Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Factors Associated With Parental Acceptance of COVID-19 Vaccination: A Multicenter Pediatric Emergency Department Cross-Sectional Analysis

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Study objective: During the delta surge of the COVID-19 pandemic in 2021, we sought to identify characteristics and beliefs associated with COVID-19 vaccination acceptance in parents of pediatric emergency department (ED) patients.

Methods: We conducted a cross-sectional survey-based study of the parents of children aged 3 to 16 years presenting to 1 of 9 pediatric EDs from June to August 2021 to assess the parental acceptance of COVID-19 vaccines. Using multiple variable regression, we ascertained which factors were associated with parental and pediatric COVID-19 vaccination acceptance.

Results: Of 1,491 parents approached, 1,298 (87%) participated, of whom 50% of the parents and 27% of their children aged 12 years or older and older were vaccinated. Characteristics associated with parental COVID-19 vaccination were trust in scientists (adjusted odds ratio [aOR] 5.11, 95% confidence interval [CI] 3.65 to 7.15), recent influenza vaccination (aOR 2.66, 95% CI 1.98 to 3.58), college degree (aOR 1.97, 95% CI 1.36 to 2.85), increasing parental age (aOR 1.80, 95% CI 1.45 to 2.22), a friend or family member hospitalized because of COVID-19 (aOR 1.34, 95% CI 1.05 to 1.72), and higher income (aOR 1.60, 95% CI 1.27 to 2.00). Characteristics associated with pediatric COVID-19 vaccination (children aged $\geq$12 years) or intended COVID-19 pediatric vaccination, once approved for use, (children aged $<$12 years) were parental trust in scientists (aOR 5.37, 95% CI 3.65 to 7.88), recent influenza vaccination (aOR 1.89, 95% CI 1.29 to 2.77), trust in the media (aOR 1.68, 95% CI 1.19 to 2.37), parental college degree (aOR 1.49, 95% CI 1.01 to 2.20), and increasing parental age (aOR 1.26, 95% CI 1.01 to 1.57).

Conclusion: Overall COVID-19 vaccination acceptance was low. Trust in scientists had the strongest association with parental COVID-19 vaccine acceptance for both themselves and their children. [Ann Emerg Med. 2022;80:130-142.]

Please see page 131 for the Editor's Capsule Summary of this article.

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INTRODUCTION

By October 1, 2021, the number of worldwide SARS-CoV-2 (COVID-19) infections totaled 219 million cases, with nearly 4.6 million deaths.[1] With the broad availability of COVID-19 vaccines for adults and older children, hope arose that the United States (US) could achieve a sufficient level of immunization to reach herd immunity.[2,3] Yet, vaccine hesitancy hampered this public health goal.[4-6] Prior to its release, the COVID-19 vaccine acceptance in the general population ranged from 56% to 75%.[7-11] These data were disappointingly prescient; as of October 2021, only 56% of the US population had been fully vaccinated against COVID-19.[12]

Importance

Although multiple investigators have documented vaccine hesitancy in adults, less data on pediatric populations exist.[13-15] Using an established national internet panel, Szilagyi et al[10] found that less than half of parents are likely to have their child receive a COVID-19 vaccine. Yet, telephone and internet-based surveys may miss disadvantaged and highly vulnerable populations—those who may be at the greatest risk of morbidity and mortality and who would benefit the most from COVID-19 vaccination.[6,10,16-20] Furthermore, by focusing only on vaccine hesitancy and not addressing vaccine acceptance, it is possible that important and modifiable factors that can lead to increased vaccination rates are overlooked.

Editor's Capsule Summary

What is already known on this topic

Although COVID-19 vaccines are widely available, vaccine hesitancy has limited their uptake.

What question this study addressed

How do the parents of children presenting to a pediatric emergency department feel about COVID-19 vaccination for themselves and their children?

What this study adds to our knowledge

In this multicenter survey conducted during the summer of 2021, most parents of children aged 2 to 16 years presenting to the emergency department had concerns about COVID-19 vaccination. Trust in scientists was associated with a higher likelihood of parental and child COVID-19 vaccination receipt.

How is this relevant to clinical practice

Improving trust in scientists could reduce vaccine hesitancy for parents and their children.

The emergency department (ED) serves ethnically and racially diverse populations, including many vulnerable patients with limited access to primary care. In this cross-sectional study conducted during real-time pediatric ED patient visits, we examined parents' and children's COVID-19 vaccination rates and the likelihood of future vaccination in potentially medically underserved populations. Our primary goals were to identify parental characteristics and beliefs that may be associated with COVID-19 vaccine acceptance, both for themselves and their children. By gathering data in EDs where many parents and children from at-risk minority groups seek pediatric care, we hoped to obtain a sample more broadly representative of vulnerable populations.

