HHS Public Access
Author manuscript
Prev Med. Author manuscript; available in PMC 2024 May 01.

Published in final edited form as:
Prev Med. 2023 December ; 177: 107751. doi:10.1016/j.ypmed.2023.107751.

Racial and ethnic disparities in influenza vaccination coverage among pregnant women in the United States: The contribution of vaccine-related attitudes

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Abstract

Objective: Racial and ethnic disparities in influenza vaccination coverage among pregnant women in the United States have been documented. This study assessed the contribution of vaccine-related attitudes to coverage disparities.

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Declaration of Competing Interest
The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: The authors have no conflicts of interest relevant to this article to disclose.

Appendix A. Supplementary data
Supplementary data to this article can be found online at https://doi.org/10.1016/j.ypmed.2023.107751.

Methods: Surveys were conducted following the 2019–2020 and 2020–2021 influenza seasons in a US research network. Using electronic health record data to identify pregnant women, random samples were selected for surveying; non-Hispanic Black women and influenza-unvaccinated women were oversampled. Regression-based decomposition analyses were used to assess the contribution of vaccine-related attitudes to racial and ethnic differences in influenza vaccination. Data were combined across survey years, and analyses were weighted and accounted for survey design.

Results: Survey response rate was 41.2% (721 of 1748) for 2019–2020 and 39.3% (706 of 1798) for 2020–2021. Self-reported influenza vaccination was higher among non-Hispanic White respondents (79.4% coverage, 95% CI 73.1%–85.7%) than Hispanic (66.2% coverage, 95% CI 52.5%–79.9%) and non-Hispanic Black (55.8% coverage, 95% CI 50.2%–61.4%) respondents. For all racial and ethnic groups, a high proportion (generally >80%) reported being seen for care, recommended for influenza vaccination, and offered vaccination. In decomposition analyses, vaccine-related attitudes (e.g., worry about vaccination causing influenza; concern about vaccine safety and effectiveness) explained a statistically significant portion of the observed racial and ethnic disparities in vaccination. Maternal age, education, and health status were not significant contributors after controlling for vaccine-related attitudes.

Conclusions: In a setting with relatively high influenza vaccination coverage among pregnant women, racial and ethnic disparities in coverage were identified. Vaccine-related attitudes were associated with the disparities observed.

Keywords

Influenza vaccination; Pregnancy; Disparities; Attitudes; Coverage; Electronic health records

1. Introduction

Influenza causes substantial morbidity in the United States each year (Centers for Disease Control and Prevention, 2022; Rolfes et al., 2018; Centers for Disease Control and Prevention, 2010), with disease burden falling more heavily on those with chronic medical conditions (Coleman et al., 2018) or health states such as pregnancy (Mertz et al., 2017; Prasad et al., 2019). Because vaccination represents a cornerstone strategy for preventing influenza and reducing influenza-related morbidity (Grohskopf et al., 2020; Grohskopf et al., 2021), vaccinating pregnant women has been a national public health priority for decades (Centers for Disease Control and Prevention, 1999). However, for influenza vaccination during pregnancy, the gap between coverage desired and coverage achieved has been wide: among women pregnant during the 2021–2022 influenza season, 49.6% reported receiving influenza vaccine (Kahn et al., 2022), far below the US Healthy People 2030 goal of 70% (the goal for all vaccine-eligible persons) (U.S. Department of Health and Human Services. Healthy People, 2030). Coverage among pregnant women prior to the COVID-19 pandemic was higher, at 53.7% in 2018–2019 and 61.2% in 2019–2020 (Lindley et al., 2019; Razzaghi et al., 2020).

Among pregnant women, persistent disparities in influenza vaccination by race and ethnicity have been documented, and being unvaccinated increases the vulnerability of women and their infants to influenza-associated complications during and after pregnancy (Dawood et al., 2021; Duque et al., 2023). Based on Internet panel surveys averaged over three influenza seasons (2017–2020), influenza vaccination coverage among pregnant women in the United States was almost 15 percentage points lower among non-Hispanic Black (42.1%) than non-Hispanic White (56.7%) women (Callahan et al., 2021). National coverage among Hispanic pregnant women has been similar to[16] or higher than (Kahn et al., 2022) among non-Hispanic White pregnant women in recent years. Corresponding data are unavailable for other racial and ethnic groups (e.g., Asian or Pacific Islander, American Indian or Alaska Native) (Kahn et al., 2022; Callahan et al., 2021).

Reducing racial and ethnic disparities in influenza vaccination coverage among pregnant women is an important public health goal: it represents a measurable and actionable step toward achieving health equity and reducing influenza-related morbidity (Dawood et al., 2021; Duque et al., 2023). However, it is necessary to distinguish between vaccination access barriers and attitude-related causes of non-vaccination, as each requires a different set of solutions. The objective of the current study is to assess among pregnant women the contribution of influenza vaccine-related attitudes and other factors (e.g., socioeconomic characteristics) to differences in influenza vaccination coverage by race and ethnicity. To that end, surveys were conducted during two recent influenza seasons among pregnant women receiving care in a US multi-state research network.

