Racial and Ethnic Differences in Maternal and Child COVID-19 Vaccination Intent Among Pregnant and Postpartum Women in the USA (April–June 2020): an Application of Health Belief Model

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Abstract
This study investigated racial/ethnic differences in pregnant and postpartum women’s intentions to receive the COVID-19 vaccination (maternal COVID-19 vaccination intent) and intentions to vaccinate their children against COVID-19 (child COVID-19 vaccination intent) during the early months of the COVID-19 pandemic (April–June 2020). This study also assessed Health Belief Model constructs to examine their influence on maternal and child COVID-19 vaccination intent by race/ethnicity. This study includes 489 US pregnant and postpartum women (18–49 years) recruited via Prolific Academic to complete a 55-item cross-sectional online survey. Crude and adjusted logistic regression analyses were conducted to determine the associations between race/ethnicity, maternal COVID-19 vaccination intent, and child COVID-19 vaccination intent. Among pregnant women, the odds of maternal COVID-19 vaccination intent (aOR = 2.20, 95% CI: 0.862, 5.61) and child COVID-19 vaccination intent (aOR = .194, 95% CI: .066, .565) among NH Black women were statistically significantly lower than that of NH White women after adjustment for demographic, health, and health belief model variables. Among postpartum women, although some racial differences in maternal or child COVID-19 vaccination intent were observed, these differences were not statistically significant in unadjusted and adjusted models. The findings have implications for future research and interventions which should adopt a racial health equity lens and identify strategies grounded in institutional trustworthiness and systems perspectives to address racial/ethnic disparities in COVID-19 vaccination intent among pregnant and postpartum women during novel pandemics.

Keywords COVID-19 · COVID-19 vaccine · Health disparities · Vaccine acceptance · Vaccine intent · Health Belief Model

Introduction
As of July 2022, over 90 million COVID-19 cases and 1 million deaths from COVID-19, caused by severe acute respiratory syndrome coronavirus 2 (SAR-Cov-2), have occurred in the USA [1]. The novel COVID-19 pandemic poses a significant threat to the health and well-being of pregnant and postpartum people. Current evidence indicates that pregnant and postpartum women with severe symptomatic COVID-19 infection are at increased risk for adverse outcomes including preterm birth, preeclampsia, and mortality [2, 3]. While symptomatic COVID-19 infection is associated with increased risk for intensive care unit (ICU) admission for pregnant women, pronounced racial and ethnic disparities in COVID-19-related morbidity and mortality exist [3]. Vaccination is one of the most effective public health strategies to prevent maternal and infant morbidity or death from infectious disease. Currently, COVID-19 vaccination...
is recommended for the perinatal population—pregnant and postpartum (including lactating) people—as well as for children ages 6 months or older. In 2021, nationally representative data on COVID-19 vaccination coverage and intent among adults and children were gathered using the National Immunization Surveys (NIS) [4]. According to NIS data, 76.5% of pregnant and 76.3% of lactating people have been fully vaccinated [5]. National data indicate racial and ethnic disparities in COVID-19 vaccination coverage with full vaccination being lowest among non-Hispanic (NH) Black women [6–8]. Also, data indicate that 32.7% of US children ages 6 months to 17 years are fully vaccinated [9]. Currently, 0.3% of children ages 6 months to 4 years are fully vaccinated (with 3.5% who have received at least one dose) [9]. Among children ages 5 to 11 years, 29.6% are fully vaccinated [9]. There are some variations in children’s vaccination status by race/ethnicity. Among children ages 6 months to 17 years, 33.1% of Hispanic children, 34.4% of NH White children, and 29.9% of NH Black children are fully vaccinated [9].

COVID-19 Vaccine Hesitancy and Intent

The development, authorization, and production of the COVID-19 vaccines occurred at an unprecedented speed due to increased international research collaboration, financial investment in research and manufacturing capacity, and the use of novel messenger ribonucleic acid (mRNA) vaccine technology [10]. The national COVID-19 vaccination program rollout, however, was met with several challenges including vaccine hesitancy, or a “delay in acceptance or refusal of vaccines despite availability of vaccination services” [11]. Vaccine hesitancy is not a new phenomenon, but the COVID-19 vaccine presented a novel context to the subject of vaccine hesitancy because of the dynamic confluence of macro-level factors such as public’s perception of the speed at which the COVID-19 vaccines were developed, the COVID-19 infodemic (or too much information including false or misleading information in digital and physical environments during a disease outbreak) [12], sociopolitical polarization related to the pandemic and vaccine, increased visibility of racial injustice and racialized state violence during the pandemic, public health communication missteps that influenced the public’s trust and confidence in public health experts. Common reasons for COVID-19 vaccine hesitancy or refusal include concerns about the speed at which the vaccines were developed and distributed, concerns about vaccine safety and efficacy, a general lack of trust of medical and government officials, and beliefs that COVID-19 infection led to immunity [13, 14]. Among historically marginalized racial and ethnic groups, especially Black and Indigenous communities, vaccine hesitancy (and deliberation) is largely underpinned by the legacy of historical and contemporary institutional racism that justified the experimentation, exploitation, and eradication of communities of color [14, 15]. Prior studies focused on pregnant and postpartum women have reported their concerns about the initial exclusion of pregnant women from clinical trials. Accordingly, pregnant women have expressed concerns about the safety of the COVID-19 vaccine for themselves and their developing fetus [7, 16, 17]. Among non-pregnant reproductive age, there were concerns about the effect of COVID-19 vaccines on their fertility or menstrual cycles [18–20].

