Factors associated with parental COVID-19 vaccine attitudes and intentions among a national sample of United States adults ages 18–45

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ABSTRACT

Purpose: This study explored factors associated with parents' attitudes and intentions to seek information about the COVID-19 vaccine for their children (ages 0–18) and intentions to vaccinate their age-eligible children.

Design and methods: As part of an anonymous online cross-sectional survey, parents' vaccine attitudes, COVID-19 vaccine intentions for their children, health literacy, health numeracy, and sociodemographic variables were assessed. Multivariable ordered logistic regression models identified factors associated with parents' COVID-19 vaccine intentions for their children.

Results: Parents/guardians ($n = 963$) were mostly White (82.3%), insured (88.0%), and college graduates (57.3%). Men reported higher intentions than women to seek information about the COVID-19 vaccine for their children ($p = 0.003$) and higher intentions to vaccinate their children ($p = 0.049$). Parental characteristics associated with increased intentions to have their children vaccinated included higher educational attainment ($p < 0.001$), more positive general vaccine attitudes ($p < 0.001$), preference for health information in a language other than English ($p = 0.006$), higher income ($p = 0.048$), having health insurance ($p = 0.05$), health literacy ($p = 0.024$), and health numeracy ($p = 0.049$).

Conclusions: Multiple sociodemographic characteristics including male gender, higher health literacy and numeracy, and language preference are noteworthy factors associated with parental COVID-19 vaccine intentions that could inform the planning and implementation of educational interventions.

Practice implications: Nurses are important sources of trusted information and play an important role in parent/family health education and in understanding myriad factors that may improve attitudes and enhance readiness toward vaccine uptake. Our findings emphasize the potential value of examining tailored/targeted COVID-19 vaccine education according to key influencing factors.

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Introduction

As of November 2022, >636 million cases and 6.6 million deaths are directly associated with SARS-CoV-2 worldwide, and approximately 15 million children have tested positive for the virus since the COVID-19

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pandemic initially spread to the United States (U.S.) (American Academy of Pediatrics, 2022a; World Health Organization, 2022). Although children are more likely to develop asymptomatic infections than adults and may have a milder presentation, a high percentage in this group may expose others to SARS-CoV-2 (Bullard et al., 2021; Han et al., 2021). The high prevalence of asymptomatic carriers may facilitate further spread of the pandemic, especially in younger populations who may not always fully understand or effectively undertake the necessary social distancing and other public health measures (Han et al., 2021; Moghadas et al., 2021). There has been a significant increase in COVID-19 pediatric cases across the U.S. due to the Omicron variant surge (AAP, 2022a). Silent transmission via pediatric populations can result in further outbreaks as children may transmit the virus to others, highlighting the importance of research about parental knowledge and attitudes regarding the COVID-19 vaccine in the pediatric population (Moghadas et al., 2021; Snider et al., 2021; Zhang et al., 2020; Zhen-Dong et al., 2020).

As a public health measure for mitigating the COVID-19 pandemic, several U.S. pharmaceutical companies were granted emergency use authorization (EUA) by the U.S. Food and Drug Administration (FDA) (U.S. Food and Drug Administration, 2022). Initially, EUA was granted for vaccinations in adult populations aged either 16 and older or 18 and older, including at the time of data collection for the current study (U.S. Food and Drug Administration, 2022). Currently, the COVID-19 vaccines authorized for children aged 6 months and older are the Pfizer-BioNTech COVID-19 Vaccine (Pfizer) and Moderna mRNA-1273 vaccine (U.S. Food and Drug Administration, 2022). The Advisory Committee on Immunization Practices (ACIP) began recommending administration shortly after EUA was granted (U.S. Food and Drug Administration, 2022). With the recent EUA approval of the Pfizer and Moderna vaccines for those ages 6 months and older (updated from previous approval for those ages 5 years and older), the EUA approval of the Novavax COVID-19 vaccine to be administered to those 12 and older and many individuals now eligible for booster doses (U.S. Food and Drug Administration, 2022), more research is needed to add to the ever-evolving body of literature detailing pediatric COVID-19 cases and intentions to vaccinate children.