MATERIALS AND METHODS

Study Design and Setting

From June 7, 2021, to August 13, 2021, we conducted this cross-sectional survey-based study of parents and guardians of ED patients aged 3 to 16 years during their visits to 9 pediatric EDs in 8 US cities (Miami, Florida; New Orleans, Louisiana; Boston, Massachusetts; Detroit, Michigan; Durham, North Carolina; Philadelphia, Pennsylvania; Camden, New Jersey; and Houston, Texas). Three pediatric EDs were located in general academic hospitals, and the remaining 6 were located in academic pediatric hospitals. The median annual visits to these EDs was 32,000 (range 9,300 to 87,000) in 2020, a lower census compared with that in 2019 (median annual visits 50,000, range 14,800 to 119,000). We obtained institutional review board approval or exemptions from all sites. We followed the Strengthening the Reporting of Observational Studies in Epidemiology guidelines.[21]

Survey Instrument Development

Select survey items were adapted from an earlier investigation of adult ED patients.[22] Options for the likelihood of receiving a COVID-19 vaccine were modeled after earlier investigations.[10] New items, relevant to children and the SARS-CoV-2 Delta surge, were developed by the investigators. This survey draft was refined with respect to item content, completeness of response options, cultural sensitivity, ease of administration, and length using feedback from a patient focus group containing 10 parents of children aged 3 to 16 years at Cooper University Hospital. Once the English version was finalized, a Spanish version was created using a professional medical translation service, which underwent minor revision by 3 native Spanish speakers. Both the English (n=10) and Spanish versions (n=16) were pilot tested to assess for comprehension, ease of completion, and response consistency (additional information is provided in Appendix E1 [available at http://www.annemergmed.com.]) The final pilot testing was conducted at the pediatric EDs of Cooper University Hospital, Camden, New Jersey and St. Christopher's Hospital for Children, Philadelphia, Pennsylvania.

Selection of Participants and Survey Administration

Parents or guardians of children aged 3 to 16 years were eligible if they were 18 years or older and could understand English or Spanish. Parents from this age group were selected because children aged 3 to 16 years at the time of the survey were likely to be attending secondary school in the fall. Only 1 parent per child was enrolled, and repeat enrollments were disallowed. Enrollment of the parents of critically ill children was at the discretion of the treating physician. To capture data from non-English-speaking parents, a Spanish survey was used by 8 of the 9 sites. Parents were instructed to respond to the survey items based on the child presenting to the ED at the time of enrollment. Information about the presenting child and plans for that child's COVID-19 vaccination was obtained from the parent.

Enrollment time frames were staggered across the sites due to differing institutional review board approval dates. Initial enrollments began on June 7 and ended on August 13, 2021, with most sites enrolling over 5 to 6 weeks.

Limitations on research staffing led to convenience sampling at all the sites, with sites enrolling parents in blocks of 4 to 6 hours. At all sites, parents were enrolled throughout the week, from 8 AM to 8 PM. Seven sites additionally enrolled parents up until midnight or overnight. We sequentially screened potential participants using ED triage boards. Dedicated research personnel approached parents of children aged 3 to 16 years after the family unit was placed in an examination room. Research personnel described the study in layman's terms, provided parents with a study information sheet (in English or Spanish), and obtained scripted verbal consent. Research personnel read study items in English to the parents, and data were recorded either on hard copies or directly into the REDCap database. For Spanish-speaking parents, Spanish surveys were verbally administered by research personnel whenever possible. Because of pandemic-based restrictions on nonessential staffing, 1 site administered the Spanish survey directly to the parents. Upon collection, these were reviewed to ensure the completion of all items.

Data, Definitions, and Primary Outcomes

We included the following general categories of parent and child data in the survey: demographic data, COVID-19 vaccination status (as categorized in Table 1), and parent and child likelihood of getting COVID-19 vaccination. Parents and children aged 12 years or older were considered vaccinated if they had received a full vaccination series or at least 1 dose of a COVID-19 vaccine. Parents and children were considered unvaccinated if they had not received any COVID-19 vaccine. For demographic and other factors potentially associated with vaccination status, unvaccinated parents were further divided into 2 groups based on their self-reported likelihood of obtaining a COVID-19 vaccine for themselves or their child: vaccine acceptors = "likely" or "very likely" to get vaccinated and vaccine-hesitant = "neither likely nor unlikely," "unlikely," and "very unlikely" to be vaccinated. For determining the reasons for COVID-19 vaccine hesitancy, both for themselves and their children, the parents were further divided into 2 groups: ambivalent, "neither likely nor unlikely," and "unlikely" or "very unlikely" to be vaccinated against COVID-19.

To ascertain prior experience with COVID-19, we asked the parents whether they or their children had ever been diagnosed or had a positive COVID-19 test and whether they had any friends or family members who had ever been hospitalized for COVID-19. To gauge the parental assessment of child infectivity, parents were asked to rate their agreement with the statement "children infected with COVID-19 can infect others" on a scale of 0 to 10, with 0 reflecting no agreement and 10 reflecting complete agreement. To determine the level of trust in information sources, the parents were asked to rate their agreement with the following 2 statements: "I trust the information from scientists about the safety of the COVID-19 vaccines" and "I trust the information from the media (TV/news) about the safety of the COVID-19 vaccines" using the same 0-10 scale.

Our primary outcomes were COVID-19 vaccination status of the parent and vaccination status of the child. For adults and children aged 12 years or older, vaccination status was defined as vaccinated versus unvaccinated. For our pediatric multivariable regression model, children below the age of 12 years were placed in the "vaccinated" category if the parent reported themselves as being "very likely" to vaccinate their child once a COVID-19 vaccine was available for this age group (Table 1).