2. METHODS

2.1. Study setting

The study was conducted following the 2019–2020 and 2020–2021 influenza seasons in the Vaccine Safety Datalink (VSD), a collaboration between 8 large US healthcare organizations and the Centers for Disease Control and Prevention (Baggs et al., 2011; McNeil et al., 2014). VSD sites are located in the US states of Wisconsin, Minnesota, Colorado, California, Oregon, and Washington. Most of the VSD population has private health insurance, with approximately 8% insured through Medicaid, and influenza vaccination is a covered benefit (Sukumaran et al., 2015). While demographic and socioeconomic characteristics of the VSD population are similar to the US population (Sukumaran et al., 2015), influenza vaccination coverage among pregnant women in the VSD is generally higher than national estimates (Groom et al., 2016).

2.2. Study population: Identification of pregnant women

The VSD developed and validated an algorithm to identify current (Naleway et al., 2021) and completed (Naleway et al., 2013) pregnancies with high accuracy. The algorithm relies on electronic health record (EHR) data, including pregnancy-related International Classification of Diseases, 10th revision, (ICD-10) codes, prenatal procedure codes, and obstetrical flowsheets (Naleway et al., 2021; Naleway et al., 2013).

Using this algorithm, we identified women 18 through 49 years of age who were pregnant any time between August 1 and January 31 of the respective influenza season. We excluded women who did not have continuous health insurance enrollment, defined as having no greater than a one-month (i.e., 31 day) gap in insurance enrollment during the influenza season. At one VSD site, serving predominantly public insured or uninsured patients, one outpatient visit within the prior 18 months was used as a proxy for insurance enrollment (Eisert et al., 2009). We excluded women with an ICD-10 diagnosis code indicating an adverse pregnancy outcome such as spontaneous abortion or stillbirth. We excluded those with a diagnosis code for vaccine allergy or with possible vaccine data errors (e.g., invalid doses).

2.3. Survey design and administration

After identifying eligible pregnant women, we randomly sampled subjects for survey administration. For each survey year, sampling was stratified by VSD site and EHR-based influenza vaccination status, with women unvaccinated according to EHR data oversampled. To better understand the relationship between vaccination disparities and vaccine-related attitudes, we oversampled non-Hispanic Black pregnant women. For the 2019–2020 survey, we sampled 1748 pregnant women; for the 2020–2021 survey, we sampled 1798 pregnant women.

Cognitive interviews were conducted with 8 individuals to pilot-test the survey instrument. Questions regarding influenza vaccine receipt (whether vaccination was recommended, offered, and received) were based on national surveys (Razzaghi et al., 2020; Robbins et al., 2018; Parsons et al., 2014; Santibanez and Kennedy, 2016; Kahn et al., 2018). The conceptual framework for the survey content was primarily derived from Health Belief Model, used extensively in influenza vaccine acceptance research (Bettinger et al., 2016; Ng et al., 2020; Goggins et al., 2021; Trent et al., 2021), which posits that a specific health behavior is based on perceptions of disease susceptibility and severity, combined with the perceived benefits and barriers for that health behavior (Skinner et al., 2015). Based on the work of Lindley and others (Lindley et al., 2006; King et al., 2020; Yuen and Tarrant, 2014), survey questions assessed the following constructs: perceived susceptibility to influenza; perceived severity of influenza; perceived vaccine effectiveness; perceived vaccine safety; and overall hesitancy toward influenza vaccination. Vaccination intention was not assessed because surveys were conducted after the influenza season (i.e., after the opportunity for vaccination had passed). Response options were on Likert-type scales, such as "very safe" to "not safe" or "very effective" to "not effective." Based on published surveys (Robbins et al., 2018), respondents were asked to identify their race: American Indian or Alaska Native; Asian or Pacific Islander; Black or African American; White; multiracial; other race; or rather not say. Additionally, respondents were asked if they were "Hispanic, Latino, Latina, or of Spanish origin."

For the 2019–2020 season, survey administration began February 18, 2020; for the 2020–2021 season, surveying began March 1, 2021. Surveys were fielded for 15 weeks. Survey cover letters included a quick response code, allowing users to complete the survey on a smart device. Subjects received up to 3 mailed surveys, up to 4 emails with a hyper-link, and one telephone reminder. Outreach stopped once a survey was completed, or a subject requested no further contact. One VSD site did not permit email contact; subjects at this site received an additional mailed survey. Responses were recorded using Research Electronic

Data Capture (REDCap) (Harris et al., 2019). Respondents were compensated with a $20 gift card.