The World Health Organization (WHO) describes vaccine hesitancy as postponing or rejecting the use of safe and available vaccines (Kestenbaum & Feemster, 2015; MacDonald, 2015; Troiano & Nardi, 2021). Prior research on COVID-19 vaccine hesitancy in adults suggests several sociodemographic groups are also more hesitant regarding the COVID-19 vaccine, including women, those with lower income, homeless, younger, and Black/African American individuals (Brownstein et al., 2022; Longchamps et al., 2021; Neumann-Böhme et al., 2020; Willis et al., 2021). However, there is far less information regarding the impact of parental COVID-19 vaccine hesitancy on children during the SARS-CoV-2 pandemic.

Research identifies numerous factors that influence vaccine uptake, such as social norms, health literacy (HL), ability to obtain and access accurate knowledge about vaccines, religious beliefs, and healthcare provider recommendations (Kestenbaum & Feemster, 2015; Montagni et al., 2021). The Health Belief Model (HBM) suggests that beliefs in the threat of an illness (e.g., perceived risk, perceived severity), about benefits and perceived barriers to engaging in a behavior, cues to action, and self-efficacy can explain an individuals' engagement in health-promoting behaviors (Strecher & Rosenstock, 1997). Shmueli (2021) found that the HBM and Theory of Planned Behavior (TPB), the latter which involves theoretical constructs including attitudes and normative beliefs, can predict an individual's intention to receive the COVID-19 vaccine. Further, Li et al. (2021) found that uncertainty from receiving conflicting information and negative emotions can strongly predict parents' attitudes and perceived control regarding childhood vaccinations.

Importantly, in the present pandemic, the circulation of COVID-19 misinformation has made it difficult for members of the public to assess the risk and severity of the pandemic, which resulted in risky behaviors

such as drinking bleach or alcohol in an attempt to prevent infection (Savoia et al., 2021). Those unable to deconstruct misinformation were more likely to be vaccine hesitant or against vaccines altogether (Montagni et al., 2021). As COVID-19 illness and vaccine misinformation about the present pandemic persists in media, adequate HL becomes increasingly important in understanding public health policy and parsing out the truth from multiple information sources (Abel & McQueen, 2020; Biasio et al., 2021; McCaffery et al., 2020; Strecher & Rosenstock, 1997). Further, HL demands challenge many individuals, regardless of income, when it comes to new or unfamiliar diseases, as was the case with the novel coronavirus initially. In other words, higher HL can be associated with better attitudes regarding the importance of life-saving preventive health measures such as vaccination (Silva & Santos, 2021).

Closely related to HL is health numeracy (HN), or understanding medical statistics or other quantitative information related to health topics (Schapira et al., 2008). HN has been shown to be associated with a better understanding of disease risk and decreased susceptibility to inaccurate information about the COVID-19 pandemic (Roozenbeek et al., 2020; Sobkow et al., 2020). Overall, lower HN and/or HL has been correlated with higher mistrust in the healthcare system, meaning lower likelihood of following vaccination recommendations (Roozenbeek et al., 2020). Nurses are an important resource in providing patient education and reducing COVID-19 vaccine hesitancy (Dugani et al., 2021). Several organizational-level interventions have found that nurses with adequate training and education regarding scientific evidence supporting COVID-19 vaccination efficacy and safety can help address misinformation and hesitancy among patients (Dugani et al., 2021; Finney Rutten et al., 2021).

Due to the recency of the COVID-19 vaccine EUA for children ages 6 months and older on June 2022, 59% of children aged 6 months to 4 years remain unvaccinated and about 10.9 million children ages 5–11 have yet to receive their first COVID-19 vaccine dose (AAP, 2022a; Centers for Disease Control and Prevention, 2022). Therefore, this study explored factors associated with parents' attitudes and intentions to seek information about the COVID-19 vaccine for their children (ages 0–18) and intentions to vaccinate their children.

Methods

Design and sample

The current study involves data from a larger cross-sectional online survey of 4000 adults ages 18–45 living in the United States conducted to understand relationships between HPV and HPV vaccine knowledge, health beliefs, attitudes, and HPV vaccine behaviors and intentions as well as the impact of the COVID-19 pandemic on healthcare receipt and COVID-19 vaccine intentions (Arevalo et al., 2022). Inclusion criteria included being age 18–45, current panelists of a nationwide research panel either directly or through verified partners, living in the U.S., having internet access, and ability to understand and write in English. Prior to study initiation, the [Made Anonymous for Review] Scientific Review Committee and Institutional Review Board of record [Made Anonymous for Review] approved the study protocol as exempt.