Analysis

Participants' characteristics were summarized as frequencies and percentages with corresponding 95% confidence intervals (CIs). We excluded nonresponses to individual questions in proportion denominators. Nonparametric data are presented as medians with interquartile ranges (IQRs). Median levels of agreement with the 3 statements (regarding child infectivity, trust in scientists, and trust in the media) were compared among 3 groups, vaccinated parents, vaccine acceptors, and vaccine-hesitant, using Kruskal-Wallace testing.

We identified variables a priori that we believed would be associated with the receipt of COVID-19 vaccination

Table 1. COVID-19 vaccination status and other definitions.

Vaccination Status	Definition
Vaccinated	An adult or child aged ≥12 years who has received a full vaccination series or at least 1 dose of a COVID-19 vaccine
Unvaccinated	An adult or child who has not received any COVID-19 vaccine
Vaccine acceptor	An adult who reports that they are "likely" or "very likely" to get a COVID-19 vaccine for themselves or their child
Vaccine-hesitant	An adult who reports being "neither likely nor unlikely," "unlikely," or "very unlikely" to receive any COVID-19 vaccine for either themselves or their child
Ambivalent	Selection of "neither likely nor unlikely" with respect to the receipt of a COVID-19 vaccine for either adults or children

based on the literature.[23-25] Two multivariable logistic regression analyses were performed. The first model explored the association between receipt of COVID-19 vaccination in parents and parental demographics, including sex, age (18 to 34 years, 35 to 44 years, and ≥45 years), race (African American or Black versus others), ethnicity (Hispanic versus not Hispanic), receipt of influenza vaccination within the past 2 years, annual income (<$25,000, $25,000 to $74,999, or ≥$75,000), education level (no college degree versus college degree), and knowing a family member or friend previously hospitalized for COVID-19 (none, single experience, or multiple experiences). We also included parental level of agreement in the belief that children can infect others, level of trust in scientists, and level of trust in the media in our regression model for adults. Levels of agreement were made dichotomous for the multivariable regression analysis: (high ≥7 versus not high <7).

The second logistic regression model explored the association between COVID-19 vaccination in children, defined as the vaccination of children aged 12 years or older or the parental response being "very likely" to get children below the age of 12 years vaccinated once a vaccine was available, and the following parental characteristics: sex, age, race, ethnicity, COVID-19 vaccination status, annual income, and education level. We also included child influenza vaccination within 2 years, any chronic medical condition in the child, parental agreement with the belief that children can infect others, and levels of trust in scientists and the media. Parental vaccination was not included in the pediatric model because we believed this factor to be highly associated with parental trust in scientists. By including 2 variables that are highly correlated with one another, the effect of each on the regression model becomes less precise. To avoid this potential for collinearity, we included only parental trust in scientists in our pediatric regression model.

Adjusted odds ratios (aORs) are reported with 95% CIs. In our a priori sample size calculation, assuming a small effect size (0.02), the inclusion of 11 predictor variables, a power level of 0.9, and an α of 0.05, we determined that we would need to enroll 1,071 parents. To assess for potential differences in variables associated with prior COVID-19 vaccination status (children aged ≥12 years) and the parental report of being "very likely" to pursue COVID-19 vaccination (children <12 years), we conducted 2 sensitivity analyses, analyzing these 2 groups separately. Study data were collected and managed using REDCap electronic data capture tools hosted at Cooper University Hospital.[26] We used IBM SPSS Statistics, version 27.0 (IBM Corp), to conduct the analyses.

RESULTS

Characteristics of Study Subjects

Of 2,589 parents who were screened for inclusion, 1,491 met the inclusion criteria. Of these 1,491 parents, 1,298 (87%) agreed to participate, 173 (12%) refused, 12 (1%) were excluded because of medical care interrupting enrollment, and 8 (<1%) had a language barrier. Most participants (83%) were women, and the median age (IQR) of the parents was 36 (IQR 31–42) years. The predominant minority groups were African American or Black (41%) and Hispanic or Latinx (25%). Nearly one third (31%) of parents reported an annual income below $25,000.

Of children who presented to the ED, 663 (52%) were male, and the median age was 9 (IQR 5–13) years. There were 142 (11%) children of preschool age (3 years), 722 (56%) children aged 4–11 years (not eligible for a COVID-19 vaccine), and 416 (34%) children aged 12–16 years (eligible for a COVID-19 vaccine) (Table 2).

Main Results

Vaccination status. Half of the parents were either fully vaccinated against SARS-CoV-2 (579 [45%]) or had received 1 dose of their vaccination series (67 [5%]). Of the 650 (50%) unvaccinated parents, 184 (28%) were vaccine acceptors, whereas 238 (37%) were "very unlikely" to be vaccinated. In children aged 12 years or older, 112 (27%) were already vaccinated. Of children below 12 years of age, 2 were already vaccinated, and 242 (28%) parents stated that they were "very likely" to have their child vaccinated. Data on vaccine hesitancy and other parental and child characteristics are reported in Table 2.

Characteristics and beliefs of COVID-19-vaccinated versus COVID-19-unvaccinated parents. The greatest differences in vaccination rates based on demographic characteristics were between parents aged 18–34 years (37%, 95% CI 33% to 41%) versus those aged 45 years or older (74%, 95% CI 68% to 80%) and between Black (39%, 95% CI 42% to 51%) versus non-Black parents (58%, 95% CI 54% to 61%). With respect to socioeconomic characteristics, the greatest disparities in vaccinations rates were between parents with an annual income <$25,000 (35%, 95% CI 30% to 40%) versus those earning $75,000 or more (75%, 95% CI 70% to 80%) and between those with an education level less than or equivalent to a high school graduate (36%, 95% CI

Table 2. Demographic and personal characteristics of parents and children.