2.4. Statistical analyses

Data on race and ethnicity were available from two sources, the EHR and the survey. At VSD sites, race and ethnicity data are typically entered into the EHR during patient registration based upon patient self-report. Data on race and ethnicity from the survey were also self-reported. If respondents chose not to report their race and ethnicity on the survey, EHR race and ethnicity data were utilized. If survey self-report was discordant with EHR data (i.e., a different racial category was reported), survey self-report was used. For comparison of survey respondents to non-respondents, EHR-based race and ethnicity data were used; for all other analyses, the survey was the primary source for race and ethnicity data.

Subjects were considered respondents if they confirmed they were/had been pregnant, and answered the question "Since July 1 [of the current influenza season] have you had a flu vaccination?" We compared respondents to non-respondents using Pearson chi-squared tests and *t*-tests. We accounted for the stratified sample design over two influenza seasons and incorporated inverse probability weighting for sampling and survey response probabilities by VSD site, EHR vaccination status, and EHR non-Hispanic Black race and ethnicity. Weighted percentages for survey responses were reported with Clopper-Pearson 95% confidence intervals (CI). Rao-Scott chi-square tests were used to detect difference across the 5-level self-reported racial and ethnic groups for each survey item. When making pairwise comparisons across racial and ethnic groups, differences were inferred only when Clopper-Pearson 95% CIs did not overlap.

Self-reported influenza vaccination during the current influenza season (whether before, during, or after pregnancy) was the primary study outcome. Blinder-Oaxaca decomposition was conducted to explore factors contributing to racial and ethnic differences in self-reported influenza vaccination (Fairlie, 2005; Fairlie, 2017). Using respondent data across both survey years, a weighted pooled logistic regression model predicting self-reported influenza vaccination was used to estimate non-biased coefficients for vaccine-related attitudes and other (e.g., socioeconomic) factors. The pooled logistic model used 5 categories of race and ethnicity: non-Hispanic Black, non-Hispanic White, Hispanic, non-Hispanic Asian or Pacific Islander, and non-Hispanic other (American Indian or Alaska Native, multiracial, other race, missing). Prior to modeling, variable collinearity was assessed and multicollinear variables were excluded (Kim, 2019). In decomposition analyses, we did not include overall vaccine hesitancy, because of the conceptual overlap of this question with other vaccine-related attitudes (Lindley et al., 2006; Opel et al., 2013). For Blinder-Oaxaca analyses, we estimated pairwise comparisons in two sub-samples (non-Hispanic Black vs. non-Hispanic White; Hispanic vs. non-Hispanic White) (Fairlie, 2005; Fairlie, 2017). The delta method was used in predicting the nonlinear absolute influenza vaccination coverage difference, and the fractional contribution of each variable to the differences observed (Fairlie, 2005). Analyses were conducted using SAS 9.4 (SAS Institute, Cary, NC) and STATA 16.1 (StataCorp, College Station, TX).

2.5. Research compliance

The Kaiser Permanente Colorado institutional review board approved the study, and other study sites ceded oversight to Kaiser Permanente Colorado. Written consent was not required for survey administration, and subjects could choose not to respond or could opt out from participating in the survey in writing or by telephone.

3. Results

For the 2019–2020 influenza season survey, the sampling frame included 97,661 women, of whom 409 (0.4%) were removed based on study exclusion criteria, leaving 97,252 survey-eligible women. For the 2020–2021 influenza season survey, the sampling frame included 86,565 women, of whom 372 (0.4%) were removed based on study exclusion criteria, leaving 86,193 survey-eligible women.

For the 2019–2020 influenza season survey, 1748 individuals were surveyed (1460 unvaccinated, 784 non-Hispanic Black): 721 (41.2%) responded and were survey-eligible, 24 (1.4%) responded but failed screening because they did not confirm being pregnant during the influenza season, and 1003 (57.4%) did not respond. For the 2020–2021 influenza season survey, 1798 individuals were surveyed (1474 unvaccinated, 1110 non-Hispanic Black): 706 (39.3%) responded and were survey-eligible, 28 (1.6%) responded but did not confirm being pregnant, and 1064 (59.2%) did not respond. Combining survey-eligible respondents across the two survey years, the analytic cohort comprised 1427 individuals.

The characteristics of survey respondents and nonrespondents are shown in Supplemental Table 1. Respondents differed from non-respondents with respect to age (a higher proportion of respondents were older) and race and ethnicity (a higher proportion of respondents were non-Hispanic White, a lower proportion non-Hispanic Black). A higher proportion of respondents had been vaccinated in the current or prior influenza season (per EHR data).