Procedures

Potential participants received an email directly from the panel company with a hyperlink. Interested individuals could click on the link to be taken to the online survey which included eligibility screening and a study description. Following completion of the eligibility screener, participants were provided with informed consent information and asked to indicate their willingness to participate electronically before the survey began. Once the participant completed the survey, they were linked back to the panel company's website to receive their incentive for participation in the form of reward points to be redeemed for

gift cards per the panel company's policy. Data were collected from February 25, 2021 to March 24, 2021.

Measures

Sociodemographic variables

Sociodemographic variables assessed included age, gender identity, race, ethnicity, educational attainment, U.S. state of primary residence (which was collapsed into the appropriate U.S. Census region), relationship status, income, and nativity to the U.S. (both for the individual and one's parents), employment status, health insurance status, preference for health information in a language other than English, and religious service attendance.

General vaccine attitudes

Eleven items assessed vaccine attitudes (Rosenthal et al., 2011; Zimet et al., 2010) using a 6-point scale, ranging from strongly agree to strongly disagree. An average score of the 11 items was utilized in analyses.

COVID-19 vaccine intentions for one's child/children

Parental intentions to obtain the COVID-19 vaccine for one's child (or children) were assessed using 3 items (Gerend et al. (2013) and using a 7-point scale (Head et al., 2020), ranging from very likely to very unlikely. Questions were as follows: (1) "How likely is it that you will try to get more information about a COVID-19 vaccine for your child or children, if/when it becomes available?" (2) "How likely is it that you will get a COVID-19 vaccine in the next year for your child or children, if/when it becomes available?" and (3) "If your child's healthcare provider strongly recommended a COVID-19 vaccine in the next year, how likely is it that you would get your child or children vaccinated if/when the COVID-19 vaccine becomes available?" Of note, these data were collected prior to EUA for children under 16.

Health literacy

One HL item from the Behavioral Risk Factor Surveillance System (BRFSS) questionnaires related to HL was utilized (Centers for Disease Control and Prevention, 2016): "In general, how difficult is it for you to understand written health information?" The question had seven responses, including very easy, somewhat easy, somewhat difficult, very difficult, I don't look for health information, don't know/not sure, or I prefer not to answer. Responses were collapsed as follows: Very easy, Difficult (including 3 response options: Somewhat Easy, Somewhat Difficult, and Very Difficult) and Other (e.g., I don't look for/pay attention to health information).

Health numeracy

One item from the Health Information National Trends Survey (HINTS) assessed health numeracy, as follows: "In general, how easy or hard do you find it to understand medical statistics?" Response were collapsed as follows: Very easy vs. Not very easy/Difficult) (U.S. Department of Health and Human Services, 2008).

Statistical analyses

Descriptive analyses were conducted following a systematic data cleaning process (Arevalo et al., 2022). This data cleaning process included removal of respondents who: 1) submitted their survey in less than ten minutes, 2) responded with identical responses to all of the extreme items scaled instruments that contained reverse coding (e.g., "strongly agree" or "strongly disagree" to all items), 3) provided contradictory responses, or 4) provided responses determined to be of poor quality to open-ended items (e.g., gibberish responses, use of words that did not respond to the question asked). The subsample for the current analyses is composed of responses from participants ($n = 963$) who identified as a parent or guardian to at least one child under

the age of 18 years following the data cleaning process. Regression models examined relationships between covariates and outcomes of interest related to COVID-19 vaccine intentions and behaviors for one's child(ren). We used backward selection with a significance level of 0.10 to include variables for analysis. For binary and ordinal outcomes, we used multivariable logistic regression and multivariable ordered logistic regression models (proportional odds models), respectively. Data analysis was completed using SAS Institute Inc (2021), version 9.4.

