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# Prevalence and correlates of vaccine attitudes and behaviors in a cohort of low-income mothers

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ABSTRACT

The US is facing a rise in vaccine hesitancy, delay, and refusal, though little is known about these outcomes in socio-economically disadvantaged populations. This study examines the prevalence and correlates of vaccine attitudes and behaviors in a diverse cohort of low-income mothers receiving home visiting services. Survey data were collected from 813 recipients of evidence-based home visiting services in Wisconsin from 2013 to 2018. Analyses were performed to describe outcome measures of vaccine attitudes and self-reported completion, and multivariate regressions were used to test associations between vaccine-related outcomes and hypothesized correlates. Most women (94%) reported their children were up to date on vaccines; 14.3% reported having ever delayed vaccination. A small minority disagreed that vaccines are important (5.0%), effective (5.4%), and safe (6.2%), though a larger proportion responded ambivalently (10.9%–21.9%). Participants with greater trust in health care providers reported more positive overall vaccine attitudes (B = 0.24; 95% CI = 0.17, 0.31), a lower likelihood of vaccine delay (OR = 0.57; 95% CI = 0.46, 0.73), and a greater likelihood of being up to date on vaccines (OR = 1.79, 95% CI = 1.30, 2.44). Women with greater trust in a home visitor also rated vaccines more positively (B = 0.09; 95% CI = 0.02, 0.15), and women who reported better mental health were more likely to report their children were up to date (OR = 1.05; 95% CI = 1.02, 1.09). Compared to non-Hispanic whites, American Indians and non-Hispanic blacks had poorer vaccine-related outcomes. More research on vaccine attitudes and behaviors among higher-risk populations is needed to develop tailored strategies aimed at addressing vaccine hesitancy and underimmunization.

## 1. Introduction

Routine childhood vaccination is a cost-effective preventive health measure that will avert approximately 42,000 early deaths and 20 million cases of infectious disease while saving nearly $70 billion in societal costs among the 2009 US birth cohort (Zhou et al., 2014). Vaccines have an excellent safety record (Epling et al., 2014; Prevention, 2015), yet, confidence in vaccine safety and efficacy is falling in the US and worldwide, and rates of vaccine delay and refusal are rising (Glanz et al., 2013; Robison et al., 2012).

Unfavorable attitudes about vaccine safety and efficacy represent a threat to public health that coincides with more vaccine delay and rising rates of underimmunization (Glanz et al., 2013; Robison et al., 2012; McClure et al., 2017), which have subsequently been linked with outbreaks of measles, mumps, and rubella (Addressing Vaccine Hesitancy, 2019; Williams, 2014; Glanz et al., 2013; Phadke et al., 2016). Underimmunization is also associated with higher emergency department utilization, more hospital admissions, increased disease morbidity, and death (Glanz et al., 2013a, 2011b, 2010c, 2013d; McClure et al., 2017; Haemophilus, 2008). Therefore, to improve adherence to recommended vaccine schedules, we must better understand vaccine attitudes, including their variation among population subgroups and association with alterable factors.

Research shows that parents' vaccine decision-making is complex and that personal beliefs and characteristics influence vaccine attitudes and behaviors (Ames et al., 2017). Parental trust in health care providers is a recurring theme in the immunization literature. Health workers are often listed as trusted sources of vaccine information (Ames et al., 2017), and trust in doctors is more common among mothers with favorable vaccine perceptions and those who choose to fully immunize (Williams, 2014; Benin et al., 2006; Edwards and Hackell, 2016). Conversely, mothers who reject vaccines are more likely to report distrust in their

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pediatrician (Ames et al., 2017; Benin et al., 2006; Edwards and Hackell, 2016; Salmon et al., 2005). Although greater trust in pediatric healthcare providers has been linked to more positive parent vaccine perceptions, it is uncertain whether trust in other health and human service providers such as home visitors influences vaccine attitudes or behaviors.

