

Parental Hesitancy About Routine Childhood and Influenza Vaccinations: A National Survey

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abstract

BACKGROUND AND OBJECTIVES: The World Health Organization has designated vaccine hesitancy as 1 of the 10 leading threats to global health, yet there is limited current national data on prevalence of hesitancy among US parents. Among a nationally representative sample of US parents, we aimed to (1) assess and compare prevalence of hesitancy and factors driving hesitancy for routine childhood and influenza vaccination and (2) examine associations between sociodemographic characteristics and hesitancy for routine childhood or influenza vaccination.

METHODS: In February 2019, we surveyed families with children using the largest online panel generating representative US samples. After weighting, we assessed hesitancy using a modified 5-point Vaccine Hesitancy Scale and labeled parents as hesitant if they scored >3.

RESULTS: A total of 2176 of 4445 parents sampled completed the survey (response rate 49%). Hesitancy prevalence was 6.1% for routine childhood and 25.8% for influenza vaccines; 12% strongly and 27% somewhat agreed they had concerns about serious side effects of both routine childhood and influenza vaccines. A total of 70% strongly agreed that routine childhood vaccines are effective versus 26% for influenza vaccine ($P < .001$). In multivariable models, an educational level lower than a bachelor's degree and household income <400% of the federal poverty level predicted hesitancy about both routine childhood and influenza vaccines.

CONCLUSIONS: Almost 1 in 15 US parents are hesitant about routine childhood vaccines, whereas >1 in 4 are hesitant about influenza vaccine. Furthermore, 1 in 8 parents are concerned about vaccine safety for both routine childhood and influenza vaccines, and only 1 in 4 believe influenza vaccine is effective. Vaccine hesitancy, particularly for influenza vaccine, is prevalent in the United States.



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WHAT'S KNOWN ON THIS SUBJECT: The World Health Organization has designated vaccine hesitancy as 1 of the 10 leading threats to global health. However, there is limited current national data on prevalence of hesitancy among US parents about routine childhood and influenza vaccination.

WHAT THIS STUDY ADDS: In this study, we show that 6.1% of US parents are hesitant about routine childhood vaccines and 25.8% are hesitant about influenza vaccine. Although 1 in 8 parents are concerned about safety of both routine childhood and influenza vaccines, only 1 in 4 believe influenza vaccine is effective.

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In 2019, the World Health Organization (WHO) designated vaccine hesitancy as 1 of the 10 leading threats to global health.¹ In many countries, including the United States, hesitancy about childhood vaccines has contributed to lower rates of childhood vaccination, with associated outbreaks of vaccine-preventable diseases, including pertussis, mumps, and measles.²⁻¹⁶ Although researchers have assessed parental vaccine hesitancy in different localities, there are few recent US national data on the prevalence of hesitancy about routine childhood vaccines.¹⁷⁻¹⁹

Even less is known about the national prevalence of parental hesitancy about influenza vaccination for children. Although yearly influenza vaccination is recommended for all children 6 months to 18 years,²⁰ the influenza vaccination rate for US children in the 2018 to 2019 season was only 57.9%.²¹ It is unknown how much hesitancy contributes to this low rate. Understanding the role of hesitancy is critical given the substantial burden of seasonal influenza among children as reflected by influenza-related visits, hospitalizations, and deaths.²²⁻³⁰ The fact that another of WHO's top threats to global health is the possibility of a global influenza pandemic lends additional importance to understanding hesitancy about influenza vaccines.¹

"Vaccine hesitancy" has been inconsistently defined, with some definitions focusing only on beliefs about perceived safety, effectiveness, or necessity of vaccines³¹⁻³³ and other definitions including issues of convenience or practical barriers to vaccination.³⁴ Some experts have clearly differentiated between beliefs and behaviors, defining hesitancy as a continuum of attitudes and beliefs that do not always predict decisions to delay or refuse vaccination,^{17,31,35-37} whereas others

have used vaccination behaviors themselves to define hesitancy.^{31,35} This distinction matters because although hesitant parents may vaccinate under some circumstances, these parents may be vulnerable to antivaccine misinformation and require inoculation against misinformation.³⁸ For the current study, we adopted a recent definition from the literature defining hesitancy as "a motivational state of being conflicted about or opposed to getting vaccinated"³² without reference to whether it leads to refusal or deferral of vaccination. No recent surveys have assessed the national prevalence of US parental vaccine hesitancy about either routine childhood or influenza vaccination. Although influenza vaccine could be included as a "routine" vaccine, in that it is recommended yearly, we hypothesized that parents view it differently from other childhood vaccines because each year it needs to be given again, its content and effectiveness vary, and it addresses a disease that is often perceived as minor compared with other childhood diseases.

