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COVID-19 vaccine perceptions and hesitancy amongst parents of school-aged children during the pediatric vaccine rollout

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ABSTRACT

Background: The United States has the highest number of total cases and deaths due to coronavirus disease 2019 (COVID-19) worldwide (Johns Hopkins COVID Dashboard, 2021). Despite COVID-19 vaccine availability, uptake in the United States has been slow and vaccine hesitancy has been a significant barrier to achieving widespread vaccine uptake. Understanding determinants of vaccine acceptance is essential to implement successful population health interventions to increase COVID-19 vaccination.
Methods: We developed an anonymous cross-sectional parent survey to assess factors associated with parent and child COVID-19 vaccine acceptance and hesitancy during the initial pediatric vaccine rollout amongst adolescents 16 years +. The survey was sent via email to 25,308 parents registered to the Alachua County Public School System in May 2021 and remained active until July 2021.
Findings: There were a total of 2,620 survey responses. Overall, 31.5 % of parents with children ages 16 years + reported their child had received the COVID-19 vaccine, 65.2 % reported their (eligible) child had not received the vaccine, and 3.3 % reported their child was scheduled for the vaccine. A majority of parents (60.9 %) reported they planned to vaccinate all of their children once the COVID-19 vaccine was available for their children's age. COVID-19 vaccine uptake in adolescents ages 16 + reported by Hispanic and White parents was two times higher than that reported by Black parents. Parent COVID-19 and influenza vaccine uptake were associated with increased child COVID-19 vaccination. The most commonly reported reasons why parents chose not to have their child vaccinated against COVID-19 were concerns about long–term negative side effects (75.7 %) and a negative reaction (56.5 %). Medical providers were reported as the most trusted source of information.
Conclusion: Our study provides insight into determinants of vaccine acceptance, vaccine hesitancy, and trusted sources of information that may be helpful to develop targeted interventions to increase youth COVID-19 vaccination.

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1. Introduction

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) emerged in China in the fall of 2019 and quickly evolved into a worldwide pandemic. Globally, the United States has the highest number of total cases and deaths due to coronavirus disease 2019 (COVID-19). [1].

The Food and Drug Administration (FDA) issued Emergency Use Authorization (EUA) for the Pfizer-BioNTech COVID-19 vaccine for ages 16 years + in December 2020 and expanded to ages 12 years + in May 2021 before issuing full approval on August 23, 2021 for individuals ages 16 years +. The EUA for the Pfizer-BioNTech vaccine was issued for ages 5–11 years old on October 29, 2021. The Moderna and Janssen COVID-19 vaccines received EUA for ages 18 years + in December 2020 and February 2021, respectively. Despite COVID-19 vaccine availability, uptake in the United States has been slow. As of May 2022, with this evolution of emergency and fully approved vaccines, roughly 66 % of people in the United States are fully vaccinated against COVID-19, including 59 % of vaccine eligible individuals 12–17 years old and 29 % of individuals 5–11 years old. [2] Although minority populations have been disproportionally affected by COVID-19, they have lower rates of COVID-19 vaccination compared to White Americans. [3–5].

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Vaccine hesitancy has been a significant barrier to achieving COVID-19 vaccine uptake in the United States. Vaccine hesitancy, defined as a delay in acceptance or refusal of vaccination despite availability of vaccination services, was named by the World Health Organization as one of the top ten threats to public health in 2019 prior to the COVID-19 pandemic. [6] Concerns about vaccine side effects and safety are the most common reasons for delay or non-acceptance of routine childhood vaccinations. [7] In reference to COVID-19 vaccines, the unprecedented speed of vaccine production, adverse side effects, long-term safety, novel mRNA technology, and uncertainty about durability of immunity of the COVID-19 vaccine are often cited as reasons for hesitancy. [4,8–12] Others cite pharmaceutical corruption and distrust of the medical system as reasons for vaccine skepticism. [13–15].

Understanding determinants of vaccine acceptance, defined as the individual or group decision to choose to vaccinate when presented with the opportunity, is essential to implement successful population health interventions to increase COVID-19 vaccination. [16] Recent survey studies found that personal demographics (e.g. age, race, education), prior vaccination history, and trust in sources of information influence COVID-19 vaccine acceptance. [17–19] Although surveys on parental COVID-19 vaccine acceptance prior to pediatric vaccine availability provide some insight, there is limited information on parents' perspective, hesitancy, and factors associated with vaccination during the pediatric vaccine rollout, a population that has influence over multiple people within a family unit. [8,11–12,20–21].

This study aims to better understand parents' and caregivers' perspectives, hereafter called parents, on COVID-19 vaccination in themselves, and their children and adolescents, determinants of vaccine acceptance, and trusted sources of information using a school-based survey to 1) inform vaccine uptake using readily available information, 2) identify populations with greatest vaccine hesitancy and 3) guide implementation of successful public health interventions to increase COVID-19 vaccination.