Research also shows that poorer maternal mental health correlates with fewer visits for pediatric preventive care (Minkovitz et al., 2005; Jhanjee et al., 2004), greater utilization of emergency care (Minkovitz et al., 2005; Mandl et al., 1999; Sills et al., 2007), and underimmunization (Cullen et al., 2010). One study found that infants of mothers with more anxiety symptoms were nearly 4 times more likely to have an incomplete vaccination status (Ozkaya et al., 2010), and another suggested that mothers with poorer overall mental health were 3–5 times more likely to delay or refuse the routine immunization schedule (Turner et al., 2003). Parents may also consider a child's health status when making immunization decisions, but maternal perceptions of a child's health has not been studied as a correlate of vaccine outcomes. Likewise, access to a consistent health care location has been identified as a predictor of up-to-date immunization status (Pati et al., 2017), and studies have shown that underimmunized children have lower rates of preventive care visits (Glanz et al., 2013), but it is uncertain whether vaccine perceptions are associated with the frequency of visits for pediatric health care.

Vaccine attitudes and behaviors have been shown to vary by socioeconomic and demographic factors. Poverty and low socioeconomic status (SES) have been linked to greater concerns about vaccine safety, distrust of providers (Shui et al., 2006; Wu et al., 2008; Hill et al., 2017), and lower vaccination coverage (Hill et al., 2017; Hilderman et al., 2011; Kruk et al., 2011; Kendrick et al., 2000; Luman et al., 2003). Some studies suggest that low educational attainment is a barrier to vaccine uptake (Stockwell et al., 2011; Schuller and Probst, 2013) while others suggest that less-educated mothers have more positive vaccine perceptions and that their children have higher immunization rates (Kim et al., 2007). Variation in vaccine perceptions by race and ethnicity also have been observed. Compared to non-Hispanic whites, Hispanics and non-Hispanic blacks have lower coverage rates and more frequent negative attitudes toward vaccination (Luman et al., 2003; Shui et al., 2006; Wu et al., 2008; Hill et al., 2017), though it is uncertain if these differences hold after accounting for the confounding influence of SES (Shui et al., 2006, 2005; Centers for Disease Control and Prevention, 2012). Few studies have examined the vaccine attitudes and behaviors of American Indians, although evidence indicates that their immunization coverage is below the national average (Woinarowicz and Howell, 2020; Hill et al., 2018).

There remain significant gaps in our understanding of vaccine attitudes and behaviors, especially in socioeconomically disadvantaged populations. Whereas research to date represents samples that are whiter, more educated, and more affluent than the general population (Ames et al., 2017; Kennedy et al., 2011), this study examines the prevalence and correlates of vaccine attitudes and behaviors in a racially and ethnically diverse sample of low-income mothers who received home visiting services. Because home visiting programs often provide prenatal and postpartum support to high-risk families with lower vaccine uptake, these interventions have the potential to promote adherence to recommended vaccine schedules (Guide to Community Preventive Services, 2019; Briss et al., 2000; Isaac et al., 2015). Therefore, in addition to household demographics, five alterable factors that are potential intervention targets were examined as potential correlates of vaccine attitudes: trust in health care providers, trust in home visitors, maternal mental health, perceived child health, and frequency of pediatric health care.

## 2. Methods

### 2.1. Study and sample design

This study analyzes data collected from a sample of 813 women with children who enrolled in the Families and Children Thriving (FACT) Study, a longitudinal investigation of low-income families in Wisconsin, United States that began in 2015. All participants received home visiting services within a statewide network of evidence-based programs, including Early Head Start, Healthy Families America, Nurse-Family Partnership, and Parents as Teachers. Subsidized by the federal Maternal Infant and Early Childhood Home Visiting (MIECHV) Program, each home visiting model provides prenatal and postpartum services to at-risk families to enhance maternal health, parenting practices, and infant development. More than 98% of participating households were within 200% of the federal poverty line or were eligible for means-tested benefits.