Given the importance of understanding the prevalence of hesitancy and factors related to hesitancy, our study objectives were, among a nationally representative sample of US parents, to (1) assess and compare the levels of hesitancy about routine childhood and influenza vaccinations, (2) assess the relationship between parent-reported vaccination concerns and parent-reported refusal and deferral of routine childhood or influenza vaccinations, (3) assess parent demographic factors that are associated with hesitancy about routine childhood and influenza vaccines, and (4) assess the association between sociodemographic and health characteristics and hesitancy about childhood or influenza vaccination.

METHODS

In February 2019, we surveyed families with children 6 months to <18 years of age using an online panel. The study was approved as exempt by the Colorado Multiple Institutional Review Board.

Ipsos Survey Panel

We used the Ipsos panel as the sampling frame (see Supplemental Information for additional details). The KnowledgePanel is constructed from a random sampling of addresses to create the largest Internet-based survey panel ($N = 55\,000$) representative of the noninstitutionalized US population. Recruitment is achieved by using address-based sampling methods via the US Postal Service's Delivery Sequence File (DSF). This method improves coverage compared with random-digit dialing and better represents the majority of households that no longer have landlines but rather only have mobile phones. Recruitment to the panel occurs through a series of mailings, including an initial invitation letter, a reminder postcard, and a subsequent follow-up letter. Panelists are offered a small incentive for completing questionnaires (eg, sweepstakes, small cash rewards). Ipsos routinely collects data regarding health status and sociodemographic variables predominately using the Current Population Survey (US Census Bureau) among other sources as needed. Data are weighted by using geodemographic benchmarks from the US Census Bureau's Current Population Survey, including sex, age, race and ethnicity, education, census region, household income, home ownership, and geographic region. The KnowledgePanel has been used to collect the primary data for a large number of publications in peer-reviewed journals, with 10 PubMed publication listings in 2019 alone.³⁹⁻⁴⁸

Sample Selection

Inclusion criteria were (1) being a parent, stepparent, or foster parent of a child 6 months to <18 years and (2) being able to complete the online survey in English or Spanish. We did not include parents of children <6 months because the influenza vaccine is not recommended for this group, and we wanted parents to have had some experience with routine childhood vaccination. We randomly selected 1 child within each family to be the focus of the interview. Families were selected to reach a desired sample size of ~2000 survey completions.

Questionnaire Development

Vaccine Hesitancy

We modified the Vaccine Hesitancy Scale (VHS), an instrument developed by WHO's Strategic Advisory Group of Experts on Immunization in 2015.^{49,50} The tool was developed on the basis of global pilot data of indicators for vaccine hesitancy and a literature review and incorporated elements of a tool developed in higher-income US populations.^{31,51,52} Although relatively new, the VHS has been used in numerous countries, either in part or as a complete scale, to assess hesitancy among parents for childhood or adolescent vaccines^{53–56} and among adults for general vaccine hesitancy.⁵⁷ The tool has been psychometrically validated and encompasses 10 items with Likert responses, including dimensions of vaccine confidence and vaccine risks.^{53,55,58} The tool has been validated in 2 studies on the basis of reported refusal of vaccination.^{53,54} Notably, it does not include issues of convenience or barriers to vaccination related to payment, transportation, or intercurrent illness. To increase the VHS's relevance to a US population, we excluded this question: "All childhood vaccines offered by the government program in my community are beneficial." To allow for comparisons between

routine childhood and influenza vaccines, we also excluded a statement not relevant to influenza: "New vaccines carry more risks than older vaccines." Thus, our scale for measuring both routine childhood and influenza hesitancy included 8 items. We also used a 4-point rather than a 5-point response scale (ie, we excluded the "neutral or not sure" response category) because of evidence that omitting the neutral option decreases the potential for socially desirable responding.⁵⁹ We modified slightly the wording of the VHS to address influenza rather than childhood vaccines in general.

Deferral and Refusal of Vaccines

We used a question similar to those used to validate the VHS^{49,50} to assess whether concerns about either routine childhood or influenza vaccines had led the respondent to defer or refuse these vaccines.