Parent Characteristics	N = 1,298	Child Characteristics	N = 1,298
Parent/guardian age in y, median (IQR)	36 (median 31– 42) Mean 37.1 y Range: 18 to 81	Child age in y, median (IQR)	9 (median 5–13) Mean 8.9 y Range: 3 to 16
Sex of parent, n (%)		**Sex of child, n (%)**	
Male	213 (16.7)	Male	663 (52.0)
Female	1056 (83.0)	Female	611 (47.9)
Trans, nonbinary, or other	3 (<1)	Trans or nonbinary	2 (<1)
Prior diagnosis of COVID-19	267 (21)	**Prior diagnosis of COVID-19**	147 (11)
COVID-19 vaccination status		**COVID-19 vaccination status (<12 y)**	
Already vaccinated*	646 (50)	Already vaccinated	2
Very likely	91 (14)	Very likely	242 (28)
Likely	93 (14)	Likely	133 (15)
Neither likely nor unlikely	149 (23)	Neither likely nor unlikely	173 (20)
Unlikely	77 (12)	Unlikely	95 (11)
Very unlikely	238 (37)	Very unlikely	216 (25)
Relation to child		**Vaccination status (≥12 y)**	
Mother	1014 (79.7)	Already vaccinated	112 (27)
Father	194 (15.3)	Very likely	87 (21)
Guardian	64 (5.0)	Likely	33 (8)
Race/ethnicity of parent		Neither likely nor unlikely	68 (16)
White	711 (54.8)	Unlikely	29 (7)
African American or Black	532 (41.0)	Very unlikely	85 (20)
Asian	47 (3.6)	**Chronic medical condition (child)**	
American Indian or Alaska Native	11 (1)	Asthma or chronic lung disease	280 (21.6)
Native Hawaiian or Pacific Islander	3 (<1)	Obesity	44 (3.4)
Latinx (Hispanic)	326 (25.1)	Metabolic or genetic disorder	31 (2.4)
Primary language		SCD, thalassemia, G6PD	31 (2.4)
English	1,204 (92.9)	Diabetes mellitus	27 (2.1)
Spanish	92 (7.1)	Immunosuppression	25 (1.9)
Highest level of education		Congenital heart disease	14 (1.1)
Did not complete high school	126 (9.9)	Cancer	8 (0.6)
Graduated high school or GED	410 (32.2)	Down syndrome	6 (0.5)
Some college	353 (27.7)	Cerebral palsy	5 (0.4)
College degree (BS or BA)	260 (20.4)	**Any chronic medical condition in a child**	425 (32.7)
Advanced college degree (Masters, MD, or PhD)	125 (9.8)	**Higher-risk cohabitants**	
Annual income		Children aged <16 y	864 (66.6)
<$25,000	398 (31.2)	Someone aged ≥65 y	137 (10.6)
$25,000 to $74,999	487 (38.1)	Someone immunocompromized	108 (8.3)
$75,000 to $150,000	198 (15.5)	Someone who is pregnant	42 (3.2)
>$150,000	124 (9.7)	None of the above	315 (24.3)
Declined to answer	70 (5.5)		
Hybrid or virtual schooling made it difficult for me or my partner to work	334 (25.7)		

BA, Bachelor of Arts; *BS,* Bachelor of Science; *G6PD,* glucose-6-phosphate-dehydrogenase deficiency; *GED,* general educational development; *IQR,* interquartile range; *MD,* Doctor of Medicine; *PhD,* Doctor of Philosophy; *SCD,* sickle cell disease.
*Vaccinated is defined as being fully immunized or receiving 1 of 2 injections of a 2 series vaccine.

Table 3. Characteristics and beliefs of COVID-19-vaccinated versus COVID-19-unvaccinated parents.