Data from the first two waves of the FACT Study were analyzed. Wave 1 recruitment activities occurred at least two weeks after the birth of a child associated with a home visiting service episode, at which time a baseline survey was administered to English- and Spanish-speaking mothers. For this analysis, baseline surveys supply data on maternal demographics and perceived trust with home visitors. Wave 2 surveys, which were collected about one year after the baseline assessment, provide data on vaccine-related outcomes and multiple correlates, described below. All participants provided informed consent prior to voluntary study enrollment and received a $40 incentive for completing Wave 1 and a $20 incentive for completing Wave 2 surveys. No families were denied services for declining to participate. Study protocols were approved by a university Institutional Review Board before engaging human subjects.

## 3. Measures

An original three-item measure of attitudes toward childhood vaccines was used to assess the degree to which respondents perceived childhood vaccines to be (1) important for my child's health; (2) effective; and (3) safe. Participants rated their level of agreement with each statement on a scale from (1) strongly agree to (5) strongly disagree. Development of the measure was informed by a review of extant literature prior to study Wave 2 (Larson et al., 2015; Opel et al., 2013), and item content validity was assessed by a panel of experts. A total vaccine attitudes score was computed by summing the items (range 3–15); internal consistency reliability was 0.92. Participants also reported if they had ever delayed vaccinating their child out of safety concerns (yes = 1), and if their child had received all vaccines that are recommended for children up to his/her age (yes = 1). No electronic health record data was used to reinforce this self-reported vaccination data.

At study wave 1, participants reported their level of *home visitor trust* on a single item: "My home visitor and I trust each other." Response options ranged from (1) strongly disagree to (5) strongly agree. Four hypothesized correlates of vaccine hesitancy and delay were assessed at study wave 2. *Child's health* was measured from participants' ratings of their child's overall health on a scale from (1) poor to (5) excellent. Participants reported the *number of child health care visits* (range 0–24) in response to the following question: "In the past six months, not counting emergency room visits, how many times did your child go to a doctor's office or clinic to get health care?" *Health care provider trust* was assessed based on responses to a single item: "Overall, how much do you trust your regular doctor or health care provider?" Responses ranged from (1) not at all to (5) completely. Finally, *global mental health* was assessed using a four-item subscale of the PROMIS® Global-10 (Hays et al., 2009). Raw scores were converted to T-scores and summed (range 21–68), with higher values signifying better mental health. Research indicates that the subscale has good internal consistency reliability and construct validity (Hays et al., 2009). Internal reliability in the present

sample was 0.81.

Demographic factors are analyzed as potential correlates, including *mother's age* at baseline (range 18–50) and *child's age* at study wave 2 (range 1–6). Using baseline data, *mother's race/ethnicity* was categorized as Hispanic or one of four non-Hispanic groups: whites, blacks, American Indians, and other race/ethnicity. *Mother's education* was coded as an ordinal variable ranging from (1) less than high school to (6) four-year college degree.

### 3.1. Statistical analysis

A descriptive analysis was used to calculate the means and proportions for all study measures. Multivariate regressions were conducted to test associations between outcomes and their hypothesized correlates while controlling for covariates. Multiple linear regression along with robust maximum-likelihood estimation was used to estimate associations with perceived vaccine importance, effectiveness, safety, and a total vaccine attitudes score, and logistic regression was used to model associations with dichotomous self-reported outcomes: vaccines delayed and vaccines up to date. The same model specification was used for each regression, with all variables entered simultaneously. Listwise deletion was used to exclude a small proportion of cases with missing data for study outcomes (0.0% to 2.1%). All descriptive analyses were performed using SPSS 25 (Corp, 2017), and regression models were performed using *Mplus* 8.4 (Muthen, 1998–2017).

