic, and linguistic groups.

Acknowledgments

We thank CDC and VSD site Data Managers who reviewed our sampling program and procured population estimates at each site for weighting purposes. The authors thank collaborators who helped to review and edit the paper.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

This study was supported by the Centers for Disease Control and Prevention (CDC), contract number 200-2012-53581-0011. This activity was reviewed by the CDC and was conducted consistent with applicable federal law and CDC policy. See, for example, 45 C.F.R. part 46.102(l)(2), 21 C.F.R. part 56; 42 U.S.C. §241(d); 5 U.S.C. §552a; 44 U.S.C. §3501 et seq.

Notes on contributor

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Data sharing statement

Data are available upon request through the Centers for Disease Control and Prevention published acquisition guidelines.

Disclaimer

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

Role of the funder/sponsor

The study sponsor, CDC, participated as a coinvestigator and contributed to protocol development, conduct of the study, interpretation of the data, review, and revision of the manuscript, approval of the manuscript through official CDC scientific clearance processes, and the decision to submit the manuscript for publication. CDC authors must receive approval through the CDC scientific clearance process to submit an article for publication. Final decision to submit rested with the first author. The study sponsor did not have the right to direct the submission to a particular journal.

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