Although no nationally representative data are available for 2020, data from April to May 2021 indicate that the percentage of pregnant and lactating people reporting that they will definitely get vaccinated was 2.9% and 3.7%, respectively [5]. By July–August 2022, 3.1% of pregnant people and 6.9% of lactating people reported that they will definitely get vaccinated [5]. During both time periods, COVID-19 vaccination intent was highest among NH White adults, followed by Hispanic adults, and NH Black adults [5]. A growing number of studies have investigated parents’ intentions to vaccinate their child against COVID-19. Some studies have reported that parents may demonstrate greater hesitancy in vaccinating their child against COVID-19 due to concerns about efficacy and safety [21–23]. Also, some studies suggest that parents’ intentions to vaccinate their child against COVID-19 differ by race and ethnicity and other characteristics [23–25]. Relatively few studies, however, have focused specifically on pregnant and postpartum (or lactating) women’s intentions to vaccinate their child against COVID-19 [26]. Since mothers are often the chief decision-makers for their children’s immunization care [27, 28], it is important to understand pregnant and postpartum women’s intent to vaccinate their child against novel infectious diseases such as COVID-19. More research is needed, however, to identify and understand the factors that may predict COVID-19 vaccination intent in this population.

Health Belief Model

The Health Belief Model (HBM) is used widely to predict COVID-19 vaccine intent in the general adult population and among parents of children aged 5 years or older [29–32]. HBM posits that individuals’ decision to engage in health behavior is predicted by six constructs: perceived susceptibility, perceived severity, benefits to action, barriers to action, self-efficacy, and cues to action [33]. In the context

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1 Children 6 months to 4 years are fully vaccinated if they are reported to have received three doses and their first dose was a Pfizer vaccine or if they are reported to have received two doses and their first dose was a Moderna vaccine. Children ages 5–17 years are fully vaccinated if they are reported to have received at least two COVID-19 vaccine doses [9].
of COVID-19, perceived susceptibility refers to one’s belief about their likelihood of being infected by SARS-CoV-2 and developing COVID-19 symptoms [33]. Perceived severity refers to one’s perception that those symptoms are likely to be severe or lead to hospitalization, long-term health outcomes, or death [33]. Among US adults, perceived susceptibility and severity of COVID-19 are positively associated with COVID-19 vaccination intent [34]. Although there are no identifiable studies using HBM to examine COVID-19 vaccination intent among pregnant and postpartum women, there are numerous studies documenting high levels of COVID-19 related fear and anxiety in this population [35, 36]. Among caregivers with children, perceived severity of COVID-19 infection for their child is associated with COVID-19 vaccine intent [37]. According to HBM, even if an individual perceives personal susceptibility and severity of the disease, their behavior change will be influenced by that individual’s personal beliefs regarding perceived benefits of available actions for reducing the disease threat. Perceived benefits of the vaccine are associated with vaccination intent [34, 38]. In general, perceived benefits to getting the COVID-19 vaccine include the vaccine decreasing the chance of COVID-19 infection or its complications and general beliefs about vaccines being safe or preventing disease [38, 39]. Among pregnant women and mothers of young children, perceived benefits include belief in the protective effects of the COVID-19 vaccine [40]. Also, among caregivers of children, perceived benefits of vaccinating their child against COVID-19 include belief in the safety and efficacy of the vaccine, and an opportunity to return to normalcy (e.g., returning to school and traveling to see family and friends) [41].

In terms of perceived barriers, previous studies have examined clinical barriers and access barriers regarding the COVID-19 vaccine and perceived barriers to protecting oneself from COVID-19 infection. Among adults in general, reported clinical barriers include side effects from the vaccine, death from the vaccine, and pain or illness associated with the vaccine [39]. Barriers related to vaccine access include perceived difficulty in getting the vaccine, perceived shortage of vaccines, and perceived monetary cost of the vaccine [39]. Pregnant women and postpartum women have often cited concerns about lack of data about the COVID-19 vaccine safety in pregnant populations and potential harm to fetus [16, 42]. Even among women planning for pregnancy, there have been concerns about the impact of COVID-19 vaccines on fertility [18]. Caregivers of children have reported similar concerns such as the novelty of the vaccine, potential side effects of the vaccine, and concerns about its efficacy [43].