Characteristic	N=1,298 N	Vaccinated With At Least 1 Dose N=646 n (%; 95% CI)	COVID-19 Vaccine Acceptor N=184* n (%; 95% CI)	COVID-19 Vaccine-Hesitant N=464† n (%; 95% CI)
Sex				
Female	1055	517 (49; 46–52)	141 (13; 11–16)	397 (38; 35–41)
Male	212	113 (53; 47–60)	41 (19; 15–25)	58 (27; 22–34)
Age				
18 to 34 y	542	200 (37; 33–41)	91 (17; 14–20)	251 (46; 42–51)
35 to 44 y	504	271 (54; 49–58)	68 (14; 11–17)	165 (33; 29–37)
≥45 y	221	164 (74; 68–80)	21 (10; 6–14)	36 (16; 12–22)
Race				
African American or Black	532	207 (39; 35–43)	90 (17; 14–20)	235 (44; 40–48)
Not African American or Black	762	439 (58; 54–61)	94 (12; 10–15)	229 (30; 27–33)
Ethnicity				
Hispanic or Latinx	325	164 (51; 45–56)	59 (18; 14–23)	102 (31; 27–37)
Not Hispanic or Latinx	969	482 (50; 47–53)	125 (13; 11–15)	362 (37; 34–40)
Annual income				
<$25,000	398	139 (35; 30–40)	77 (19; 16–24)	182 (46; 41–51)
$25,000 to $74,999	487	227 (47; 42–51)	74 (15; 12–19)	186 (38; 34–43)
≥$75,000	321	241 (75; 70–80)	21 (6.5; 4.3–9.8)	59 (18; 15–23)
Education				
Less than high school graduate	535	194 (36; 32–40)	104 (19; 16–23)	237 (44; 40–49)
Some college	353	166 (47; 42–52)	52 (15; 11–19)	135 (38; 33–43)
College degree	384	278 (72; 68–77)	23 (6; 4–9)	83 (22; 18–26)
In the past 2 years, have you received the flu (influenza) vaccine (at least once)?				
Yes	760	482 (63; 60–67)	105 (14; 12–17)	173 (23; 20–26)
No	504	148 (29; 26–34)	74 (15; 12–18)	281 (56; 52–60)
Unsure	28			
Do you have a friend or family member who was hospitalized for or died of COVID-19?				
Both hospitalized and died and hospitalized and lived (multiple hospitalized friends or family members)	66	43 (65; 53–76)	7 (11; 5–20)	16 (24; 16–36)
Hospitalized and lived or died	474	238 (50; 46–55)	51 (11; 8–14)	185 (39; 35–44)
Neither	754	365 (48; 45–52)	126 (17; 14–20)	263 (35; 32–38)
Before the pandemic (March 2020), was your child up to date with his or her vaccinations?				
Yes	1,233	630 (51; 48–54)	174 (14; 12–16)	428 (35; 32–37)
No	40	11 (28; 17–44)	4 (10; 4–24)	24 (62; 46–75)
Unsure	11			
Did your child receive a flu vaccine in the past 2 years (at least once)?				
Yes	866	507 (59; 55–62)	125 (14; 12–17)	234 (27; 24–30)
No	367	120 (33; 28–38)	47 (13; 10–17)	200 (55; 49–60)

Table 3. Continued.

Characteristic	N=1,298 N	Vaccinated With At Least 1 Dose N=646 n (%; 95% CI)	COVID-19 Vaccine Acceptor N=184* n (%; 95% CI)	COVID-19 Vaccine-Hesitant N=464† n (%; 95% CI)
Unsure	53			
Agreement with the following statements:	**Median (IQR) (Range)**	**Median (IQR)**	**Median (IQR)**	**Median (IQR)‡**
Children infected with COVID-19 can infect others.‡	10 (9–10) (0–10)	10 (10–10)	10 (8.75–10)	10 (7–10)
I trust the information from scientists about the safety of the COVID-19 vaccines.‡	6 (4–10) (0–10)	9 (6–10)	6 (4–10)	4 (1–5)
I trust the information from the media (TV or news) about the safety of the COVID-19 vaccines.‡	4 (0–6) (0–10)	5 (3–8)	5 (2–7)	2 (0–5)

IQR, Interquartile range.
*Not vaccinated; but likely or very likely to get immunized.
†Neither likely nor unlikely; unlikely or very unlikely to get vaccinated.
‡Kruskal-Wallis test resulted in significant differences for all three items, infectivity, trust in scientists, and trust in the media (P<.0001).

32% to 40%) versus parents who received a college degree (72%, 95% CI 68% to 77%) (Table 3).

Prior influenza vaccination status of parents was also associated with current COVID-19 vaccination status, with those being vaccinated against influenza in the past 2 years being more likely to be vaccinated against COVID-19 (63%) compared to those who had not recently received an influenza vaccination (29%). Having a friend

Table 4. Reasons for COVID-19 vaccine hesitancy for parents.

Reasons	N=464 N	Ambivalent N=149* N (%; 95% CI)	Unlikely or Very Unlikely N=315 N (%; 95% CI)
If unlikely or unsure of accepting the COVID-19 vaccine, what are the reasons you would not accept it?			
I am concerned about long-term effects or safety of the vaccine.	310 (67)	99 (66; 59–74)	211 (67; 62–72)
I want to see what happens to vaccinated adults before I will consider it.	221 (48)	82 (55; 47–63)	139 (44; 39–50)
I have concerns about short-term (within 3 weeks) effects or safety of the vaccine.	192 (41)	64 (43; 35–51)	128 (41; 35–46)
I need more information about the vaccine	186 (40)	67 (45; 37–53)	119 (38; 32–43)
I don't believe the COVID-19 vaccine will work	72 (16)	10 (7; 3–11)	62 (20; 15–24)
I already had COVID-19	55 (12)	15 (10; 5–15)	40 (13; 9–16)
I do not get vaccines because of my religious beliefs	41 (9)	5 (3; 0.5–6)	36 (11; 8–15)
I don't believe I will get COVID-19	26 (6)	3 (2; −0.2 to 4)	23 (7; 4–10)
People don't get very sick from COVID-19	14 (3)	2 (1.3; −0.5–3)	12 (4; 2–6)
Other reasons	73 (16)	18 (12; 7–17)	55 (18; 13–22)
Median number of reasons (IQR) Mean (range)		2 (1–4) 2.45 (6.0)	2 (1–4) 2.6 (7.0)

CI, Confidence interval; *IQR,* interquartile range.
*Neither likely nor unlikely to get vaccinated.