Results

Participants' characteristics

Descriptive statistics for the participants in the subsample ($n = 963$) are reported in Table 1. Briefly, participants were classified as White (82.3%), Black (7.4%), or multiple or other races (10.3%). The average age was 34.4 years (range 18–45 years, Std. Dev., $\pm$ 6.7), over half of were female (59.0%), 12.3% were Hispanic, and the majority (84.0%) were married. While 93.4% were born in the United States, 16.3% reported having at least one foreign-born parent. Most of the subsample completed either graduate school (24.6%) or a bachelor's degree (32.7%), while 27.2% had completed some college, and 15.5% completed less than some college. Approximately 35.3% of the parents earned $100,000 or more. Most were employed (84.7%) and had health insurance (88.0%). While 43.4% reported having two children, 34.8% reported having one child, and 21.8% reported having three or more children.

Parental COVID-19 vaccine attitudes and intentions

The average score of general attitudes toward vaccines was 4.29 with an SD of 0.89 (range 1–6). More than half (52.6%) reported that they would be likely to seek more information about the COVID-19 vaccine if or when it becomes available for children, whereas 12.9% reported they would be very unlikely to seek more information about the COVID-19 vaccine. Nearly half of the participants (48.3%) reported that they would be somewhat or very likely get the COVID-19 vaccine for their children in the subsequent 12 months, if/when it were to become available, which increased to 52.2% with a strong healthcare provider recommendation. Predictors of outcome variables are displayed in Table 2.

Predictors of parental intentions to seek more information about the COVID-19 vaccine for their child(ren)

Higher self-reported likelihood of seeking more information on the COVID-19 vaccine for one's child(ren) was associated with strong positive attitudes about vaccines (aOR 2.65, 95% CI: 2.27–3.08), male gender (aOR 1.48, 95% CI: 1.14–1.92), and educational attainment ($p < 0.0001$), with respective odds ratios for completing graduate school (aOR 3.32, 95% CI: 2.11–5.21), holding a bachelor's degree (aOR 2.07, 95% CI: 1.39–3.10), and completing high school (aOR 1.41, 95% CI: 0.96–2.06) compared to less than high school education. Lower likelihood of seeking additional information about the COVID-19 vaccine was related to not understanding written health information (aOR 0.39, 95% CI: 0.20–0.75) (see Table 2). Intentions to seek more information about the COVID-19 vaccine also varied by income level ($p = 0.0218$), with odds ratios lower for all but the lowest income group compared to the highest income group ($100 K or more). Specifically, lower information seeking odds were associated with income levels of $75-99 K (aOR 0.59, 95% CI: 0.42–0.84), and marginally lower for income levels $20-49 K (aOR 0.71 95% CI 0.47–1.06) and $50-74 K (aOR 0.76, 95% CI 0.53–1.10). Odds of seeking additional COVID-19 vaccine information also differed by number of children ($p = 0.0485$), with higher odds for two children compared to one child (aOR 1.20 95% 0.91–1.58) and lower odds for three children (aOR 0.82, 95% CI 0.59–1.13).

Table 1
Sociodemographic Characteristics.