Survey Delivery

Randomly selected eligible panel members received an e-mail with a link to the survey. One automatic e-mail reminder was sent after 3 days if there was no response.

Analyses

We examined demographics both without and with the poststratification weights provided by Ipsos to account for possible differential nonresponse. The poststratification weights were then used in all subsequent analyses. The score on the modified VHS was calculated by first reverse-coding negatively worded items and scoring responses for each item in the following manner: strongly agree = 1, agree = 2, disagree = 4, and strongly disagree = 5, such that higher values always indicated greater hesitancy. We scored responses in this manner to be able to map our results to previous literature using a 5-point response scale. We then calculated the average score of the 8 items included in our modified VHS. We

defined "hesitant" as an average score >3 because this score would indicate a hesitancy level higher than the midpoint of the scale. We also did a sensitivity analysis to examine hesitancy using the cutoff of a score >4.

Separately for noninfluenza and influenza surveys, we calculated the proportion of respondents that reported deferral or refusal because of concerns about the vaccine for subjects with hesitant versus nonhesitant scores and calculated unadjusted risk ratios (URRs). We conducted multivariable Poisson regression models with robust error variance with the dependent variable being hesitant for routine childhood vaccination and, separately, being hesitant for influenza vaccination. Independent variables included the child's reported general health, the number of children in the household, the age of the index child, and the respondent's education, race and ethnicity, marital status, household income, region of residence, and metropolitan statistical area status, all factors shown to be related to vaccine hesitancy.⁶⁰

RESULTS

Of the 4445 parents sampled, 2176 completed the survey (response rate 49%), with 2052 eligible respondents. In Table 1, we show characteristics of respondents and their child. The Cronbach α for our modified VHS was 0.89 for the childhood items and 0.95 for the influenza items, indicating that good internal consistency was maintained in our modified scales.

Level of Hesitancy About Childhood and Influenza Vaccines

For routine childhood vaccines (Table 2), the median score and interquartile range for the modified VHS scale was 1.4 (1.1–2.0); the mean was 1.7 (SD = 0.02). The percentage with scores >3 was 6.1% (95% confidence interval [CI]: 5.0%–7.3%).

TABLE 1 Characteristics of Surveyed Population

	Unweighted Sample (n = 2052), n (%)	Weighted Sample (n = 2052), n (%)
Child's health		
Poor, fair, or good	217 (10.6)	230 (11.3)
Excellent or very good	1827 (89.4)	1812 (88.7)
Age of index child		
1: 6 mo through 2 y	259 (12.6)	302 (14.7)
2: 3–5 y	323 (15.7)	326 (15.9)
3: 6–10 y	534 (26.0)	530 (25.8)
4: 11 y or older	936 (45.6)	893 (43.5)
No. children in household		
1	820 (40.0)	831 (40.5)
2	791 (38.5)	769 (37.5)
3 or more	441 (21.5)	452 (22.0)
No. children in household (Ipsos data)		
0	64 (3.1)	85 (4.1)
1	767 (37.4)	775 (37.8)
2	804 (39.2)	776 (37.8)
3 or more	417 (20.3)	416 (20.3)
No. adults in household (Ipsos data)		
1	166 (8.1)	158 (7.7)
2	1462 (71.2)	1446 (70.5)
3 or more	424 (20.7)	448 (21.8)
Respondent employment		
Working	1615 (78.7)	1582 (77.1)
Not working	437 (21.3)	470 (22.9)
Respondent marital status		
Other (widowed, divorced, separated, never married, living with partner)	370 (18.0)	383 (18.7)
Married	1682 (82.0)	1669 (81.3)
Respondent age, y		
18–24	20 (1.0)	33 (1.6)
25–34	463 (22.6)	551 (26.9)
35–44	909 (44.3)	852 (41.5)
45–54	534 (26.0)	501 (24.4)
55+	126 (6.1)	115 (5.6)
Respondent education		
HS or less	533 (26.0)	698 (34.0)
Some college	520 (25.3)	551 (26.8)
Bachelor's degree or higher	999 (48.7)	804 (39.2)
Respondent race and ethnicity		
White, non-Hispanic	1384 (67.4)	1178 (57.4)
African American, non-Hispanic	181 (8.8)	225 (11.0)
Hispanic	328 (16.0)	443 (21.6)
Other or multiracial, non-Hispanic	159 (7.7)	206 (10.1)
Household income		
1: <\$25 000	146 (7.1)	150 (7.3)
2: \$25–49 000	363 (17.7)	405 (19.7)
3: \$50–74 000	363 (17.7)	340 (16.6)
4: \$75–99 000	312 (15.2)	300 (14.6)
5: ≥\$100 000	868 (42.3)	857 (41.7)
Percent of FPL		
<100% FPL	271 (13.2)	290 (14.1)
100%–400% FPL	1132 (55.2)	1089 (53.1)
>400% FPL	649 (31.6)	673 (32.8)
Region 4, based on state of residence		
Northeast	341 (16.6)	337 (16.4)
Midwest	473 (23.1)	433 (21.1)
South	715 (34.8)	773 (37.7)
West	523 (25.5)	509 (24.8)
MSA status		
Nonmetro	262 (12.8)	266 (12.9)
Metro	1790 (87.2)	1786 (87.1)