Table 5. Parental reasons for COVID-19 vaccine hesitancy for their child.

	N=670	Ambivalent N=242*	Unlikely or Very Unlikely N=428
Reasons	**N**	**N (%; 95% CI)**	**N (%; 95% CI)**
If unlikely or unsure of accepting the COVID-19 vaccine for your child, what are the reasons you would not accept it?			
I am concerned about long-term effects of the vaccine	451 (67)	157 (65; 59–71)	294 (69; 64–73)
I want to see what happens to vaccinated children before I consider it	342 (51)	141 (58; 52–65)	202 (47; 43–52)
I have concerns about short term (within 3 weeks) effects or safety of the vaccine	337 (50)	129 (53; 47–60)	208 (49; 44–53)
I need more information about the vaccine	301 (45)	129 (53; 47–60)	172 (40; 36–45)
I don't believe the COVID-19 vaccine will work	94 (14)	11 (5; 2–7)	83 (19; 16–23)
Children don't get very sick from COVID-19	58 (9)	17 (7; 4–11)	41 (10; 7–12)
My child does not get vaccines because of our religious beliefs	38 (6)	5 (2; 0.3–4)	33 (8; 5–10)
My child already had COVID-19	32 (6)	6 (3; 0.5–4)	26 (6; 4–8)
I don't believe that my child will get COVID-19	24 (4)	6 (3; 0.5–4)	18 (4; 2–6)
Other reasons	79 (12)	18 (7; 4–11)	61 (14; 11–18)
Median number of reasons (IQR)		3 (1–4)	3 (1–4)
Mean (range)		2.6 (8)	2.7 (9)

CI, Confidence interval; IQR, interquartile range.
*Neither likely nor unlikely to get vaccinated.

or family member hospitalized due to COVID-19 was also associated with increased parental COVID-19 vaccination rates. The greatest effect on COVID-19 vaccination status was in parents who had multiple friends or family members hospitalized due to COVID-19 (Table 3).

In our Kruskal-Wallis analysis, parents vaccinated against COVID-19 reported a higher median level of agreement with the statement "children infected with COVID-19 can infect others" compared to vaccine-hesitant parents. Vaccinated parents also reported a higher level of trust in the information from scientists about the safety of COVID-19 vaccines when compared to vaccine-hesitant parents. Median agreement with trusting the media about the safety of COVID-19 vaccines was low in all groups but still differed between vaccinated versus vaccine-hesitant parents (Table 3).

SARS-CoV-2 vaccination hesitancy. Tables 4 and 5 present the reasons parents gave for their hesitancy in accepting a COVID-19 vaccine for themselves and their children. For both, the most common reasons were concern about the long-term effects or safety of the vaccine, a desire to see what happens to vaccinated adults or children before considering it, and concerns about the short-term effects or safety of the vaccine. Two items, not believing that the vaccine will work and religious beliefs, ranked higher in parents who were "unlikely" or "very unlikely" to accept the vaccine for either themselves or their children than in those who reported themselves as being ambivalent.

Characteristics associated with COVID-19 vaccination determined using multivariable regression. Characteristics most highly associated with adult COVID-19 vaccination included a high degree of trust in scientists, receipt of influenza vaccination in the past 2 years, and attainment of a college degree (Table 6). Characteristics independently associated with COVID-19 vaccination in children or rated by the parents as "very likely" to accept vaccination in children below 12 years of age are presented in Table 7. The characteristic most highly associated with pediatric COVID-19 vaccination was high level of parental trust in scientists about the safety of the vaccine (aOR 5.37, 95% CI 3.65 to 7.88).

Sensitivity Analyses

Characteristics associated with pediatric COVID-19 vaccination were further examined based on eligibility for the vaccine. In children aged 12 years or older (eligible for a vaccine), COVID-19 vaccination was most highly associated with the parental belief (rated $\geq$7) that children infected with COVID-19 can infect others (aOR 4.12,

Table 6. Adjusted odds ratios for characteristics associated with COVID-19 vaccination in adults.

Characteristic	n/N (%)	Odds Ratio	95% Confidence Interval
Female sex	1,056/1,270 (83)	0.77	0.51–1.15
Parental age: 18 to 34 y (reference)	536/1,255 (43)	1.80	1.45–2.22
35 to 44 y	500/1,255 (40)		
≥45 y	219/1,255 (18)		
African American or Black	527/1,269 (42)	0.90	0.63–1.27
Hispanic or Latinx	324/1,269 (26)	1.26	0.85–1.87
Influenza vaccination in the past 2 y	741/1,265 (59)	2.66	1.98–3.58
Income: <$25,000 (reference)	393/1,192 (33)	1.60	1.27–2.00
$25,000 to $74,999	484/1,192 (41)		
≥$75,000	315/1,192 (26)		
Education: college degree versus no college degree	376/1,257 (30)	1.97	1.36–2.85
Family or friend hospitalized: none (reference)	740/1,269 (58)	1.34	1.05–1.72
Hospitalized and lived or died (single)	465/1,269 (37)		
Hospitalized lived or died (multiple family members or friends)	64/1,269 (5)		
Belief that children infected with COVID-19 can infect others (agreement level ≥7 on a scale of 0 to 10)	1,060/1,255 (85)	1.19	0.79–1.81
Trust the information from scientists about the safety of the COVID-19 vaccines (agreement level ≥7 on a scale of 0 to 10)	620/1,258 (49)	5.11	3.65–7.15
Trust the information from the media about the safety of the vaccine (agreement level ≥7 on a scale of 0 to 10)	299/1,260 (24)	1.36	0.92–2.02

95% CI 1.17 to 14.48). In children below 12 years of age, this belief was not associated with a parental report of being "very likely" to vaccinate their child. Rather, a high level of parental trust in the information from scientists was most highly associated with a parental report of being "very likely" to pursue COVID-19 vaccination for their child (aOR 7.79, 95% CI 4.74 to 12.75) (additional information is provided in Appendix E2 [available at http://www.annemergmed.com.])