Self-efficacy refers to one’s confidence in their ability to execute health protection behaviors. In the existing literature, studies have explored COVID-19 self-efficacy (confidence in one’s ability to execute behaviors to protect themselves from COVID-19 infection) [38, 44] and vaccine self-efficacy (confidence in one’s ability to receive the vaccine in order to protect themselves from COVID-19 infection) [38, 45]. It appears that vaccine self-efficacy may be associated with COVID-19 vaccination intent, while COVID-19 self-efficacy is not [38, 44, 45]. Due to gaps in the literature, it is not clear what the associations between self-efficacy and COVID-19 vaccination intent are among pregnant and postpartum women. One limitation of the HBM is its failure to account for the impact of broader contextual factors [33]. Vaccine intent is complex and is driven by diverse demographic, sociopolitical, psychological, and structural factors.

Study Objective

It is important to recognize that structural racism is a driver of racial/ethnic disparities in COVID-19 vaccination intent and rates [46], and thus policy and systems-level intervention is crucial. However, identification of individual-level factors associated with maternal and child COVID-19 vaccination intent may prove to be useful to the development of multi-level public health interventions designed to improve vaccine uptake. Knowledge gaps in the literature include a lack of studies examining both maternal and child COVID-19 vaccination intent among pregnant and postpartum women—especially during the early months of the pandemic before the availability of COVID-19 vaccines—and a limited understanding of racial/ethnic and other sociodemographic variations in COVID-19 vaccine intent among pregnant and postpartum women.

Therefore, the study objective was to investigate racial/ethnic differences in pregnant and postpartum women’s intentions to receive the COVID-19 vaccination (maternal COVID-19 vaccination intent) and intentions to vaccinate their children against COVID-19 (child COVID-19 vaccination intent) during the early months of the COVID-19 pandemic (April–June 2020). At the time of this study, COVID-19 vaccines were not available. This study incorporated Health Belief Model constructs (e.g., perceived susceptibility and perceived severity) to understand their potential influence on maternal and child COVID-19 vaccination intent by race/ethnicity among pregnant and postpartum women.

Methods

Study Design and Recruitment

The current study used a cross-sectional online survey of pregnant and postpartum women (a woman who delivered a live birth in the last 12 months at the time of the survey) in the USA. Eligible participants were women ages 18–49 years old, English-speaking, and had permanent
residence in the USA. Prolific Academic, a high-quality online research recruitment platform, was used to recruit participants [47]. Eligible participants enrolled in the study on a first-come, first-serve basis and responses were capped at 600 respondents. The survey was created using QuestionPro and was posted to Prolific Academic between 15 April 2020 and 30 June 2020—during the first phase of the COVID-19 mandatory lockdown in the USA, which was prior to the development of any COVID-19 vaccines. Eligible individuals clicked the survey study link, completed the informed consent, and if they agreed to the study, completed the survey. Participants were compensated at the rate of USD $11.00 per hour to complete the survey. The survey took on average 10 min to complete.

The online survey included 55 questions that assessed COVID-19 knowledge, perceptions of COVID-19 messaging, COVID-19 preventive behaviors, vaccination intent, perceived social support and barriers, use of health and social services during COVID-19, stress, medical, and government mistrust, and demographic information. The survey included items from validated survey instruments and/or adapted from prior studies applying HBM to infectious disease outbreaks [39, 48–51]. Guided by Prolific Academic’s attention and comprehension check policy, three instructional manipulation checks were included in the study with a plan to reject responses that failed at least two of the checks. The authors pilot-tested the survey with 10 pregnant and postpartum women to evaluate readability, comprehension, duration, and confirm survey functionality.

Measures

The independent variable in this study was race/ethnicity. Participants were able to select one ethnicity (Hispanic, Non-Hispanic) and one racial category including American Indian/Alaska Native, Arab American, Asian American or Pacific Islander (AAPI), Black/African American, Other (open-ended), and White. Responses were collapsed to create a new race/ethnicity variable with the following categories: Hispanic, NH AAPI, NH Black, and NH White. The “American Indian/Alaska Native,” “multiracial,” NH AAPI, and “other” response categories were dropped from the new variable and analyses due to small numbers which resulted in wide confidence intervals. The research team decided against creating a “NH Other” group which lumps all of the smaller racial/ethnic subgroups into one category because it is uninformative, may be considered pejorative, and makes it difficult to identify tailored program and policy interventions [52]. The present study used NH White as a reference group. Race and ethnicity are complex social constructs that influence personal identity, group social relations, and differential access to the goods, services, information, and opportunities of society (Jones, 2000). A consequence of the systems that create and reinforce structural racism is that NH White people as a group experience systematic advantages which manifest as better health and healthcare outcomes [53–55]. Therefore, we used NH White as a reference group because within the context of COVID-19 racial inequities and the realities of structural racism, this group is expected to demonstrate outcomes that are consistent with access to high-quality information and resources due to their social position in US society.