Variable	Level	N = 63	%
Age	18–26	193	20.0
	27–45	770	80.0
How do you describe yourself?	Female	565	59.0
	Male	392	41.0
	Missing	6	-
Race	White	791	82.3
	Black/African American	71	7.4
	Other	99	10.3
	Missing	2	-
Ethnicity	Hispanic	118	12.3
	Non-Hispanic	843	87.7
	Missing	2	-
Were you born in the United States?	No	63	6.6
	Yes	898	93.4
	Missing	2	-
Were either of your parents born outside the United States?	No	798	83.7
	Yes	155	16.3
	Missing	10	-
Education	Less than high school/High school degree/GED	149	15.5
	Some college/Associates degree	262	27.2
	Bachelor's Degree	315	32.7
	Graduate school	237	24.6
Annual Income	$0–$19,999	68	7.1
	$20,000–$49,999	177	18.4
	$50,000–$74,999	190	19.8
	$75,000 to $99,999	186	19.4
	$100,000 or more	339	35.3
	Missing	3	-
Relationship Status	Married/Partnered	809	84.0
	All others	154	16.0
Employment Status	Employed	816	84.7
	Unemployed	53	5.5
	Other	94	9.8
Do you currently have any form of health insurance?	No	115	12.0
	Yes	844	88.0
	Missing	4	-
Do you prefer to receive health information in a language other than English?	No	884	91.8
	Yes	79	8.2
Geographic Region	Midwest	203	21.1
	Northeast	162	16.8
	South	423	43.9
	West	175	18.2
How many children do you have?	1	335	34.8
	2	418	43.4
	3 or more	210	21.8
In the past 12 months, how often did you attend religious services (either in-person or remotely/virtually)?	Never	420	43.8
	Less than weekly	418	43.6
	Once a week or more	121	12.6
	Missing	4	-
In your household, who is the main person who makes decisions about your child's/children's health care?	You	602	62.6
	You and your spouse/partner share equally in the decision-making	266	27.7
	Your spouse or partner/someone else	94	9.8
	Missing	1	-
In general, how difficult is it for you to understand written health information?	Very easy	386	40.2
	Difficult	541	56.3
	Other	34	3.5
	Missing	2	-
In general, how easy or hard do you find it to understand medical statistics?	Very easy	254	26.5
	Difficult	705	73.5
	Missing	4	-
Average Score of Vaccine Attitudes	Mean	4.29	-
	Standard Deviation	0.89	-
	Missing	0	-

Predictors of parental intentions to obtain the COVID-19 vaccine for their child(ren) in the next year, if/when available

Among parents, greater self-reported intentions of getting a COVID-19 vaccine for one's child(ren) in the subsequent 12 months were associated with the following: strong positive attitudes about vaccines in general (aOR 2.71, 95% CI: 2.32–3.16), male gender (aOR 1.30, 95% CI: 1.00–1.68), educational attainment ($p < 0.0001$), especially completing graduate education compared to less than high school (aOR 3.61, 95% CI: 2.30–5.69), or holding a bachelor's degree compared to less than high school (aOR 2.11, 95% CI: 1.41–3.15), higher numeracy (aOR 1.37, 95% CI: 1.01–1.87), having health insurance (aOR 1.43, 95% CI: 0.99–2.06), and preferring to receive health information in a language other than English (aOR 1.90, 95% CI: 1.20–3.01). Likelihood of parental

Table 2
Predictors of Parental Intentions to Seek Information and Obtain the COVID-19 Vaccination for their Children.

Variable	Level	A1: Seeking information		A2: Intentions to vaccinate		A3: Following recommendation	
		Odds Ratio (95% CI)	Overall P value	Odds Ratio (95% CI)	Overall P value	Odds Ratio (95% CI)	Overall P value
Vaccine Attitudes	–	**2.65 (2.27–3.08)**	<0.001	**2.71 (2.32–3.16)**	<0.001	**2.97 (2.54–3.48)**	<0.001
Gender (ref: Female)	Male	**1.48 (1.14–1.92)**	0.003	**1.30 (1.00–1.68)**	0.049	–	–
US Born (ref: No)	Yes	0.62 (0.38–1.01)	0.057	–	–	–	–
Education (ref: GED or lower)	Some College/Associate's	1.41 (0.96–2.06)	<0.001	1.14 (0.78–1.66)	<0.001	0.99 (0.68–1.45)	<0.001
	Bachelor's Degree	**2.07 (1.39–3.10)**		**2.11 (1.41–3.15)**		**2.03 (1.36–3.05)**	
	Graduate School	**3.32 (2.11–5.21)**		**3.61 (2.30–5.69)**		**3.25 (2.06–5.11)**	
Annual Income (ref: ≥ $100,000)	$0 to $19,000	1.09 (0.63–1.88)	0.022	0.64 (0.37–1.12)	0.048	0.63 (0.36–1.10)	0.037
	$20,000 to $49,999	0.71 (0.47–1.06)		0.74 (0.49–1.11)		**0.59 (0.40–0.89)**	
	$50,000 to $74,999	0.76 (0.53–1.10)		0.72 (0.50–1.03)		0.72 (0.50–1.04)	
	$75,000 to $99,000	**0.59 (0.42–0.84)**		**0.59 (0.42–0.84)**		**0.61 (0.43–0.86)**	
Health Insurance (ref: No)	Yes	–	–	1.43 (0.99–2.06)	0.054	**1.58 (1.09–2.27)**	0.015
# Children (ref: 1 child)	2 children	1.20 (0.91–1.58)	0.049	1.18 (0.90–1.55)	0.070	1.13 (0.86–1.49)	0.080
	3 or more	0.82 (0.59–1.13)		0.82 (0.59–1.14)		0.79 (0.57–1.09)	
Language Preference other than English (ref: No)	Yes	–	–	**1.90 (1.20–3.01)**	0.006	**2.16 (1.36–3.44)**	0.001
In general, how difficult is it for you to understand written health information? (ref: Not very easy*)	Very easy	1.01 (0.79–1.30)	0.018	0.86 (0.65–1.14)	0.024	0.82 (0.62–1.09)	0.001
	Other**	**0.39 (0.20–0.75)**		**0.40 (0.21–0.79)**		**0.30 (0.15–0.58)**	
In general, how easy or hard do you find it to understand medical statistics? (ref: Difficult)	Very easy	–	–	**1.37 (1.01–1.87)**	0.049	1.34 (0.97–1.84)	0.074