FPL, federal poverty level; HS, high school; MSA, metropolitan statistical area.

For influenza vaccine, the median score for the influenza modified VHS scale was 1.9 (interquartile range: 1.3–3.1), and the mean was 2.3 (SD = 0.03). The percentage of respondents with scores >3 was 25.8% (95% CI: 23.7%–28.0%). If cutoff levels of >4 were used, hesitancy levels (with 95% CIs) were 2.8% (range: 1.9%–3.6%) for routine childhood and 10.3% (range: 8.8%–11.8%) for influenza vaccines.

Association Between Hesitancy and Report of Vaccine Deferral and/or Refusal Related to Concerns

Regarding routine childhood vaccines, among hesitant respondents, 67.5% had deferred or refused routine vaccination for their child because of concerns about that vaccine compared with 8.7% of nonhesitant parents; the URR for deferral and/or refusal among hesitant parents was 7.8 (95% CI: 6.3–9.6) (Table 2).

Regarding influenza vaccine, among hesitant respondents, 70.1% had ever deferred or refused influenza vaccination for their child because of concerns about that vaccine compared with only 10.0% of nonhesitant respondents (URR: 7.0; 95% CI: 5.8–8.5). Among influenza vaccine–hesitant respondents, only 10.1% reported their child had received the vaccine or that they planned to have them vaccinated during the current season (8.6% had already been vaccinated) versus 84.1% of nonhesitant respondents (URR: 8.3; 95% CI: 6.1–11.4).

Comparison of Factors Contributing to Hesitancy for Childhood and Influenza Vaccines

The item most associated with hesitancy about childhood vaccines was having concerns about serious side effects, with 12% strongly and 27% somewhat endorsing this concern (Fig 1). Thirteen percent either strongly or somewhat disagreed that “all childhood vaccines...are beneficial.” All other concerns were endorsed by <10%.

The percentages of parents who were strongly or somewhat concerned about serious side effects of influenza vaccine were identical to those seen for routine childhood vaccines (Fig 1). However, only 26% strongly agreed that the influenza vaccine is effective, compared with 70% for childhood vaccines ($P < .0001$). Parents were also less likely to perceive influenza vaccines as important for their child's health, to agree that influenza vaccines are beneficial and a good way to protect their child from disease, and to report doing what their child's health care provider recommended regarding influenza vaccines.

Association of Child Health Status and Sociodemographic Factors With Hesitancy

Lower respondent educational level and household income $<400\%$ of the federal poverty level were significantly associated with hesitancy for both routine childhood and influenza vaccines (Table 3). Poorer child health was associated with higher levels of hesitancy for routine childhood but not for influenza vaccines. Parents in the western United States and those with a referent child in the preschool years also were more hesitant about childhood vaccines. Race and ethnicity were not significantly associated with hesitancy about childhood vaccines, but Hispanic parents were less hesitant about influenza vaccines than white, non-Hispanic parents. Having more

children in the household and being an unmarried respondent were also associated with hesitancy about influenza vaccines.

DISCUSSION

In our study, we provide the first national estimates of hesitancy about routine childhood and influenza vaccination among representative samples of US parents of children across the age span, using a scale specifically developed and validated to assess vaccine hesitancy. In addition, because we used the same scale to assess hesitancy about both routine childhood and influenza vaccinations in the same parents, our data allow for direct comparisons of the levels of hesitancy for these different vaccine categories. In our data, it is demonstrated that (using a cutoff greater than the midpoint on the hesitancy scales), 6.1% of parents are hesitant about routine childhood vaccination, whereas >4 times that (25.8%) are hesitant about influenza vaccination. Whereas hesitancy about routine childhood vaccination is driven primarily by safety concerns, hesitancy about influenza vaccination is largely driven by concerns about low vaccine effectiveness. Concerns about the safety of routine childhood and influenza vaccinations were almost identical.