Covariates included demographic and health belief variables. Demographic variables included education level (1 = less than 4-year college degree, 2 = 4-year college degree or more), employment status (1 = employed full-or part-time, 2 = unemployed), type of residence (1 = rural, 2 = urban, 3 = suburban), presence of chronic health condition (1 = no reported chronic health conditions, 2 = at least one chronic health condition), nativity (1 = US born, 2 = foreign born), ever received an influenza vaccine (flu shot) (1 = yes, 2 = no), and reproductive category (1 = pregnant, 2 = postpartum). We defined chronic health condition as “conditions that last one year or more and require ongoing medical attention or limit activities of daily living or both” [56]. This variable was measured using a select-all-that-apply question which provided a list of common chronic conditions and an open-ended option for conditions that were not presented in the list. This variable was recoded and dichotomized.

Health belief variables included perceived severity (“If diagnosed with COVID-19, I will get very ill”), perceived susceptibility (“I am at increased risk for getting COVID-19”), self-efficacy (“I am confident that I can reduce my risk of exposure to COVID-19”), and perceived benefits of protective measures (“Washing my hands frequently can reduce my chances of getting COVID-19,” “Practicing social/physical distancing can reduce my chances of getting COVID-19”). Participants used a 4-point Likert scale (agree, somewhat agree, somewhat disagree, disagree). Responses were collapsed to create a dichotomous variable (1 = agree, 2 = disagree). The final health belief variable was perceived barriers which was a dichotomous variable (1 = no reported social barriers, 2 = at least one reported social barrier) based on a select-all-that-apply question with the following options: I am a medical essential worker, I am a non-medical essential worker, I live with an essential worker, I live with people who do not believe the virus is serious, I cannot afford to stop working, I rely on public transportation, I do not have childcare, and I feel isolated and need social interaction.

Two dependent variables were evaluated in this study. Participants were asked to indicate whether they would get a COVID-19 vaccination if one was recommended by their doctor and whether they would allow their child to receive a COVID-19 vaccination if one was recommended by their doctor. The response options included 1 = yes and 2 = no.
Statistical Analyses

Descriptive statistics were calculated for all variables, including mean and standard deviation for continuous variables and percentages for categorical variables. We used Little’s MCAR test to check for the extent and pattern of missing values in the data [57]. Also, post-stratification weights were created for race/ethnicity (Hispanic, NH Black, NH White). Post-stratification weights can help ensure that the proportions for race/ethnicity in a sample match that of the US population of reproductive age women [58]. According to available data, the 2016 population estimates for reproductive age women were 56.7% White women, 20.5% Hispanic women, and 14.6% Black women [59]. Post-stratification weights increase or decrease the influence of each respondent’s data depending on whether their characteristics are under or over represented in the survey sample relative to the population [60]. A post-stratified base weight was calculated for each person in the sample as follows:

\[ WP_{hi} = \frac{N_h}{\sum_{i=1}^{n_h} W_{hi}} \]

where \( WP_{hi} \) is the post-stratified base weight for the \( ih \) person in the \( hth \) racial/ethnic group; \( W_{hi} \) is the base weight for the \( ih \) person in the \( hth \) racial/ethnic group; \( N_h \) is the population total for the \( hth \) racial/ethnic group; and \( n_h \) is the number of respondents in the \( hth \) racial/ethnic group.

Bivariate analyses (chi-square tests, \( p < 0.05 \)) were conducted to make comparisons between racial/ethnic groups and pregnancy status for predictor variables and covariates. Crude and adjusted binary logistic regression analyses stratified by pregnancy status were performed to determine the association between race/ethnicity and (1) maternal COVID-19 vaccination intent and (2) child COVID-19 vaccination intent.

SAS Version 9.4 (SAS 9.4, Cary, NC. SAS Institute Inc.) was used to perform all statistical analyses. A \( p \)-value of 0.05 or less was the threshold for statistical significance. This study was approved by the Institutional Review Board at the University of Texas at Arlington (protocol # 2020–0596).

Results

Participant Characteristics

Six hundred respondents completed the survey. Sixteen cases were excluded from analysis after eligibility screening and data cleaning. For analysis purposes, respondents who did not self-report as Hispanic, NH Black, or NH White were excluded from analyses due to small subgroup counts. The final unweighted sample size was 489. Table 1 provides the participant characteristics.

As shown in Table 1, the sample consisted mostly of participants who were postpartum, had a 4-year college degree or more, were ages 18–34, partnered/married, employed, and insured. All participants self-identified as “woman.” Among pregnant participants, 62.2% were primigravida.

There were some racial/ethnic differences in participant characteristics For example, a greater proportion of NH White participants resided in suburban areas and a greater proportion of NH Black participants resided in urban areas \((p=0.001)\). A greater proportion of NH Black participants were employed full- or part-time at the time of the study \((p=0.044)\). A greater proportion of NH Black participants reported ever having influenza \((p=0.001)\).

There were only a few statistically significant differences in characteristics among pregnant and postpartum participants. Compared to postpartum participants, a greater proportion of pregnant participants reported having a 4-year college degree or more \((p=0.014)\), and reported greater perceived severity of COVID-19 infection \((p=0.001)\). Compared to pregnant participants, a greater proportion of postpartum women reported having a chronic health condition \((p=0.011)\), and reported being employed \((p=0.047)\). Also, analyses indicate that compared to participants with no chronic health condition, those with chronic health conditions were more likely to make less than $40,000 annually \((p=0.01)\), more likely to report ever having influenza \((p=0.043)\), more likely to report greater susceptibility to COVID-19 infection \((p=0.001)\), and greater perceived illness severity from COVID-19 infection \((p=0.001)\).