Legend: Analysis (A)
A1: Predictors of parental intentions to seek more information about the COVID-19 vaccine for their child(ren)
A2: Predictors of parental intentions to obtain the COVID-19 vaccine for their child(ren) once available
A3: Predictors of parental intentions to obtain the COVID-19 vaccine for their child(ren) if they received a strong provider recommendation to vaccinate
Bold font indicates there is a 95% probability that the true odds ratio is likely to fall in the designated range without bias or confounding.
* The "Not very easy" category includes response options ranging from "Difficult" to "Somewhat easy."
** Response options under the "Other" category included: "I don't pay attention to written health information," and "I don't know/I'm not sure."

intentions to obtain the COVID-19 vaccine for their children was related to income level ($p = 0.0480$), with higher intentions associated with the highest income level ($100 K or more), lower income of $50 K-$75 K (aOR 0.72, 95% CI: 0.50–1.03), and income of $75 K-$99 K (aOR 0.59, 95% CI: 0.42–0.84). Individuals reporting more difficulty following written health information (aOR 0.40, 95% CI: 0.21–0.79; $p = 0.0235$) reported lower intentions. (see Table 2). Mirroring the information seeking model, intentions differed by number of children, with higher odds for parents of two children (aOR 1.19 95% CI 0.9–1.55) and lower odds for parents of three or more children (aOR 0.82, 95% CI 0.59–1.14) compared to parents of only one child.

Factors associated with parental intentions to obtain the COVID-19 vaccine for their child(ren) in the next year if they received a strong provider recommendation to vaccinate

Parents were asked their intentions of getting the COVID-19 vaccine in the next year *if* a healthcare provider strongly recommended it for their child(ren). Findings show higher reported parental vaccination intention odds with a strong healthcare provider recommendation associated with strong positive attitudes about vaccines (aOR 2.97, 95% CI: 2.54–3.48), educational attainment ($p < 0.0001$), particularly completing graduate education compared to less than high school (aOR 3.25, 95% CI: 2.06–5.11) or holding a bachelor's degree compared to less than high school (aOR 2.03, 95% CI: 1.36–3.05), having health insurance (aOR 1.58, 95% CI: 1.09–2.27), preference for receiving health information in a language other than English (aOR 2.16, 95% CI: 1.36–3.44), and higher health numeracy (aOR 1.34, 95% CI: 0.97–1.84). Lower likelihood of parental intentions after a strong recommendation from a healthcare provider was related to having two children (aOR 1.13, 95% CI: 0.86–1.49), and lower odds for having three or more children (aOR

0.79, 95% CI: 0.57–1.09) compared to having one child. Odds of higher parental intentions to vaccinate their children after a strong healthcare provider recommendation was associated with higher self-reported HL (aOR 0.82, 95% CI: 0.62–1.09) compared to lower self-reported HL. Odds of parental intentions if a healthcare provider strongly recommended the COVID-19 vaccine for one's child(ren) varied by income level, with odds highest in the $100 K or more group, and lower values for other groups compared to $100 K or more (aOR 0.63 for <$20 K, 95% CI 0.36–1.10, aOR 0.59 for $20-50 K, 95% CI: 0.40–0.89, aOR 0.72 for $50 K-$74 K, 95% CI: 0.50–1.04, or aOR 0.61 for $75-99 K, 95% CI: 0.43–0.86).