## 4. Results

Sample demographics are shown in Table 1. Out of 813 women, 44.9% self-identified as non-Hispanic white, 24.6% Hispanic, 18.7% African American, 7.1% American Indian, and 4.7% as other race/ethnicity. Mothers ranged in age from 18 to 50 with a mean of 28.3 years. Children's ages ranged from 1 to 6 with a mean of 1.9 years.

Table 1 shows that 5.0% of respondents disagreed that vaccines are important for their child's health, while 5.4% disagreed that vaccines are effective, and 6.2% disagreed that vaccines are safe. The proportion who responded somewhat agree and disagree to the vaccine hesitancy items was as follows: (1) important for child's health = 10.9%; (2) effective = 14.5%; (3) safe = 21.9%. 14.3% of parents had delayed vaccinating their child and 94.0% of sample children were up to date on all recommended vaccines.

Multivariate analyses (Table 2) showed that participants who reported greater trust in their health care provider rated vaccines as more important for their child's health (B = 0.21; 95% CI = 0.14, 0.28), more effective (B = 0.21; 95% CI = 0.14, 0.28), and safer (B = 0.25; 95% CI = 0.17, 0.32), and they reported more positive vaccine attitudes overall (B = 0.24; 95% CI = 0.17, 0.31). As shown in Table 3, greater trust in health care providers was associated with a reduced likelihood of vaccine delay (OR = 0.57; 95% CI = 0.46, 0.73) and an increased likelihood of being up to date on vaccines (OR = 1.79, 95% CI = 1.20, 2.44). Respondents who reported greater trust in their home visitor also rated vaccines as more effective (B = 0.07; 95% CI = 0.00. 0.13) safer (B = 0.10; 95% CI = 0.04, 0.17), and more positively overall (B = 0.09; 95% CI = 0.02, 0.15).

Racial/ethnic differences in vaccine attitudes were observed (see Tables 2 and 3). Compared to non-Hispanic whites, American Indians rated vaccines as less important for their child's health (B = −0.08; 95% CI = −0.14, −0.01), less effective (B = −0.10; 95% CI = −0.16, −0.03), and less safe (B = −0.08; 95% CI = −0.14, −0.02), and their vaccine attitudes were less positive overall (B = −0.09; 95% CI = −0.16, −0.03). American Indians were also less likely to report that their child's vaccines were up to date (OR = 0.30; 95% CI = 0.12, 0.76). Vaccines were rated as less effective by blacks than whites (B = −0.11; 95% CI = −0.18, −0.03), and blacks were more likely than whites to report that they had delayed vaccination (OR = 1.84; 95% CI = 1.10, 3.06).

Few other correlates were consistently associated with study

**Table 1**
Study Variables (N = 813).

| | Range | M (*SD*) or % |
|---|---|---|
| *Correlates* | | |
| Child's health | 1–5 | 4.4 (0.8) |
| Number of child health care visits | 0–24 | 2.5 (2.4) |
| Health care provider trust | 1–5 | 4.4 (0.8) |
| Home visitor trust | 1–5 | 4.5 (0.7) |
| Mother's mental health | 21–68 | 46.5 (8.9) |
| Child's age | 1–6 | 1.9 (1.0) |
| Mother's age | 18–50 | 28.3 (6.0) |
| Mother's race/ethnicity | | |
| Non-Hispanic White | 0–1 | 44.9% |
| American Indian | 0–1 | 7.1% |
| African American | 0–1 | 18.7% |
| Hispanic | 0–1 | 24.6% |
| Other | 0–1 | 4.7% |
| Mother's education | 1–6 | 3.4 (1.1) |
| *Outcomes* | | |
| Vaccines important for child's health[1] | 1–5 | 4.3 (1.0) |
| Disagree/Strongly disagree | 0–1 | 5.0% |
| Somewhat agree and disagree | 0–1 | 10.9% |
| Agree/Strongly agree | 0–1 | 84.0% |
| Vaccines effective[1] | 1–5 | 4.2 (1.0) |
| Disagree/Strongly disagree | 0–1 | 5.4% |
| Somewhat agree and disagree | 0–1 | 14.5% |
| Agree/Strongly agree | 0–1 | 80.0% |
| Vaccines safe | 1–5 | 4.0 (1.0) |
| Disagree/Strongly disagree | 0–1 | 6.2% |
| Somewhat agree/disagree | 0–1 | 22.0% |
| Agree/Strongly agree | 0–1 | 71.9% |
| Vaccine attitudes, total score | 3–15 | 12.5 (2.7) |
| Vaccines delayed | 0–1 | 14.3% |
| Vaccines up to date | 0–1 | 94.0% |