Previous data assessing childhood vaccine hesitancy rates in the United States have most often been measured by using the Parent

Attitudes about Childhood Vaccines (PACV) scale,^{31,51,61-65} which was developed and validated in primarily higher-income populations in Washington state. Estimates of the prevalence of hesitancy for childhood vaccines using a cutoff of >50 out of a possible score of 100 on the PACV have varied substantially depending on age and setting, from a high of 25% among parents of 19- to 35-month-old children within a closed-model health maintenance organization in Seattle³¹ to a low of 5.9% among parents of 24-month-olds in Washington state.⁶¹ By using a cutoff for the VHS indicating a hesitancy level higher than the midpoint of the scale (similar to >50 on the PACV scale), our rate of hesitancy about routine childhood vaccines is lower than some previous estimates using the PACV but is in line with others. Notably, previous estimates using the PACV were among parents of young children and were in a single state, whereas our data include parents of children across the age span and are weighted to be representative of regions and sociodemographic factors throughout the United States.

Researchers of another national study evaluated the effect of parent concerns on vaccination using questions from the 2009 National Immunization Surveys to examine the percentage of parents of 24- to 35-month-old children who had delayed or refused a vaccine dose on the basis of safety, concurrent illness, missed

TABLE 2 Association Between Hesitancy on Modified VHS and Reporting Previous Vaccine Deferral or Refusal

	<i>n</i> (%) in Category	Percentage Who Had Refused Because of Concerns ^a	URR (95% CI)	<i>P</i>
Hesitancy for childhood vaccines (>3)				
Yes	126 (6.1)	67.5	7.8 (6.3–9.6)	$<.0001$
No	1926 (93.9)	8.7	Reference	—
Hesitancy for influenza vaccine (>3)				
Yes	530 (25.8)	70.1	7.0 (5.8–8.5)	$<.0001$
No	1522 (74.2)	10.0	Reference	—

—, not applicable.

^a Questions were as follows: "Did concerns about childhood vaccines ever keep you from getting your child any childhood vaccines?" "Did concerns about the flu vaccine ever keep you from getting your child the flu vaccine?"