LIMITATIONS

As with all survey studies, our results might have been biased because of refusals to participate, recall bias, and social desirability in self-reported behaviors. Those who refused participation might have been less interested or even against COVID-19 vaccination and, thus, less likely to engage with research staff. We attempted to mitigate this and response bias by using scripted recruitment and neutrally worded descriptions and study items in our survey. Our results pertaining to adults might not be representative of the general US adult population because we only enrolled the parents of children aged 3 to 16 years presenting to an ED. As such, most of our study participants were mothers; so, we might not have had sufficient men in our sample to demonstrate differences in vaccine acceptance between the 2 sexes. Additionally, since all sites were urban pediatric EDs affiliated with academic centers, our findings might not accurately reflect parental perceptions or vaccine receptiveness prevalent in more rural settings. Our inclusion of children not yet eligible for vaccination in our multivariable analyses might have resulted in reporting bias. We hoped to mitigate this effect by only including children parents deemed "very likely" to be vaccinated, as opposed to including all vaccine acceptors, and by performing our sensitivity analyses. Finally, we enrolled during the Delta variant surge in 2021, just prior to the return to school. As such, parental responses might have been influenced by news and personal events surrounding the surge and might not truly reflect their

Table 7. Adjusted odds ratios for characteristics associated with COVID-19 vaccination in children (aged 12 to 16 years) or parental rating "very likely" to accept vaccination in children aged <12 years.

Characteristic	n/N (%)	Odds Ratio	95% Confidence Interval
Parental female sex	278/352 (79)	1.36	0.92–2.03
Parental age: 18 to 34 y (reference)	108/352 (31)	1.26	1.01–1.57
35 to 44 y	154/352 (44)		
≥45 y	89/352 (25)		
The parent is African American or Black	103/352 (29)	0.82	0.56–1.20
The parent is Hispanic or Latinx	105/352 (30)	1.32	0.88–1.98
The child received the influenza vaccine in the past 2 y	292/343 (85)	1.89	1.29–2.77
Parental income: <$25,000 (reference)	88/330 (27)	1.06	0.84–1.35
$25,000 to $74,999	118/330 (36)		
≥$75,000	124/330 (38)		
Parental education: college degree versus no college degree	145/349 (42)	1.49	1.01–2.20
Parental belief that children infected with COVID-19 can infect others (agreement ≥ 7 on a scale of 0 to 10)	317/346 (92)	1.52	0.92–2.50
Parental trust the information from scientists about the safety of the COVID-19 vaccines (agreement level ≥7 on a scale of 0 to 10)	294/352 (84)	5.37	3.65–7.88
Parental trust the information from the media about the safety of the vaccine (agreement level ≥7 on a scale of 0 to 10)	152/349 (44)	1.68	1.19–2.37
Any chronic medical problem in the child	126/352 (36)	1.24	0.90–1.70

long-term views. Nevertheless, we believe that our use of pediatric EDs for in-person enrollment was an improvement over random telephone or internet-based survey methods commonly found in the extant literature.[10,15,27-32] Given that most of our sites are in inner cities and/or serve as referral sites for outlying rural areas, this likely contributed to our findings' generalizability.

DISCUSSION

To assess for parental COVID-19 vaccine hesitancy in a diverse, potentially vulnerable population, we conducted this cross-sectional study in a true, safety-net health care setting. Two thirds of our participants were Black or Hispanic, and nearly a third had an income of less than $25,000. We observed the following principal findings: approximately half of the parents and 27% of children aged 12 to 16 years had already received at least 1 dose of a COVID-19 vaccine; of the remaining unvaccinated parents, only 28% reported a likelihood of future COVID-19 vaccination; of the remaining unvaccinated children, 40% (12 to 16 years) and 44% (< 12 years) were likely to be vaccinated in the future; and the primary characteristics associated with parental COVID-19 vaccine acceptance for both themselves and their children were a high level of trust in scientists and prior receipt of an influenza vaccine.

Our parental vaccination rate of 50% (with at least 1 dose of the vaccine) was slightly less than US vaccination rates of 52% to 58%, documented for early June to early August 2021.[12] We believe this discrepancy was mainly due to our high percentage of African American participants, the majority of whom were not vaccinated. Concerns about the long-term effects and safety of the COVID-19 vaccine were listed the most frequently by vaccine-hesitant parents. When we examined reasons why parents and their children were not vaccinated, the factor with the greatest discrepancy between parents who were ambivalent and those who were unlikely to get vaccinated was not believing that the COVID-19 vaccine would work. To address these misconceptions, some have called for public education campaigns directed at populations with low vaccine rates. Yet, in isolation, these efforts may not suffice.[33-35] Belief in whether the vaccine will work may be grounded in trust in the scientific community, a factor we

found to be highly associated with vaccine acceptance. For the scientific community to engender trust, full disclosure of both benefits and risks of the vaccine is essential. As demonstrated by Petersen et al,[36] transparently disclosing the negative features of the COVID-19 vaccine induces vaccine skepticism and decreased acceptance in the short term. However, vague communication about the vaccine results in long-term erosion of trust in health authorities and increases the reception of conspiracy theories. Although neither is an ideal outcome, the latter is far more detrimental to public health.