[1] Item percentages do not sum to 100% due to rounding error.

**Table 2**
Correlates of Vaccine Attitudes.

| | Important | Effective | Safe | Total Score |
|---|---|---|---|---|
| | B (95% CI) | B (95% CI) | B (95% CI) | B (95% CI) |
| Child's health score | 0.07 (−0.01, 0.15) | 0.06 (−0.02, 0.13) | 0.03 (−0.05, 0.10) | 0.06 (−0.02, 0.13) |
| N of health care visits | 0.03 (−0.05, 0.10) | 0.03 (−0.05, 0.10) | 0.00 (−0.07, 0.07) | 0.02 (−0.05, 0.09) |
| Health care provider trust | 0.21 (0.14, 0.28)** | 0.21 (0.14, 0.28)** | 0.25 (0.17, 0.32)** | 0.24 (0.17, 0.31)** |
| Home visitor trust | 0.07 (0.00, 0.13) | 0.07 (0.00, 0.13)* | 0.10 (0.04, 0.17)** | 0.09 (0.02, 0.15)* |
| Mother's mental health score | 0.03 (−0.04, 0.10) | 0.04 (−0.04, 0.11) | 0.07 (−0.01, 0.14) | 0.06 (−0.02, 0.13) |
| Child's age | 0.02 (−0.04, 0.09) | −0.01 (−0.07, 0.06) | 0.02 (−0.04, 0.08) | 0.01 (−0.05, 0.07) |
| Mother's age | 0.02 (−0.04, 0.09) | 0.06 (0.00, 0.13) | 0.04 (−0.02, 0.10) | 0.05 (−0.01, 0.11) |
| Mother's race/ethnicity | | | | |
| American Indian | −0.08 (−0.14, −0.01)* | −0.10 (−0.16, −0.03)** | −0.08 (−0.14, −0.02)* | −0.09 (−0.16, −0.03)** |
| African American | −0.05 (−0.12, 0.03) | −0.11 (−0.18, −0.03)** | −0.03 (−0.09, 0.04) | −0.06 (−0.13, 0.00) |
| Hispanic | 0.05 (−0.02, 0.13) | 0.03 (−0.05, 0.11) | 0.02 (−0.05, 0.10) | 0.03 (−0.04, 0.11) |
| Other | 0.06 (0.00, 0.11)* | 0.01 (−0.05, 0.07) | 0.06 (0.01, 0.12)* | 0.05 (−0.01, 0.10) |
| Mother's education | −0.02 (−0.09, 0.05) | 0.03 (−0.04, 0.10) | −0.06 (−0.13, 0.01) | −0.02 (−0.09, 0.05) |
| Sample size | 813 | 811 | 810 | 808 |

*Note.* B = standardized beta. CI = confidence intervals. *$p < .05$ **$p < .01$.