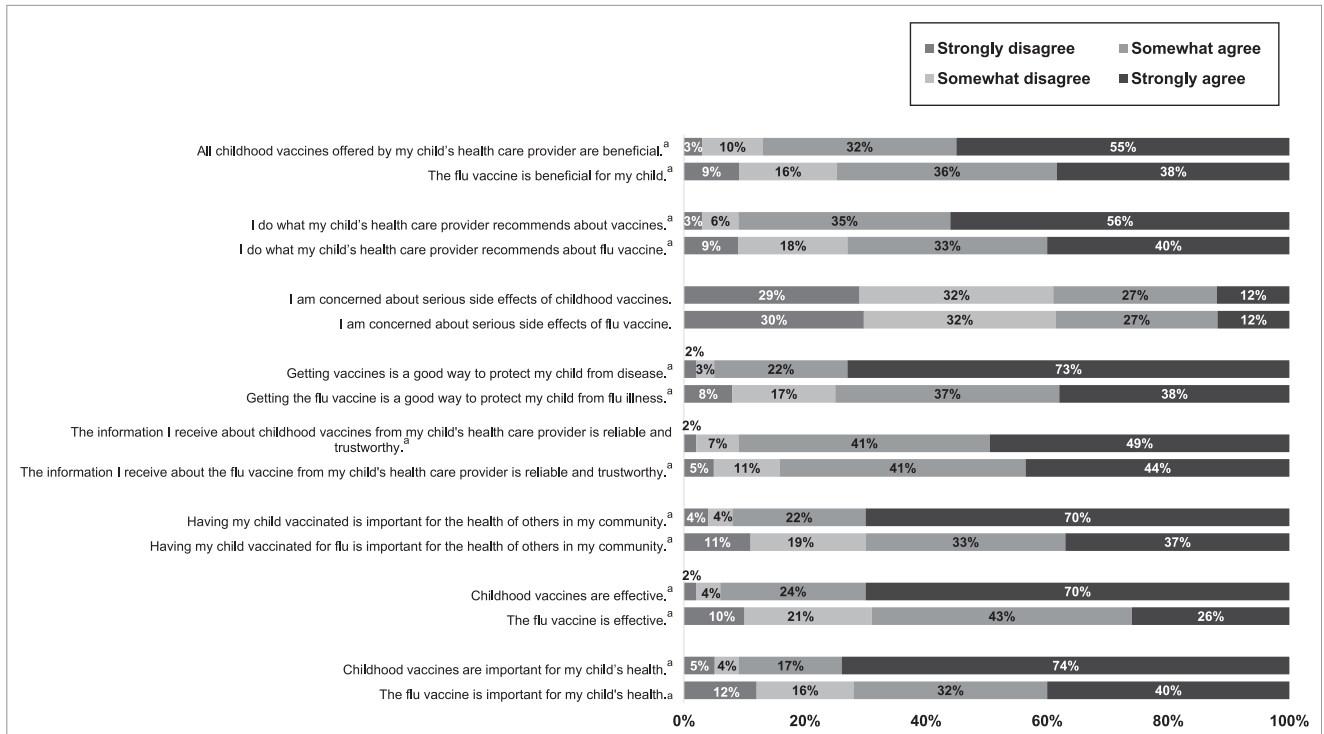


FIGURE 1

Results of modified VHS for influenza vaccine (8 item) compared with modified VHS for childhood vaccines (8 items). ^a All questions are significant ($P < .0001$) except for "I am concerned about serious side effects of childhood vaccines" ($P = .18$).

appointments, cost, or other issues.¹⁷ At that time, 25.8% of parents reported delaying, 8.2% had refused, and 5.8% had both delayed and refused ≥ 1 recommended vaccines. Many parents who delayed or refused a vaccine did so for reasons other than concerns about vaccines. For example, 45.9% of parents who both delayed and refused vaccines did so because of an illness in their child. These data are not an ideal comparison with the current study because they are >10 years old and were gathered from parents of children in a narrow age range.

We are not aware of researchers of any studies reporting nationally representative rates of parental hesitancy about influenza vaccination in any country. In 2 previous studies, both in Washington state, researchers used a modified PACV to measure hesitancy for influenza vaccine among parents with children seen in a pediatric emergency department

and among a sample of hospitalized children. Levels of hesitancy in these 2 samples were 26%⁶³ and 24%,⁶² respectively. Interestingly, these are much in line with national estimates we obtained for influenza hesitancy.

In our data, it is shown that hesitancy for influenza vaccination was >4 times higher than for routine childhood vaccination, and, importantly, the factors driving hesitancy differed. Concerns about serious side effects were similar, but concerns about many of the other factors were much higher for influenza vaccination, especially concerns about effectiveness. Concerns about low effectiveness may have led to other concerns. For example, parents convinced that the influenza vaccine is ineffective might also deny that it is "important for the health of others," "important for their child's health," or "a good way to protect my child from disease" and might be less likely to do "what my

child's health care provider recommends about flu vaccine." Confidence in influenza vaccine effectiveness may have been eroded during well-publicized influenza seasons during which there was a significant mismatch between circulating and vaccine strains of influenza.⁶⁶⁻⁷¹ Poor live attenuated influenza vaccine effectiveness, with removal of the vaccine from Advisory Committee on Immunization Practices recommendations during 2 seasons, also may have eroded confidence in influenza vaccine's effectiveness.⁶⁶

Previous US-based studies have revealed inconsistent relationships between parental vaccine hesitancy or deferrals and/or refusals and vaccine assessed, age of child, parent demographics, and whether data were national or regional. Although researchers of most national surveys have found lower income to be associated with higher levels of

TABLE 3 Multivariable Models Predicting Childhood and Influenza Vaccine Hesitancy (Score >3)