Among 1427 respondents, race and ethnicity data were concordant between EHR and survey for 1137 (79.7%). Examples of discordance included 50 individuals recorded as non-Hispanic Black in EHR data who reported by survey as multiracial, and 29 recorded as non-Hispanic Black in EHR data who reported Hispanic ethnicity by survey. Seventy-four respondents (5.2%) chose not to report their race and ethnicity when surveyed. EHR-based race and ethnicity data were used for 73 of these missing values; for one individual, race and ethnicity data were missing from both data sources.

Overall, the percent who self-reported influenza vaccination was 74.0% (95% CI, 69.4%–78.7%). In rank order, self-reported influenza vaccination was highest for non-Hispanic Asian respondents at 82.3% (95% CI, 72.5%–92.1%), followed by non-Hispanic White respondents at 79.4% (95% CI, 73.1%–85.7%), Hispanic respondents at 66.2% (95% CI, 52.5%–79.9%), non-Hispanic Black respondents at 55.8% (95% CI, 50.2%–61.4%), and respondents who identified as multiracial or other race and ethnicity at 39.7% (95% CI, 22.0%–57.4%). Self-reported influenza vaccination in the study population was generally higher than national estimates, as shown in Supplemental Table 2.

Across all race and ethnicity groups, a high proportion reported having been seen for care during the influenza season, recommended for influenza vaccination, and offered influenza vaccination during a visit (see Table 1). For example, among unvaccinated non-Hispanic Black respondents, 92.3% reported having been seen for health care, 80.4% reported having been recommended for influenza vaccination, and 82.2% reported having been offered influenza vaccination during a visit; proportions were not significantly different compared to unvaccinated respondents from other racial and ethnic groups.

Attitudes related to influenza infection and vaccination were compared across racial and ethnic groups; results were combined across influenza seasons because attitudes did not significantly differ between seasons by race and ethnicity. As shown in Table 2, non-Hispanic Black pregnant women were significantly more likely than non-Hispanic White pregnant women to report being very/somewhat worried about "getting the flu from the flu vaccine" (38.3% [95% CI 31.4–45.2] vs. 9.6% [95% CI 5.9–13.3], respectively). Non-Hispanic Black pregnant women were also more likely to express concerns about vaccine safety during pregnancy, and report less confidence in influenza vaccine effectiveness, than non-Hispanic White pregnant women. The influenza-related attitudes of Hispanic respondents and non-Hispanic Asian or Pacific Islander respondents were not significantly different compared to non-Hispanic White respondents (Table 2).

Attitudes related to influenza infection and vaccination were also significantly associated with receipt of influenza vaccine (see Table 3). Overall, 7.4% (95% CI 3.6–11.2) of women who reported being vaccinated were very/somewhat worried about "getting the flu from the flu vaccine" compared to 41.6% (95% CI 34.0–49.2) of unvaccinated women. Among unvaccinated women, reasons reported for not being vaccinated included concerns about vaccine effectiveness and safety (see Supplemental Table 3); few reported barriers to vaccination such as cost, vaccine availability, or time constraints.

As shown in Table 4, multivariate decomposition analyses explained 97.5% of the difference in coverage observed between non-Hispanic Black and non-Hispanic White women, with vaccine-related attitudes providing the greatest contribution to explaining the differences in influenza vaccination coverage. Among non-Hispanic Black women, worry about getting influenza from influenza vaccination contributed 33.8%; other significant contributors included concern about influenza vaccine safety for pregnant women (21.5% contribution), concern about vaccine effectiveness at preventing influenza (22.0% contribution), and concern about vaccine effectiveness at protecting the baby from influenza (17.8% contribution). For education level and age group, the point estimates for contribution were smaller and not statistically significant. For Hispanic pregnant women, decomposition analyses explained 74.4% of the difference in coverage observed compared to non-Hispanic White women. Significant contributors to the observed difference in coverage included worry about getting influenza from influenza vaccination (30.2% contribution), concern about influenza vaccine safety for pregnant women (30.7% contribution), and concern about vaccine effectiveness at protecting the baby from influenza (11.3% contribution). Finally, to provide additional context for the decomposition analyses, we performed a secondary analysis, assessing the factors associated with holding the attitude "worried about getting influenza from influenza vaccination." In a multivariate logistic regression, self-reported race and ethnicity were significantly ($p < 0.001$) associated with this attitude, while the following factors were not significantly associated (all p-values >0.05) with this attitude: age group, education level, annual household income, presence of a chronic condition, prior pregnancy, private health insurance, having been seen by a provider during pregnancy.

4. Discussion

During two recent influenza seasons in the VSD network, a setting with high influenza vaccination coverage among pregnant women relative to national estimates (Groom et al., 2016), we found lower self-reported influenza vaccination coverage among non-Hispanic Black and Hispanic pregnant women compared to non-Hispanic White pregnant women. Differences in attitudes related to influenza disease and vaccination appeared to explain most of the vaccination disparities observed, with maternal education, age, and presence of a chronic health condition contributing less to the observed differences. Barriers to vaccination appeared to be less influential, as a high proportion of unvaccinated women across all racial and ethnic groups reported having been seen for care, recommended for influenza vaccination, and offered vaccination during a visit. Additionally, few respondents offered access barriers as a primary reason for non-vaccination.