**Table 3**
Correlates of Vaccine Delay and Adherence.

| | Vaccines Delayed | Vaccines Up to Date |
|---|---|---|
| | OR (95% CI) | OR (95% CI) |
| Child's health score | 1.04 (0.78, 1.38) | 1.16 (0.77, 1.73) |
| N of child health care visits | 1.01 (0.92, 1.11) | 1.20 (0.96, 1.51) |
| Health care provider trust | 0.57 (0.46, 0.73)** | 1.79 (1.30, 2.44)** |
| Home visitor trust | 1.16 (0.83, 1.63) | 1.02 (0.71, 1.46) |
| Mother's mental health score | 0.99 (0.96, 1.01) | 1.05 (1.02, 1.09)** |
| Child's age | 0.98 (0.81, 1.19) | 1.49 (1.00, 2.21)* |
| Mother's age | 0.97 (0.94, 1.01) | 1.01 (0.96, 1.06) |
| Mother's race/ethnicity | | |
| American Indian | 1.75 (0.86, 3.54) | 0.30 (0.12, 0.76)* |
| African American | 1.84 (1.10, 3.06)* | 0.83 (0.38, 1.80) |
| Hispanic | 0.70 (0.38, 1.29) | 1.08 (0.44, 2.64) |
| Other | 1.59 (0.63, 4.03) | 1.04 (0.21, 5.12) |
| Mother's education | 1.12 (0.93, 1.36) | 0.88 (0.65, 1.19) |
| Sample size | 810 | 796 |

*Note.* OR = odds ratio; CI = confidence intervals. *$p < .05$ **$p < .01$.

outcomes. Children were more likely to be up to date on vaccines if they were older (OR = 1.49; 95% CI = 1.00, 2.21) and if their mothers reported more positive mental health scores (OR = 1.05; 95% CI = 1.02, 1.09). Compared to non-Hispanic whites, American Indians were less likely to report that their child's vaccines were up to date (OR = 0.30; 95% CI = 0.12, 0.76), and blacks were more likely to report that they had delayed vaccination (OR = 1.84; 95% CI = 1.10, 3.06).

## 5. Discussion

This study examined the prevalence and correlates of vaccine attitudes and behaviors in a racially and ethnically diverse sample of low-income mothers. Overall, 94% of sample women reported that their children were up to date on recommended vaccines, which is higher than both national estimates (70.4%) and Wisconsin state estimates (69.2%) (Hill et al., 2018). The high rate of reported vaccine adherence may be partly due to the use of self-report data rather than medical records, though it also may be related to receiving home visiting services that aim to enhance maternal and child health outcomes, including adherence to well child visit schedules.

Despite this finding, many caregivers (14%) reported that they had delayed vaccination at least one time. Moreover, a substantial minority of caregivers disagreed that vaccines are important for their child's health (5.0%), effective (5.4%), and safe (6.2%). An even higher percentage responded ambivalently, indicating that they somewhat agreed and disagreed that vaccines are important (10.9%), effective (14.5%), and safe (21.9%). The results underscore that vaccine hesitancy is common, even among this highly immunized population, which could lead to future vaccine delay or refusal.

Results from a multivariate analysis showed that respondents who reported greater trust in their health care provider were more likely to agree that vaccines are important, effective, and safe. These caregivers were less likely to have delayed vaccines and more likely to report being up to date on vaccines, confirming that greater trust in healthcare providers is associated with reduced vaccine hesitancy (Williams, 2014; Ames et al., 2017; Benin et al., 2006; Edwards and Hackell, 2016; Salmon et al., 2005). Because socioeconomically disadvantaged groups tend to have more distrust in healthcare providers (Shui et al., 2006; Wu et al., 2008; Hill et al., 2017), interventions to increase their confidence may be especially vital to promoting vaccine acceptance in these populations.