Racial/Ethnic Differences in Maternal and Child COVID-19 Vaccination Intent Among Pregnant Women (April–June 2020)

Maternal COVID-19 Vaccination Intent Among pregnant women, 80% reported maternal COVID-19 vaccination intent. As shown in Table 2, the odds of maternal COVID-19 vaccination intent were statistically significantly lower among NH Black women compared with NH White women (OR = 0.290, 95% CI: 0.125, 0.675). After adjustment for demographic, health, and HBM variables, the odds of maternal COVID-19 vaccination intent remained statistically significantly lower among NH Black women. Although being primigravida was statistically significantly associated with maternal vaccination intent in model 2 (aOR = 2.73, 95% CI: 1.13, 6.51), this association failed to reach statistical significance in model 3 (aOR = 2.31, 95% CI: 0.922, 5.81) and model 4 (aOR = 2.20, 95% CI: 0.862, 5.61). In the final adjusted model, history of ever receiving the influenza
vaccine remained statistically significantly associated with maternal COVID-19 vaccination intent regardless of race/ethnicity (aOR = 4.22, 95% CI: 1.51, 11.82).

Child COVID-19 Vaccination Intent Among pregnant women, 78% reported child COVID-19 vaccination intent. As shown

### Table 1 Participant characteristics

| Variable                     | Unweighted (N=489) | Weighted (N=536) |
|------------------------------|--------------------|------------------|
|                              | N     | %    | N     | %    |
| **Demographic variables**    |       |      |       |      |
| Race/ethnicity               |       |      |       |      |
| Hispanic                     | 69    | 22%  | 120   | 22.3%|
| NH Black                     | 95    | 16%  | 85    | 15.9%|
| NH White                     | 325   | 62%  | 331   | 61.7%|
| **Reproductive status**      |       |      |       |      |
| Pregnant                     | 171   | 35%  | 187   | 34.9%|
| Postpartum                   | 318   | 65%  | 350   | 65.1%|
| **Education**                |       |      |       |      |
| Less than a 4-year degree    | 193   | 41%  | 213   | 41.1%|
| Four-year degree or more     | 279   | 59%  | 305   | 58.9%|
| Not reported                 | 17    | 3.5% | 18    | 3.11%|
| **Age group**                |       |      |       |      |
| 18–34                        | 366   | 74.8%| 404   | 77.9%|
| 35–49                        | 106   | 21.7%| 114   | 22%  |
| Not reported                 | 17    | 3.5% | 18    | 3.1% |
| **Marital status**           |       |      |       |      |
| Married/partnered            | 239   | 50%  | 259   | 49.9%|
| Unmarried/unpartnered        | 233   | 50%  | 260   | 50.1%|
| Not reported                 | 17    | 3.5% | 18    | 3.1% |
| **Nativity**                 |       |      |       |      |
| US born                      | 447   | 96%  | 491   | 95.7%|
| Foreign born                 | 20    | 4.2% | 22    | 4.2% |
| Not reported                 | 22    | 4.5% | 25    | 4.3% |
| **Residence type**           |       |      |       |      |
| Rural                        | 71    | 14.5%| 78    | 14.5%|
| Suburban                     | 241   | 48.3%| 259   | 48.3%|
| Urban                        | 152   | 32.4%| 174   | 32.4%|
| Not reported                 | 25    | 5.1% | 26    | 4.6% |
| **Annual gross income**      |       |      |       |      |
| Less than $40,000            | 150   | 30.6%| 166   | 32.1%|
| $40,001–$65,000              | 113   | 23%  | 128   | 24.8%|
| More than $65,001            | 209   | 43%  | 223   | 43.1%|
| Not reported                 | 17    | 3.4% | 19    |      |
| **Employment status**        |       |      |       |      |
| Yes                          | 300   | 61.3%| 323   | 59.7%|
| No                           | 171   | 35%  | 195   | 37%  |
| Not reported                 | 18    | 3.7% | 18    | 3.3% |
| **Current health insurance** |       |      |       |      |
| Yes                          | 429   | 87.7%| 470   | 88.1%|
| No                           | 43    | 8.8% | 48    | 8.8% |
| Not reported                 | 17    | 3.5% | 18    | 3.1% |
| **Primigravida (pregnant women only)** |       |      |       |      |
| Yes                          | 98    | 62.2%| 71    | 62.2%|
| No                           | 67    | 37.8%| 108   | 37.8%|

### Table 1 (continued)

| Variable                              | Unweighted (N=489) | Weighted (N=536) |
|---------------------------------------|--------------------|------------------|
|                                      | N     | %    | N     | %    |

| **Health variables**                  |       |      |       |      |
| Report at least one chronic health condition | 67    | 37.8%| 108   | 37.8%|

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1Defined as health conditions that last 1 year or more and require ongoing medical attention or limits activities of daily living or both such as diabetes, hypertension, and asthma.
in Table 2, the odds of child COVID-19 vaccination intent were also statistically significantly lower among NH Black women in unadjusted and adjusted models. In the final adjusted model, history of ever receiving the influenza vaccine remained statistically significantly associated with child COVID-19 vaccination intent regardless of race/ethnicity (aOR = 3.34, 95% CI: 1.27, 8.74).