Only 27% of children aged 12 to 16 years had received at least 1 dose of a COVID-19 vaccine. For the remaining eligible, unvaccinated children, 182 (60%) parents were vaccine-hesitant. Our results in younger children were also troubling. Other than the 2 who were already vaccinated, only 28% of parents were "very likely" to have their children vaccinated once eligible and 56% were vaccine-hesitant. Vaccine acceptance in our sample was lower than that in prior international studies, in which 60% to 65% of parents reported an intention to vaccinate their children.[25,37-39]

Our multivariable logistic regression findings differed from those of prior studies with respect to factors and characteristics associated with COVID-19 vaccination in adults. In our analysis, sex, race, and ethnicity were no longer associated with vaccination because of the inclusion of our "trust" variables. For parents, vaccine acceptance was most highly associated with trust in scientists about vaccine safety. Many early studies have examined demographics and prior vaccination status but not perceptions or beliefs. Like these earlier studies, we also demonstrated that recent influenza vaccination, increasing parental age, increasing annual income levels, and the receipt of a college degree are associated with COVID-19 vaccination in adults.[15,25,29-31]

With respect to characteristics associated with the vaccination of children (or the high likelihood of getting children not yet eligible for the vaccine vaccinated), several factors significant in our adult regression model no longer demonstrated significance or were less positively associated with vaccination. As in the adult model, trust in scientists about the safety of the COVID-19 vaccine was the characteristic that was the most highly associated with vaccination status in children. A new factor, trust in the information from the media, emerged. Why this occurred is unclear. We suspect that parents were wary of the media when the vaccine was first released to the (adult) public. Thus, our question item may reflect parents' views of the media at the time of their vaccinations. As public health messaging became more consistent, compared to earlier in the pandemic, parents might have developed a more favorable view of the media as a reliable source of information. As such, this might be reflected in parental views regarding the vaccination of their children.

Finally, our sensitivity analyses provided slightly different results from those of our original multivariable regression. For vaccinated children, parental education and parental trust in the media no longer demonstrated significance. In contrast to our original multivariable regression, parental belief in child infectivity was the factor most highly associated with COVID-19 vaccination in children aged 12 years or older. In younger children, not yet eligible for the vaccine, 4 of the original 5 variables remained significant, with parental trust in the information from scientists being the most highly associated with the parental rating of "very likely" to vaccinate their child against COVID-19. We believe that these findings more closely approximated our original multivariable regression because parents of younger children outnumbered parents of older children by two-fold. What remains to be seen is whether the characteristics associated with a parental declaration of "very likely" to vaccinate their young child actually translate into COVID-19 vaccination. Further investigation of parental COVID-19 vaccination intent and practice is warranted.

Our investigation adds to the current body of literature in further identifying characteristics of parents who may be reluctant to pursue COVID-19 vaccination for both themselves and their children. Prior studies have identified those who are less likely to obtain COVID-19 vaccination—Hispanics and African Americans, those of lower socioeconomic and educational standing, and individuals who have conservative political views.[7-12,40] Our investigation adds to this body of knowledge in that our findings provide guidance toward what may need to be done to improve COVID-19 vaccination rates.

Generation of trust in public health officials is a dynamic process, and lessons from successful influenza vaccination campaigns should be considered. Communication with the public needs to be timely and, especially in cases of vaccine failures or adverse effects, transparent. In the ED, the establishment of trust can be achieved by initiating a discussion with unvaccinated patients about the COVID-19 vaccine's effectiveness as well as its risks and shortcomings. The risk of COVID-19 infection and potential sequelae should also be presented in a clear, yet, non-threatening nor judgmental, manner.[41-43] Consistent messaging by public officials, including physicians, where personal actions mirror official policies (mask wearing, acceptance of vaccination, and compliance with social distancing policies), must also occur to gain and maintain trust from the community. Finally, input and support from

other community leaders, such as clergy, business leaders, and community activists, should also be considered because these individuals have already established a level of trust that may be difficult to achieve by outsiders in a timely manner during a pandemic. The above, when coupled with efforts to make vaccination accessible and affordable to targeted populations, including ED-based COVID-19 vaccination, should help increase public trust and the acceptance of COVID-19 vaccines.[22,40-43]

In summary, we demonstrated that COVID-19 vaccine acceptance remains relatively low, for both parents and their eligible children, despite months-long vaccine availability. Unlike other studies, we did not find strong associations between race or ethnicity and vaccine acceptance. Rather, trust in scientists demonstrated the strongest association with vaccine acceptance in adults and in parental report of being very likely to pursue COVID-19 vaccination in children below 12 years of age. Our findings may inform future COVID-19 vaccine messaging campaigns in pediatric populations.

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