Although we are unaware of other studies estimating the relative contribution of attitudes to influenza vaccination disparities among pregnant women, the results are generally consistent with other research findings in this area (King et al., 2020; Arnold et al., 2019; Lutz et al., 2018; Wilson et al., 2015). For example, pregnant women from different racial and ethnic groups were found to have significantly different attitudes about influenza infection and vaccination (Dudley et al., 2021; Callahan et al., 2022). Dudley and colleagues demonstrated that compared to non-Hispanic White pregnant women, non-Hispanic Black and Hispanic pregnant women were less confident in vaccine safety and effectiveness, less concerned about acquiring influenza, and less likely to trust vaccine information provided to them (Dudley et al., 2021). In a separate study with pregnant women in two US states, Callahan and colleagues found that more than twice the proportion of White respondents (63.6%) compared with Black respondents (30.0%) agreed with the statement “it is important for my health and safety to get a flu shot while I am pregnant”; Black women also reported lower rates of influenza vaccination (Callahan et al., 2022). Several prior studies among pregnant women have found an association between lower influenza vaccination coverage and lower educational attainment (King et al., 2020; Arnold et al., 2019). In the current study, after controlling for attitudinal factors, we did not find that educational attainment contributed significantly to explaining racial and ethnic disparities in coverage.

Because this study was cross-sectional, we cannot definitively conclude that the difference in attitudes caused the disparities in vaccination observed. Nonetheless, these data suggest that if non-Hispanic Black and Hispanic pregnant women held vaccine- and infection-related attitudes similar to those of non-Hispanic White women, disparities in influenza coverage could be reduced. Attitudes of particular importance were related to whether someone could get influenza infection from the vaccine, the safety of influenza vaccine during pregnancy, and vaccine effectiveness. Changing attitudes and vaccination behaviors may prove challenging, however. In a recent literature review of interventions to reduce disparities in influenza vaccination coverage among pregnant women, Callahan and colleagues found that most interventions were unsuccessful at improving coverage and reducing disparities (Callahan et al., 2021). While provider recommendation and offer of vaccination have been found to be important predictors of vaccination (Callahan et al., 2021), we found a high proportion of pregnant women remained unvaccinated despite having been recommended for and offered influenza vaccine.

The factors contributing to persistent racial and ethnic disparities in influenza vaccination coverage are complex (Callahan et al., 2021; Wilson et al., 2015; Quinn et al., 2017). Influenza vaccine-related attitudes among pregnant women clearly differ across racial and ethnic groups (Dudley et al., 2021). The effects of structural racism and social disadvantage may contribute to differences in attitudes and access barriers (Zerbo et al., 2020), mediated through mistrust of health care systems and government-led public health programs (Dudley et al., 2021). In this context, it is essential to better understand how health care institutions may inadvertently neglect the concerns of racial and ethnic groups regarding preventive health services in general and influenza vaccination in particular (Lin et al., 2021). Improved communication approaches that address influenza vaccination attitudes among non-Hispanic Black pregnant women are needed. These may include tailored social media campaigns, rigorously evaluated by members of the intended audience, containing transparent and consistent messages delivered by trusted sources (Lin et al., 2021; Bonnevie et al., 2020).

4.1. Study limitations

Our study should be interpreted in the context of several limitations. First, the study setting and population affects the generalizability of findings. VSD sites predominantly serve an insured population (Sukumaran et al., 2015) and achieve relatively high influenza vaccination coverage (Groom et al., 2016); therefore, access barriers may be less common or less challenging to overcome at VSD sites compared to other settings. Second, differences in survey respondents and nonrespondents could have led to response bias. Third, race and ethnicity could have been misclassified, particularly among those who did not report race and ethnicity on the survey. A fourth limitation, shared with national vaccine-related surveys (Kahn et al., 2022), is that the precision of estimates was limited by small sample sizes for several racial and ethnic groups. Related, it was necessary analytically to create a category of “other, multiracial, and missing” race and ethnicity; this represents a heterogeneous group with limited interpretability. More work is needed to understand the influenza-related attitudes and vaccination patterns of racial and ethnic groups other that those reported here. Fifth, the study was cross-sectional, conducted after the influenza season, with self-reported vaccination assessed at the same time as influenza-related attitudes. Therefore, it is possible that vaccination behaviors shaped reported vaccination attitudes, or that attitudes other than those assessed led to decisions not to vaccinate. Lastly, it is possible that factors not assessed in the survey (e.g., cost, transportation, health literacy), were more directly responsible for vaccination outcomes. Related, the decomposition model was based on the main effects of the available variables, and it was not possible to account for potentially complex causal chains between study covariates.