### Racial/Ethnic Differences in Maternal and Child COVID-19 Vaccination Intent Among Postpartum Women (April–June 2020)

**Maternal COVID-19 Vaccination Intent** Among postpartum women, 83.4% reported maternal COVID-19 vaccination intent. As shown in Table 3, there were no statistically significant differences in maternal COVID-19 vaccination intent by race/ethnicity before and after adjusting for demographic, health, and HBM variables. Although not statistically significant, the odds of child COVID-19 vaccination intent were lower among NH Black women and slightly higher among Hispanic women. In the final adjusted model (model 4), postpartum women with a history of ever receiving the influenza vaccine (aOR = 3.78, 95% CI: 1.89, 7.55) and postpartum women with a chronic health condition (aOR = 0.430, 95% CI: 0.211, 0.874) were more likely to report child COVID-19 vaccination intent regardless of race/ethnicity.

| Table 2 Crude and adjusted logistic regression results (95% CI) for maternal and child COVID-19 vaccination intent by race/ethnicity among pregnant women |
|---------------------------------|-----------------|-----------------|-----------------|-----------------|
| Maternal COVID-19 vaccination intent | Model 1<sup>a</sup> | Model 2<sup>b</sup> | Model 3<sup>c</sup> | Model 4<sup>d</sup> |
| Maternal COVID-19 vaccination intent | | | | |
| Hispanic women | 1.23 (0.328, 4.58) | 0.935 (0.233, 3.75) | 1.24 (0.295, 5.20) | 1.14 (0.266, 4.87) |
| NH Black women | 0.290 (0.125, 0.675) | 0.209 (0.079, 0.551) | 0.254 (0.092, 0.701) | 0.227 (0.077, 0.672) |
| NH White women | 1.00 | 1.00 | 1.00 | 1.00 |
| Child COVID-19 vaccination intent | | | | |
| Hispanic women | 1.05 (0.322, 3.42) | 0.881 (0.258, 3.1) | 1.01 (0.289, 3.58) | 0.833 (0.227, 3.06) |
| NH Black women | 0.311 (0.137, 0.707) | 0.224 (0.089, 0.560) | 0.252 (0.096, 0.662) | 0.194 (0.066, 0.565) |
| NH White women | 1.00 | 1.00 | 1.00 | 1.00 |

<sup>a</sup>Unadjusted model  
<sup>b</sup>Adjusted for demographic variables (age, insurance status, marital status, income level, employment status, primagravida, and education)  
<sup>c</sup>Adjusted for model 2 + health factors (presence of at least one chronic health condition, ever had influenza vaccine)  
<sup>d</sup>Adjusted for model 3 + HBM variables (perceived severity, perceived susceptibility, COVID-19 self-efficacy, perceived barriers, perceived benefits)  

Bolded values indicate statistical significance (p < .05)

**Discussion**

The present study used the Health Belief Model as a framework to investigate racial/ethnic differences in pregnant and postpartum women’s intentions to receive the COVID-19 vaccination (maternal COVID-19 vaccination intent) and intentions to vaccinate their children against COVID-19 (child COVID-19 vaccination intent). This study was conducted during the early months of the COVID-19 pandemic (April–June 2020) and the latter stages of the COVID-19 stay-at-home mandates. This was a time period during which health and government officials relied heavily on health communication and physical distancing strategies to reduce the spread of COVID-19. There was limited, yet constantly evolving, scientific literature about the impact of COVID-19 among pregnant and postpartum people. There was also inconsistent or incomplete information about potential risk of maternal-to-infant transmission and guidelines and policies related to lactation, mother-infant separation, and hospital visitation [61, 62]. During 2020, COVID-19 vaccine trials (which initially excluded pregnant and lactating women) started in March 2020 [63], by April 2020, Operation Warp Speed was launched, and in December 2020, the Food and
Drug Administration issues an Emergency Use Authorization for the first COVID-19 vaccine [64]. Therefore, this study sought to provide insight into racial/ethnic differences in COVID-19 vaccination intent among the pregnant and postpartum population prior to the development and distribution of any COVID-19 vaccine. As the COVID-19 pandemic persists, and in anticipation of the next pandemic, this insight may be crucial for strengthening clinical and public health strategies during the early stages of a public health emergency [65].

The first major finding is the percentage of pregnant women indicating maternal and child COVID-19 vaccination intent was slightly lower than that of postpartum women, but this difference was not statistically significant. It is not surprising that maternal and child COVID-19 vaccination intent among pregnant women was lower because of their unique concerns about COVID-19 vaccine safety [14, 16, 42].