	URR (95% CI) for Childhood Vaccine Hesitancy	Adjusted RR (95% CI) for Childhood Vaccine Hesitancy	URR (95% CI) for Influenza Vaccine Hesitancy	Adjusted RR (95% CI) for Influenza Vaccine Hesitancy
Child's health				
Good, fair, or poor	1.85 (1.16–2.93)	1.74 (1.08–2.83)	1.11 (0.86–1.43)	1.01 (0.79–1.30)
Excellent or very good	Reference	Reference	Reference	Reference
No. children in household				
1 child	Reference	Reference	Reference	Reference
2 children	0.81 (0.50–1.29)	0.79 (0.49–1.27)	0.99 (0.81–1.20)	1.06 (0.87–1.28)
≥3 children	1.15 (0.72–1.82)	1.11 (0.70–1.76)	1.27 (1.03–1.56)	1.29 (1.04–1.60)
Age of index child				
6 mo to 2 y vs 11+ y	1.28 (0.70–2.36)	1.66 (0.87–3.16)	0.88 (0.66–1.16)	0.88 (0.67–1.16)
3–5 y vs 11+ y	1.46 (0.87–2.45)	1.79 (1.04–3.06)	1.01 (0.79–1.27)	0.96 (0.76–1.22)
6–10 y vs 11+ y	1.04 (0.64–1.69)	1.11 (0.68–1.80)	0.89 (0.73–1.10)	0.83 (0.67–1.02)
11+ y	Reference	Reference	Reference	Reference
Respondent education				
High school or less	2.88 (1.84–4.51)	2.42 (1.46–4.02)	1.76 (1.44–2.15)	1.57 (1.25–1.96)
Some college	2.14 (1.32–3.46)	1.79 (1.06–3.04)	1.71 (1.39–2.10)	1.52 (1.23–1.88)
Bachelor's degree or higher	Reference	Reference	Reference	Reference
Respondent race and ethnicity				
African American, non-Hispanic	1.61 (0.91–2.87)	1.79 (1.00–3.20)	1.26 (0.99–1.61)	1.14 (0.88–1.47)
Hispanic	1.27 (0.78–2.08)	0.90 (0.53–1.53)	0.83 (0.65–1.06)	0.68 (0.52–0.88)
Other or multiracial, non-Hispanic	0.64 (0.23–1.77)	0.83 (0.29–2.42)	0.76 (0.51–1.11)	0.91 (0.62–1.34)
White, non-Hispanic	Reference	Reference	Reference	Reference
Household income				
<100% FPL	0.85 (0.47–1.53)	0.59 (0.30–1.19)	1.13 (0.91–1.41)	0.97 (0.76–1.25)
100%–400% FPL	Reference	Reference	Reference	Reference
>400% FPL	0.36 (0.22–0.60)	0.53 (0.32–0.87)	0.61 (0.49–0.75)	0.73 (0.58–0.92)
Region of residence				
Midwest	1.14 (0.67–1.94)	1.26 (0.74–2.16)	1.01 (0.82–1.26)	0.97 (0.79–1.20)
Northeast	1.25 (0.68–2.31)	1.49 (0.79–2.83)	0.89 (0.69–1.15)	0.92 (0.71–1.18)
West	1.63 (1.00–2.65)	1.75 (1.09–2.82)	0.91 (0.73–1.13)	0.95 (0.76–1.19)
South	Reference	Reference	Reference	Reference
MSA status				
Nonmetro	0.99 (0.58–1.67)	0.79 (0.45–1.37)	1.17 (0.94–1.46)	0.94 (0.75–1.18)
Metro	Reference	Reference	Reference	Reference
Marital status				
Unmarried	1.33 (0.85–2.08)	1.00 (0.61–1.65)	1.43 (1.18–1.72)	1.25 (1.02–1.54)
Married	Reference	Reference	Reference	Reference

FPL, federal poverty level; MSA, metropolitan statistical area; RR, risk ratio.

concern about the safety or necessity of vaccines,^{36,72,73} researchers of at least one study, on the basis of the 2009 National Immunization Surveys, showed the opposite.¹⁷ Similarly, although researchers of most past studies have found lower educational level to be associated with more concerns about vaccine safety or efficacy,^{36,72,73} others have shown that parents with higher educational levels are more likely to forego immunizations^{17,37} or to have safety concerns.³¹ National data have generally revealed that, although Hispanic and African American

parents have expressed high levels of concern about childhood vaccines,^{18,72} they have demonstrated a lower likelihood of refusal of childhood vaccinations.^{18,35} It is important to note that all of these surveys were conducted 6 to 16 years ago, and no national data are available on parental influenza vaccine hesitancy with which to directly compare our data.

We found higher rates of hesitancy for both childhood and influenza vaccines among parents with less

than a bachelor's degree and with household incomes <400% of the federal poverty level, consistent with the findings of most previous national studies. Although we did not find racial or ethnic differences in degree of hesitancy for routine childhood vaccines, we did see lower hesitancy about influenza vaccine among parents of Hispanic children. This is consistent with data from the Centers for Disease Control and Prevention about influenza vaccine coverage for the 2018 to 2019 influenza season, which revealed higher levels of receipt among

Hispanic children,⁷⁴ although beliefs were not examined.