5. Conclusions

In a setting with high influenza vaccination coverage, racial and ethnic disparities in coverage among pregnant women were identified. Attitudes related to influenza infection and vaccination were strongly associated with the disparities observed. Further research is needed to better understand factors driving racial and ethnic differences in attitudes about influenza vaccination, and to develop effective strategies to improve vaccine confidence in these populations.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

The study authors acknowledge that not every individual who can become pregnant identifies as a woman. However, this survey was conducted among individuals who self-reported as female gender. Consequently, we use the term “pregnant women” throughout the manuscript.

The authors Matthew F. Daley, MD, Liza M. Reifler, MPH, and Jo Ann Shoup, PhD had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. The authors would like to acknowledge Bradley Crane and Stephanie Irving for their contributions to this work. Participating VSD sites included: Marshfield Clinic Health System; HealthPartners; Denver Health; Kaiser Permanente (KP) Washington; KP Northwest; KP Northern California; KP Southern California; and KP Colorado.

This activity was reviewed by the Centers for Disease Control and Prevention and was conducted consistent with applicable federal law and Centers for Disease Control and Prevention policy. 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.

The authors disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: this research was funded by the Centers for Disease Control and Prevention, through a Task Order (contract #200-2012-53582-21454), issued as part of the Vaccine Safety Datalink project (contract #200-2012-53582). Co-authors from the Centers for Disease Control and Prevention were involved in design and conduct of the study, interpretation of data, and review and approval of the manuscript.

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Financial disclosure

Matthew F. Daley, MD: no financial relationships relevant to this article to disclose.

Liza M. Reifler, MPH: has an immediate family member who owns stock in Merck, Abbott Laboratories, and AstraZeneca.

Jo Ann Shoup, PhD: no financial relationships relevant to this article to disclose.

Jason M. Glanz, PhD: no financial relationships relevant to this article to disclose.

Allison L. Naleway, PhD: has received research support from Pfizer unrelated to the current study.

Jennifer C. Nelson, PhD: received grant funding as member of the External Safety Advisory Board for Moderna’s COVID-19 vaccine program.

Joshua T. B. Williams: no financial relationships relevant to this article to disclose.

Huong Q. McLean, PhD, MPH: has received research support from Seqirus unrelated to the current study.

Gabriela Vazquez-Benitez, PhD, MSC: has received research support from Sanofi Pasteur and AbbVie unrelated to the current study.

Kristin Goddard, MPH: no financial relationships relevant to this article to disclose.

Bruno J. Lewin, MD, DTMH: no financial relationships relevant to this article to disclose.

Eric S. Weintraub, MPH: no financial relationships relevant to this article to disclose.

Michael M. McNeil, MD, MPH: no financial relationships relevant to this article to disclose.

Hilda Razzaghi, PhD, MSPH: no financial relationships relevant to this article to disclose.

James A. Singleton, PhD: no financial relationships relevant to this article to disclose.

Data availability

Data will be made available on request.

Abbreviations:

EHR	electronic health records
CD-10	International Classification of Diseases 10th revision
CI	confidence interval
ACIP	Advisory Committee on Immunization Practices
KP	Kaiser Permanente
VSD	Vaccine Safety Datalink

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Table 1

Among survey respondents (n = 1427), percent reporting being seen for care, recommended for and offered influenza vaccine, Wisconsin, Minnesota, Colorado, California, Oregon, and Washington, 2019–2021.[a,b,c]

Question	Self-reported vaccination status	Non-Hispanic Black, % (95% CI)	Non-Hispanic White, % (95% CI)	Hispanic, % (95% CI)	Non-Hispanic Asian or Pacific Islander, % (95% CI)	Non-Hispanic Other/ Multi-racial/Missing, % (95% CI)	p-value[d]
Seen by a health professional since July 1 [of the current influenza season]	Vaccinated	96.3 (91.7, 100.0)	99.7 (99.3, 100.0)	94.7 (86.3, 100.0)	99.1 (97.4, 100.0)	92.6 (83.0, 100.0)	0.002
	Not vaccinated	92.3 (88.5, 96.1)	95.1 (90.5, 99.6)	91.1 (83.1, 99.1)	99.3 (98.4, 100.0)	86.6 (70.7, 100.0)	0.203
Since July 1 [of the current influenza season], a health professional recommended flu vaccination	Vaccinated	94.9 (92.2, 97.6)	98.0 (96.2, 99.8)	89.7 (78.0, 100.0)	99.9 (99.7, 100.0)	96.6 (90.9, 100.0)	<0.001
	Not vaccinated	80.4 (74.2, 86.7)	78.3 (70.2, 86.3)	86.8 (78.6, 95.0)	86.2 (69.3, 100.0)	76.6 (51.8, 100.0)	0.606
Since July 1 [of the current influenza season], a health professional offered flu vaccination during a visit	Vaccinated	84.4 (76.2, 92.6)	88.4 (77.6, 99.3)	89.9 (78.1, 100.0)	65.6 (38.3, 92.9)	86.3 (72.5, 100.0)	0.064
	Not vaccinated	82.2 (75.8, 88.6)	74.7 (65.1, 84.3)	89.7 (82.4, 97.1)	90.4 (75.0, 100.0)	72.8 (47.8, 97.8)	0.089

Abbreviation: CI, confidence interval.