Discussion

This study examined associations between sociodemographic characteristics, and other factors such as HL, health numeracy, vaccine attitudes, and intentions to obtain the COVID-19 vaccine for one's child(ren) among parents ages 18–45 living in the U.S. Data were collected February 25, 2021, to March 24, 2021, prior to approval of COVID-19 vaccines for the majority of children. Overall, males had greater intentions to seek information on and to obtain the COVID-19 for their children even without provider recommendation, as were parents who had higher education, higher annual income, were insured, and found it easier to understand medical statistics. Further, our study highlights the importance of various sociodemographic characteristics and other factors, such as HL and health numeracy, related to parents' intentions. Only 48.3% reported a high likelihood of obtaining the COVID-19 vaccine for their children within 12 months, which increased to 52.2% with a strong healthcare provider recommendation. In the U.S., about 15.3 million children aged 6 months to 4 years old have yet to receive their first COVID-19 vaccine dose and only 10% received at least one dose and only 31% of children ages 5–11 had completed the primary COVID-19

vaccination series since November 2022 highlighting the importance of our study (AAP, 2022a). These findings having important educational implications for nurses and other providers working in pediatric or school settings working to promote COVID-19 vaccination uptake.

Interestingly, parental intentions varied with the number of children, with higher vaccine intentions among parents with two children compared to parents with one child and lower intent among parents of three or more children compared to parents with one child. This is in contrast to another U.S. study that found as the number of children increased in the household, the willingness to obtain the COVID-19 vaccine increased (Catma & Reindl, 2021). Therefore, this study emphasizes the need to explore parental barriers to vaccine uptake for their children and deliver appropriate education and decision-making for parents concerned about the vaccine.

In our study, males reported higher intentions to get more information about the COVID-19 vaccine for their child(ren). These findings are consistent with prior parental COVID-19 vaccine studies (Goldman et al., 2020; Goldman et al., 2021; Scherer et al., 2021). Specifically, these studies, conducted in the U.S., Canada, Israel, Spain, and/or Switzerland (Goldman et al., 2020; Goldman et al., 2021; Scherer et al., 2021), found that fathers were more willing than mothers to get the COVID-19 vaccination for their children, and that mothers reported more concerns regarding adolescent vaccine safety. The similarity of our findings with current literature may be explained by males' role in making decisions about their children's healthcare. Prior literature reported that fathers who receive discouraging or conflicting information, father's ethnicity, father's vaccination hesitancy, and male children are parental determinants of vaccination timeliness and can impact intentions to receive the COVID-19 vaccination for their children (Gilchrist et al., 2021; Goldman & Ceballo, 2022). On the other hand, prior literature suggest that mothers experienced vaccine hesitancy due to concerns about safety and efficacy and felt a sense of confusion over conflicting information (Walker et al., 2021). Leveraging the role of nurses in parental COVID-19 vaccine education can help to promote vaccine uptake among children for both parents. Recent literature supports nurses having the training, knowledge, and confidence to actively execute COVID-19 vaccine educational interventions to increase parental knowledge and increase vaccine uptake among children (Blake et al., 2022).

Based on the variety of sociodemographic information and health behaviors regarding COVID-19 vaccine intentions and hesitancy, providing appropriate health education information to families must contain multiple strategies to increase parental confidence and promote positive attitudes. Our study adds insights about the relative importance of HL and numeracy to the body of the pediatric COVID-19 vaccine literature and showed positive associations between HL, numeracy, and pediatric COVID-19 vaccine intentions and seeking additional vaccine information. The provider's role in promoting clear communications and in deconstructing difficult COVID-19 vaccine terminology and concepts is emphasized here. However, more research is needed to understand the uptake and impact of how parents and adolescents understand and use health messages regarding COVID-19 vaccination. Compared to similar literature among adults, McCaffery et al. (2020) found individuals with limited HL had a poorer understanding of COVID-19 symptoms and were less able to identify health behaviors that can prevent infection and to rate social distancing as necessary. Additionally, having higher numeracy skills and more trust in scientists has been associated with lower susceptibility to COVID-19 misinformation (Roozenbeek et al., 2020).