Our data have some notable strengths and weaknesses. To our knowledge, we are the first to assess and compare hesitancy about routine childhood and influenza vaccines in a nationally representative sample of parents. We used a modification of the WHO internationally validated scale to assess hesitancy, which should allow for international comparisons. However, survey data have inherent potential weaknesses, including reporting bias based on social desirability. In addition, there has been insufficient discussion of the cutoff that should be used for defining hesitancy using the VHS. To make comparisons and model associations, we created a midscale cutoff for hesitancy, comparable to what has been done for the PACV. However, different cutoffs could be used with different results, as demonstrated in our sensitivity analyses. Our response rate was ~50%, although weighting helps to mitigate any bias introduced by differential nonresponse. Our exclusion of infants <6 months of age, which was done because flu vaccination is recommended only for those >6 months of age, may bias our assessment of hesitancy for routine childhood vaccinations. There are 2 studies whose authors examine hesitancy longitudinally in infancy, both using the PACV; 1 revealed a hesitancy rate of 9.7% at birth and 8% at 6 months and another revealed similar levels of hesitancy at ~2 and 4 months of age, with both scores⁶¹ predictive of childhood immunization

status at 19 months of age.⁵² Therefore, the exclusion of infants <6 months of age in our study may have no effect or may result in a slight underestimate of hesitancy. Finally, we could internally validate our data only by comparing to parent report of receipt of vaccines rather than actual vaccination data.

In our data, we demonstrate the extent of parental concerns about vaccine safety for both routine childhood and influenza vaccines and identify substantial additional concerns about the effectiveness of influenza vaccines that are contributing to hesitancy for these vaccines. In view of our findings, what methods can be used to increase decisions to vaccinate among parents who are hesitant? There have been multiple recent reviews discussing interventions,^{32,75-77} but a surprising lack of evidence exists to support the effectiveness of most of them in countering hesitancy or increasing vaccination.³² Evidence is strongest for methods that build on whatever favorable intentions to vaccinate exist or those that focus on changing behavior directly rather than trying to change beliefs or attitudes. Such interventions would include strong and presumptive (rather than open-ended) recommendations by a trusted provider,⁷⁸⁻⁸¹ the use of standing orders,⁸² methods to facilitate ease of vaccine delivery (eg, influenza vaccination clinics or school-based vaccination delivery), reminder and recall,⁸³ and, at the state level, preschool and school vaccination requirements⁸⁴⁻⁹³ as

well as the minimization of philosophic exemptions to such requirements.^{2,94,95} There is evidence that communication techniques such as motivational interviewing can be helpful in convincing some hesitant parents to vaccinate in the primary care setting.^{96,97} The use of social media interventions,^{98,99} some of which involving trained parents as advocates for vaccination within their own communities,¹⁰⁰ have shown some effectiveness in overcoming hesitancy. However, more work needs to be done to develop methods that are practical and effective for convincing vaccine-hesitant parents to vaccinate. With respect to influenza vaccination, with our data, we underscore the importance of better communicating to providers and parents the effectiveness of influenza vaccines in reducing severity and morbidity from influenza, even in years when the vaccine has relatively low effectiveness.¹⁰¹ Quantifying the level of hesitancy nationally on a longitudinal basis by using a consistent measure is a critical first step in guiding and measuring the effectiveness of future interventions to counter vaccine hesitancy.

ABBREVIATIONS

CI: confidence interval
DSF: Delivery Sequence File
PACV: Parent Attitudes about Childhood Vaccines
URR: unadjusted risk ratio
VHS: Vaccine Hesitancy Scale
WHO: World Health Organization

Drs Kempe and Szilagyi conceptualized and designed the study, drafted the initial manuscript, and reviewed and revised the manuscript; Dr Zimet conceptualized and designed the study and reviewed and revised the manuscript; Ms Saville, Ms Albertin, and Ms Breck participated in the conceptualization and design of the study, coordinated and supervised data collection, and critically reviewed the manuscript for important intellectual content; Dr Dickinson, Ms Helmkamp, and Mr Vangala contributed to the design of the survey instrument, conducted the initial analyses, and reviewed and revised the manuscript; Drs Humiston and Rand contributed to the study design and reviewed and revised the manuscript; and all authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

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