[a] Based on self-reported race and ethnicity, supplemented by race and ethnicity from electronic health records for n = 74 individuals who did not self-report race and ethnicity on survey.

[b] States in the United States with Vaccine Safety Datalink sites.

[c] Values presented in table incorporate weighting to account for sampling and response probabilities with Clopper-Pearson 95% confidence intervals.

[d] *P*-value for Rao-Scott chi-square tests; detects survey item differences across racial and ethnic groups.

Table 2

Among survey respondents (n = 1427), attitudes related to influenza infection and vaccination, Wisconsin, Minnesota, Colorado, California, Oregon, and Washington, 2019–2021.[a,b,c]

Attitude	Non-Hispanic Black, % (95% CI)	Non-Hispanic White, % (95% CI)	Hispanic, % (95% CI)	Non-Hispanic Asian or Pacific Islander, % (95% CI)	Non-Hispanic Other/ Multi-racial/ Missing, % (95% CI)	p-value[d]
Worried about getting the flu from flu vaccine	38.3 (31.4, 45.2)	9.6 (5.9, 13.3)	23.6 (12.5, 34.8)	14.1 (1.9, 26.3)	29.8 (14.2, 45.4)	<0.001
Less concerned or not sure about whether flu would harm mother if she were infected	47.5 (40.3, 54.7)	42.0 (27.5, 56.4)	53.8 (34.3, 73.3)	62.7 (43.3, 82.1)	35.7 (15.2, 56.1)	0.268
Less concerned or not sure about whether flu would harm baby if she were infected	51.1 (43.9, 58.4)	58.9 (44.5, 73.2)	64.1 (45.6, 82.6)	56.6 (35.5, 77.7)	48.8 (29.5, 68.0)	0.893
Less concerned or not sure about getting sick from the flu	66.3 (59.4, 73.2)	53.9 (39.7, 68.1)	40.4 (24.3, 56.6)	49.7 (27.6, 71.8)	43.7 (25.9, 61.6)	0.368
Concerned or uncertain about vaccine effectiveness at preventing the flu	32.3 (26.8, 37.8)	16.3 (7.8, 24.9)	17.2 (9.5, 24.9)	9.4 (2.8, 15.9)	37.1 (18.0, 56.2)	0.035
Concerned or uncertain about flu vaccine safety for adult women	21.9 (16.9, 26.9)	6.6 (3.5, 9.7)	10.1 (3.0, 17.1)	3.3 (0.0, 6.9)	17.6 (6.1, 29.1)	0.003
Concerned or uncertain about flu vaccine safety for pregnant women	31.7 (26.2, 37.1)	10.1 (6.2, 14.1)	25.7 (13.5, 37.9)	6.1 (1.4, 10.9)	38.3 (19.1, 57.5)	<0.001
Concerned or uncertain about vaccine effectiveness in protecting baby from the flu	42.8 (36.3, 49.3)	26.6 (14.2, 39.0)	28.5 (16.2, 40.9)	24.9 (4.9, 44.8)	48.0 (28.9, 67.2)	0.628
Concerned or uncertain about flu vaccine safety for baby	33.7 (28.2, 39.2)	12.5 (8.0, 16.9)	25.9 (13.7, 38.1)	9.3 (2.8, 15.8)	36.8 (17.7, 55.9)	<0.001
Hesitant about flu vaccination during pregnancy	51.8 (45.0, 58.7)	28.3 (16.8, 39.7)	40.7 (22.5, 58.8)	14.7 (6.2, 23.2)	52.3 (33.2, 71.5)	0.007

Abbreviation: CI, confidence interval.

[a]Based on self-reported race and ethnicity, supplemented by race and ethnicity from electronic health records for $n = 74$ individuals who did not self-report race and ethnicity on survey.

[b]States in the United States with Vaccine Safety Datalink sites.

[c]Values presented in table incorporate weighting to account for sampling and response probabilities with Clopper-Pearson 95% confidence intervals.

[d]*P*-value for Rao-Scott chi-square tests; detects survey item differences across racial and ethnic groups.