We also discovered that mothers who reported greater trust in their home visitor were more likely to agree that vaccines are effective and safe, and they reported lower vaccine hesitancy overall. These novel results have important public health implications given that the federal MIECHV Program alone supports services for about 300,000 low-income families per year (Thrive, 2018), and many more receive home visits from non-MIECHV providers that deliver prenatal and postpartum in-home care. Our findings are notable because most home visiting programs do not vaccinate children and many do not focus on vaccine attitudes as an intervention target (Kendrick et al., 2000; Isaac et al., 2015). It is plausible that home visiting programs with intentional vaccine promotion or administration could be effective in reducing vaccine hesitancy and improving immunization in low-income families (Guide to Community Preventive Services, 2019; Briss et al., 2000; Isaac et al., 2015). Given the time limitations of most pediatrician visits, adequately addressing vaccine misinformation comes at the expense of other important anticipatory guidance (Kempe et al., 2015; Olson et al., 2004), and as such, interventions to address hesitancy in other settings are key to curbing the rise in vaccine hesitancy (McClure et al., 2017). Future work should investigate specific vaccine protocols in home visiting and other similar programs such as prenatal care coordination and community health worker interventions.

Maternal mental health status was the final modifiable correlate of vaccine uptake in our study. Although mental health scores were not significantly correlated with vaccine attitudes, mothers with better self-rated mental health were more likely to report that their child was up to date on vaccines. This finding is consistent with the limited research linking mental health disturbance with underimmunization (Cullen et al., 2010), and it further supports prior claims that poor maternal mental health is a modifiable barrier to accessing adequate preventive pediatric care (Minkovitz et al., Feb, 2005; Jhanjee et al., 2004).

Most demographic indicators were not significantly correlated with vaccine attitudes, delay, and adherence. The most notable exception is that, compared to non-Hispanic whites, American Indians rated vaccines as less important for their child's health, less effective, and less safe, and they were less likely to be up to date on vaccines. These results highlight the need for more extensive study of vaccine attitudes and behaviors among American Indians, especially given the pronounced health disparities they experience (Arias et al., 2014; Cobb et al., 2014). Non-Hispanic blacks also were less likely than non-Hispanic whites to believe that vaccines are effective and were more likely to delay vaccines. Taken together, the results add to the literature on diverse and low-SES populations that are underrepresented in literature despite evidence that they are more vaccine-hesitant (Shui et al., 2006; Wu et al., 2008; Hill et al., 2017; Hilderman et al., 2011; Kruk et al., 2011; Kendrick et al., 2000).

## 6. Limitations

Findings should be interpreted considering the cross-sectional-design, which limits our ability to infer causal association. Measures of vaccine delay and adherence, frequency of pediatric visits, and all hypothesized correlates were based on self-report data, which have known limitations such as response bias and social desirability bias. In addition, the measure of parent attitudes toward childhood vaccines warrants further psychometric testing. Given the complexity of vaccine decision-making, omitted variable bias is another limitation; salient correlates of vaccine hesitancy were absent from our measurement plan, including barriers to immunization access such as proximity of vaccine administration sites, transportation access, and insurance status. Finally, generalizability of the findings is limited by the non-representative sample comprising low-income households receiving home visiting services in a single Midwest state. It is uncertain to what degree our findings apply to the general population and to other low-income subgroups in the US.

## 7. Conclusions

This study described the prevalence and correlates of vaccine attitudes and behaviors in a racially and ethnically diverse group of low-income families receiving home visiting services. The results indicated that, although reported child vaccination rates were high, vaccine

hesitancy and delay were also prevalent, presenting a significant threat to community health. Consistent with past research, greater trust in health care providers was associated with more positive vaccine attitudes and behaviors. The findings also uniquely showed that maternal trust in a home visitor was a correlate of positive vaccine attitudes, suggesting that home visiting programs are a promising outlet for future vaccination interventions. Within this low-income sample, greater vaccine hesitancy and lower vaccine adherence was observed among American Indian and African American participants, emphasizing the need to target further research and intervention resources toward these disadvantaged and underserved populations.

## CRediT authorship contribution statement

**Ross M. Gilbert:** Conceptualization, Writing - original draft. **Joshua P. Mersky:** Conceptualization, Project administration, Writing - original draft. **Chien-Ti Plummer Lee:** Data curation, Methodology, Formal analysis.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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