Our findings underscore the important role of the nurse in health education for implementing ongoing assessments that verify comprehension and use of vaccine information as well as being able to discern misunderstandings (such as teach-back). With the Healthy People 2030 definition of literacy also including a focus on organizational HL (beyond personal HL), nurses need to be diligent in monitoring healthcare system demands and implementing system adjustments that might further enhance health literacy and understanding (such as creating additional multi-language resources, ensuring health protocols are understood and followed, disseminating evidence-based information, recommending streamlined navigation processes, etc.). Moreover, Ratzan and Parker (2020) maintain that vaccine literacy is a fundamental building block of health communication to ensure 'all understand what they need to know and do to get vaccinated.' This entails aligning people's skills and abilities with the content, processes, and systems needed to access and get vaccinated. They summarize a series of eight principles by which vaccine literacy can be facilitated, such as communicating trustworthy, up-to-date evidence, understanding risks/benefits for self and society, being aware of policies that incentivize vaccination, and equity among a few. Nurses can play integral roles in applying these principles and making recommendations to parents.

Strengths and limitations

Our study is one of the earlier studies to examine the parental intentions and behaviors of the COVID-19 vaccine after initial EUA approval, but prior to EUA authorization of the vaccine for most child age cohorts. Despite our novel findings, our study had several limitations. First, the participants in our study were majority White, English-speaking, with higher socioeconomic status, higher educational levels, and limited to those aged 18–45 and research panelists, which may limit generalizability to the larger population of parents of children eligible for the COVID-19 vaccine. Our measures of HL and HN relied on single item questions to gauge difficulty in understanding written health information and/or the ease or difficulty in understanding medical statistics respectively. Future research might include additional measures of comprehension to assess application and use of the information specific to this health content (i.e., vaccination). Generalization is vital to understand parental attitudes regarding COVID-19 vaccinations for children in diverse populations. Second, the data are cross-sectional; we are unable to make a causal inference. In addition, we did not examine knowledge about COVID-19 symptoms, COVID-19 illness, or the COVID-19 vaccine, which may be associated with our outcomes of interest. Lastly, limitations to the studies are exacerbated by the constantly evolving context of the COVID-19 vaccine information and availability to the general population.

Conclusions

In summary, we report the factors associated with parental COVID-19 vaccine attitudes and intentions, which can give practitioners insights into how we can improve the uptake of COVID-19 vaccinations in the pediatric population. Having strong positive attitudes about vaccines was correlated with COVID-19 vaccine intent, and males generally had higher intentions to obtain the COVID-19 vaccine for their children, suggesting a gender difference in intentions. Future research should investigate the use of targeted and tailored education materials for COVID-19 vaccine-hesitant parents. Our study demonstrates the need to focus public health campaigns on vaccine-hesitant populations and to increase awareness of the importance of children receiving COVID-19 vaccinations. Nurses have multiple opportunities to provide trustworthy and clear COVID-19 vaccine information and influence parental attitudes and COVD-19 vaccine uptake through health education.

CRediT authorship contribution statement

Lakeshia Cousin: Writing – original draft, Writing – review & editing, Visualization, Conceptualization. **Stephanie Roberts:** Writing – original draft, Writing – review & editing, Conceptualization. **Naomi C. Brownstein:** Writing – original draft, Methodology, Formal analysis. **Junmin Whiting:** Writing – original draft, Methodology, Formal analysis. **Monica L. Kasting:** Writing – original draft. **Katharine J. Head:** Writing – original draft. **Susan T. Vadaparampil:** Writing – original

draft, Writing – review & editing. **Anna R. Giuliano:** Writing – original draft, Writing – review & editing. **Clement K. Gwede:** Writing – original draft, Writing – review & editing. **Cathy D. Meade:** Writing – original draft, Writing – review & editing, Conceptualization. **Shannon M. Christy:** Conceptualization, Methodology, Writing – original draft, Writing – review & editing, Supervision, Investigation, Funding acquisition.

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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