Table 3

Among survey respondents (n = 1427), attitudes related to influenza infection and vaccination, stratified by self-reported vaccination status, Wisconsin, Minnesota, Colorado, California, Oregon, and Washington, 2019–2021.[a,b]

Attitude/belief	Vaccinated by self-report, % (95% CI)	Not vaccinated by self-report, % (95% CI)	p-value[c]
Worried about getting the flu from flu vaccine	7.4 (3.6, 11.2)	41.6 (34.0, 49.2)	<0.001
If infected, flu likely to harm mother	51.8 (39.1, 64.6)	49.1 (41.3, 56.8)	0.719
If mother infected, flu likely to harm baby	41.6 (29.3, 53.8)	38.3 (30.8, 45.9)	0.659
Worried about getting sick from the flu	56.8 (44.4, 69.1)	30.9 (23.1, 38.7)	0.001
Vaccination effective at preventing the flu	95.2 (90.1, 100.0)	49.0 (41.3, 56.8)	<0.001
Flu vaccines safe for most adult women	97.5 (95.3, 99.7)	75.9 (69.8, 82.0)	<0.001
Flu vaccines safe for pregnant women	95.8 (92.8, 98.8)	52.0 (44.2, 59.8)	<0.001
Flu vaccines effective in protecting baby from flu	84.5 (75.0, 94.0)	35.4 (27.8, 43.1)	<0.001
When a pregnant woman vaccinated, flu vaccine safe for baby	94.8 (91.7, 97.9)	47.9 (40.1, 55.7)	<0.001
Hesitant about flu vaccination during pregnancy	16.0 (6.6, 25.3)	74.8 (67.4, 82.2)	<0.001

Abbreviation: CI, confidence interval.

[a]States in the United States with Vaccine Safety Datalink sites.

[b]Values presented in table incorporate weighting to account for sampling and response probabilities with Clopper-Pearson 95% confidence intervals.

[c]*P*-value for Rao-Scott chi-square tests survey item differences across self-report vaccination groups.

Table 4

Difference in self-reported influenza vaccination coverage for non-Hispanic Black and Hispanic pregnant individuals compared to vaccination coverage among non-Hispanic White pregnant individuals, US Vaccine Safety Datalink, 2019–2021.[a,b]

	Non-Hispanic Black			Hispanic		
Covariates[c]	**Absolute vaccination coverage difference[d], %**	**95% CI**	**Fractional contribution, %**	**Absolute vaccination coverage difference[d], %**	**95% CI**	**Fractional contribution, %**
Age group[e]	−0.8	−1.9, 0.3	3.4	−0.6	−1.7, 0.5	4.4
Education level[f]	−0.7	−2.4, 1.0	3.1	−0.8	−3.1, 1.4	6.4
Chronic health condition	−0.1	−0.8, 0.5	0.6	−0.1	−0.6, 0.4	0.6
Worried about getting the flu from flu vaccine	−8.0	−12.2, −3.7	33.8	−4.0	−6.4, −1.6	30.2
Concerned or uncertain about flu vaccine safety for pregnant women	−5.1	−8.5, −1.7	21.5	−4.1	−7.7, −0.4	30.7
Concerned or uncertain about vaccine effectiveness at preventing the flu	−5.2	−8.3, −2.1	22.0	−0.8	−1.7, 0.2	5.8
Concerned or uncertain about vaccine effectiveness in protecting baby from flu	−4.2	−7.1, −1.3	17.8	−1.5	−2.9, −0.1	11.3
Less concerned or not sure about whether flu would harm mother if she were infected	0.6	−0.5, 1.6	−2.4	1.2	−0.9, 3.2	−9.0
Influenza season	−0.1	−0.7, 0.5	0.4	−0.6	−1.5, 0.3	4.3
VSD site	0.7	−1.2, 2.5	−2.8	1.4	−1.6, 4.4	−10.4
Total explained difference	−23.0		97.5	−9.9		74.4
Total observed difference	−23.6			−13.2		

Abbreviations: CI, confidence interval; VSD, Vaccine Safety Datalink; US, United States.

[a]Table presents findings from multivariate Blinder-Oaxaca decomposition analyses.

[b]US Vaccine Safety Datalink sites are located in Wisconsin, Minnesota, Colorado, California, Oregon, and Washington.

[c]The following variables were removed from decomposition analyses due to collinearity with other covariates: annual household income, worry about influenza harming baby, worry about getting sick from influenza, concern about influenza vaccine safety for the baby, and being offered influenza vaccine during a visit.

[d]A negative absolute difference indicates a lower self-reported influenza vaccination coverage in non-Hispanic Black or Hispanic individuals compared to non-Hispanic White individuals.

[e]Age groups were 18–24, 25–34, and 35–49 years; self-reported influenza vaccination highest among those 25–34 years of age.

[f]Education levels: high school education or less, some college/college degree (reference), advanced degree, and unknown or missing education.