Second, racial/ethnic differences in maternal and child COVID-19 vaccination intent among pregnant women persisted after controlling for demographic, health, and HBM variables. Specifically, pregnant NH Black women had statistically significantly lower odds of maternal and child COVID-19 vaccination intent during the early months of the COVID-19 pandemic (April–June 2020) compared to their NH White counterparts. The odds of maternal and child COVID-19 vaccination during the early months of the COVID-19 pandemic were also lower among pregnant Hispanic women compared with NH White women, but this association was not statistically significant. The reason for this finding is unclear. But, other studies report that COVID-19 vaccination intentions among Hispanic adults have been similar to that of NH White adults [5, 66]. Also, some studies have reported differences in COVID-19 vaccination intent among Hispanic pregnant women by primary language spoken [42]. Therefore, it is possible that the present study did not capture characteristics, such as language, that might further explain potential differences in intent. Overall, these findings, specifically those related to pregnant NH Black women, are consistent with other studies conducted after the distribution of the COVID-19 vaccine [7, 17]. Also consistent with previously published literature, having ever received the influenza vaccine prior to the COVID-19 pandemic was a strong predictor of maternal and child COVID-19 vaccination intent among pregnant women regardless of race/ethnicity [17, 34, 37, 67].

This study also found no statistically significant racial/ethnic differences in maternal and child COVID-19 vaccination intent among postpartum women before and after adjusting for demographic, health, and HBM variables. More specifically, the odds of maternal and child COVID-19 vaccination intent were lower among postpartum NH Black women compared with NH White women. Also, the odds of maternal and child COVID-19 vaccination intent among postpartum Hispanic women were lower compared to NH White women. Although surprised that there were no observed racial/ethnic differences in maternal and child COVID-19 vaccination intent, this could be explained by the fact that, in general, vaccination intent has been higher among postpartum women compared to pregnant women [5, 42]. Prior studies have examined factors associated with maternal and/or child COVID-19 vaccination intent among pregnant people [6, 17, 29, 31] or combined samples of pregnant and postpartum people [68, 69]. However, no identifiable studies examining racial/ethnic differences in maternal and/or child COVID-19 vaccination intent nor factors associated with maternal and/or child COVID-19 vaccination intent have stratified results by maternal status (pregnant/postpartum). Therefore, future studies with larger sample sizes should consider this approach. Similar to pregnant women, postpartum women reporting ever receiving an

|                           | Model 1\(^a\) | Model 2\(^b\) | Model 3\(^c\) | Model 4\(^d\) |
|---------------------------|---------------|---------------|---------------|---------------|
| Maternal COVID-19 vaccination intent |               |               |               |               |
| Hispanic women            | .719 (.326, 1.58) | .624 (.275, 1.42) | .665 (.285, 1.55) | .633 (.267, 1.50) |
| NH Black women            | .611 (.302, 1.23) | .559 (.265, 1.17) | .487 (.224, 1.05) | .522 (.235, 1.16) |
| NH White women            | 1.00          | 1.00          | 1.00          | 1.00          |
| Child COVID-19 vaccination intent |               |               |               |               |
| Hispanic women            | 1.48 (.622, 3.54) | 1.34 (.547, 3.28) | 1.45 (.579, 3.64) | 1.44 (.564, 3.70) |
| NH Black women            | .643 (.334, 1.24) | .601 (.300, 1.20) | .533 (.260, 1.09) | .549 (.262, 1.14) |
| NH White women            | 1.00          | 1.00          | 1.00          | 1.00          |

\(^a\)Unadjusted model  
\(^b\)Adjusted for demographic variables (age, insurance status, marital status, income level, employment status, and education)  
\(^c\)Adjusted for model 2 + health factors (presence of at least one chronic health condition, ever had influenza vaccine)  
\(^d\)Adjusted for model 3 + HBM variables (perceived severity, perceived susceptibility, COVID-19 self-efficacy, perceived barriers, perceived benefits)
influenza vaccine remained a statistically significant predictor of maternal and child COVID-19 vaccination intent in all adjusted models which is consistent with prior studies [17, 34, 37, 67].

Overall, the findings from this study suggest that targeting women with influenza vaccination history may be a crucial part of increasing vaccination uptake among pregnant and postpartum women regardless of race/ethnicity [70, 71]. These findings also have implications for researcher and clinicians considering approaches that involve coadministration of influenza and COVID-19 vaccinations. Considering recent research demonstrating the safety, immunogenicity, and efficacy of this approach [72], it is possible that this may become a more prominent immunization strategy in this population. Finally, the findings indicate that interventions informed by HBM alone may not be enough to reduce disparities in COVID-19 vaccination coverage among pregnant women. Other theories and theoretical constructs should be utilized to examine COVID-19 vaccination coverage (e.g., transtheoretical model).

The findings of the present study should be interpreted within a racial health equity lens. Vaccination intent and uptake are complex phenomena shaped by various demographic, sociopolitical, psychological, and structural factors. The HBM fails to clearly account for how broader contextual factors may shape intentions and behaviors [33], which may explain why HBM constructs had little influence on maternal and child COVID-19 vaccination intent among pregnant and postpartum women. Our findings underline the need for including broader social and structural variables that may aid in understanding the nuances of vaccination intent, especially among NH Black pregnant and postpartum women. It is important to consider how health-related intentions and decisions are made within a larger sociopolitical and historical context. For example, vaccination intent among the general population, including pregnant and postpartum women, is lower in the USA compared to other nations which may be associated with the pervasive anti-vaccination campaigns observed in the USA [68, 73, 74]. For many racial and ethnic minoritized groups, specifically Black women, vaccine hesitancy and deliberation are justified considering historical and contemporary practices rooted in racism, which has negatively affected the health, well-being, and social position of populations of color. Current concerns about vaccination intent and uptake among racial and ethnic minoritized groups are a symptom of a much deeper problem—structural racism [15]. The guise of medical mistrust that is often referenced as an explanation for disparities in vaccination intent and uptake masks underlying inequities in vaccine messaging and distribution efforts [15]. Public health interventions should reconsider efforts aimed at changing individuals’ trust levels and invest in efforts that demonstrate institutional trustworthiness and an authentic commitment to racial health equity [15, 75, 76]. For example, the Association of American Medical Colleges (AAMC) Center for Health Justice recently released a Principles of Trustworthiness Toolkit that can aid institutions and organizations in translating the 10 Principles of Trustworthiness into their efforts to build community partnerships, foster trust, and work toward achieving health equity in communities [75]. Relatedly, there may be a need for policies and practices that ensure Black pregnant and postpartum women have safe, non-judgmental spaces to have honest conversations about the COVID-19 vaccine and to ensure equitable access to vaccination services (e.g., mobile clinics sponsored by trusted organizations and transportation to appointments) [15, 77]. Finally, research and prevention efforts should consider adopting syndemic perspectives which can enable a holistic and nuanced understanding of the intersection of endemic and COVID-19 specific vulnerabilities experienced by Black pregnant and postpartum people [78]. Doing so has the potential to lead to impactful multi-level and multi-actor (e.g., pregnant, and postpartum people, providers, and organizations) strategies to promote COVID-19 vaccination uptake.

**Study Limitations**

Despite the strengths of the present study, there are several limitations that should be considered when interpreting the findings. First, Prolific Academic was used to recruit a convenience sample of pregnant and postpartum people in the USA. Although Prolific Academic generally provides quality data and subject pools [47, 79], the sample represents pregnant and postpartum women who have a Prolific Academic account, who own smartphones or computers with Internet access, and the ability to enroll themselves into the study. Therefore, the study results may not be generalizable to all pregnant and postpartum people in the USA. Second, the sample was majority NH White and some racial/ethnic minoritized groups were excluded from analyses due to small sample sizes. Third, the present study only reflects COVID-19 vaccine intent during the early months of the pandemic (April–June 2020) when COVID-19 vaccines were not available or widely discussed on news cycles. Relatedly, the present study did not include questions that measured perceived benefits or barriers to the COVID-19 vaccine, but rather perceived benefits and barriers to COVID-19 preventive behaviors (e.g., handwashing and sheltering in place). The inclusion of such questions may have resulted in different findings. Also, the present study did not include a question item to capture to age(s) of participants’ children. Recent research suggests that child COVID-19 vaccination intent may vary based on the age of the child [9]. Finally, although prior research has identified vaccination intent as a predictor of vaccination behavior, caution must be used in assuming that reported intentions translate into vaccine uptake, especially given...
the novelty of COVID-19. Recent reports indicate that while NH White individuals have remained relatively consistent in their COVID-19 vaccination intentions, Hispanic and NH Black adults fluctuated which was believed to be tied to major new-worthy COVID-19 events which may affect people belonging to historically minoritized group differently due to historical context [66]. Future research is needed to see if this played out among pregnant and postpartum women as well.

**Conclusion**

This study provides insight into maternal and child COVID-19 vaccination intent among US pregnant and postpartum women during the early months of the COVID-19 pandemic (April–June 2020). As the USA continues its COVID-19 vaccine rollout, more research on vaccination intent and uptake among diverse pregnant and postpartum people is warranted. Future research should consider including variables based on HBM as well as frameworks and variables that account for structural inequities which may shape maternal and child COVID-19 vaccination intent. Future research should also examine how maternal and child COVID-19 vaccination intent changes over time. Public health practitioners, providers, and researchers should adopt a racial health equity lens and identify strategies grounded in trustworthiness principles and syndemic perspectives to address racial disparities in COVID-19 vaccination intent and uptake in this population.

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**Declarations**

**Ethics Approval** This study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by the Institutional Review Board at the University of Texas at Arlington.

**Consent to Participate** Informed consent was obtained from all individual participants included in the study.

**Consent for Publication** N/A.

**Competing Interests** The authors declare no competing interests.

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