2. Methods

We developed an anonymous cross-sectional parent survey that included domains of demographic information, parent and child vaccination history, previous COVID-19 infection, chronic medical conditions, school attendance in-person vs digital, impact of the COVID-19 pandemic on health and education, perspectives on COVID-19 vaccination, factors influencing vaccine acceptance or hesitancy, and trusted sources of information about the pandemic, drawing on available literature regarding vaccine hesitancy. [9,17–18,22–24] This survey was developed and distributed in an online-enabled format, via REDCap®, an electronic data capture tool hosted by the University of Florida (UF) Clinical and Translational Science Institute. [25–26] The University of Florida's Institutional Review Board approved the study as exempt. There was no funding for the study.

With the approval of the Alachua County Public School Superintendent, the survey was sent via the school board's email notification system to parents registered to the school system's online portal (25,308 individuals) and was successfully delivered to 22,913 individuals. Parents were instructed to complete one survey per family regardless of how many children were enrolled in the school system. A school-based parent survey was chosen to evaluate parent opinions given prior successful collaboration with the Alachua County Public Schools and Health Department for the 'Control Flu' program. [27] Alachua County consists of 22 pre-K/elementary schools, nine middle schools, and seven high schools with roughly 29,500 students. Survey completion was optional and there was no financial incentive for participating; parents received one reminder message after initial distribution. The survey was offered in both English and Spanish and was designed to take approximately ten minutes to complete. There were no required survey questions. The survey was distributed in May 2021 and remained active until July 2021, reflecting the academic year of 2020–2021, during which time students had an option to attend school in-person or digitally. There were two school-based COVID-19 vaccine clinics in every middle and high school within the county during this time, in addition to plentiful access at academic health centers, community sites like churches, pediatricians' offices and the Health Department. Our study specifically asked about COVID-19 vaccine status for children ages 16 years +, given the EUA was not approved for ages 5–15 years at the time of the initial survey administration.

2.1. Data analysis

Data were collected and retained in the REDCap® repository designed for this study. [25–26] All parents who navigated the survey instrument through the final page were considered to have completed the survey and included in the analyses. Missingness was permitted, as parents could skip any survey question they did not wish to answer. All data management and analyses were conducted using SAS 9.4® (Cary, NC). A predetermined level of $\alpha = 0.05$ was used to evaluate statistical significance. Descriptive statistics (frequencies and percentages, or mean ± STD) were used for demographic information and key outcomes. Comparisons were made based upon various parent and child characteristics, vaccine acceptance, and intent to vaccinate all children for COVID-19 when it becomes available. Cochran Mantel Haenzsel tests of general association were used for most categorical variables, and the Cochran Armitage test for trend was used when variables were ordinal. Logistic regression was used to characterize independent associations between key parent/child characteristics and parental intent to vaccinate age-eligible children, and current vaccine acceptance of children 16 years +. Parents aged 18–29 years were excluded from modeling the odds of vaccination among children 16 + years of age due to very limited sample of parents in this age group with children old enough for COVID-19 vaccine eligibility at the time of the survey.

3. Results

There were a total of 2,620 survey responses. Since families could have more than one email registered to the school system and participants were asked to fill out one survey per family, a response rate could not be calculated. Survey demographics are listed in Table 1. The majority of parents were ages 40–49 years old (48.6 %), White (72.6 %) and had a graduate degree (48.2 %). Almost 40 % of parents considered themselves frontline workers or teachers [28–29]. Parents reported an average of 1.7 children currently enrolled in Alachua County Public Schools and the majority of parents had at least one elementary age child (53.1 %). Most children attended in-person school (60.2 %) compared to digital school (26.1 %). Twelve percent of parents reported having a child with a chronic medical condition; among those, the most common being asthma (49.8 %), immunocompromised (13.8 %), or a neurologic disorder (10.0 %), although a large portion (24.5 %) reported 'other' diagnoses (Table 1 and Supplementary Table A). Of all parents of children with a chronic medical condition, 75.9 % endorsed one of the seven conditions listed, all of which are classified among the conditions identified by the CDC as inferring a higher risk of severe illness from COVID-19 [30].

COVID-19 vaccination: At the time of survey completion, 31.5 % of parents with children ages 16 years + reported their child had

Table 1
Demographic Distribution of Responding Alachua County School District Parents.

	(n)	n (%) Mean ± STD (min, max)
Responding Parents	**2620**	
Age Distribution:	**2395**	
18–29 years		37 (1.5)
30–39 years		708 (29.6)
40–49 years		1164 (48.6)
50–59 years		421 (17.6)
60+		65 (2.7)
Race/Ethnicity	**2620**	
Black		172 (6.6)
Hispanic		247 (9.4)
White		1901 (72.6)
Other		300 (11.5)
Highest level of Education	**2609**	
High school or less		98 (3.8)
Some college or technical degree		264 (10.1)
College or technical degree		990 (38.0)
Graduate degree		1257 (48.2)
Do you consider yourself a frontline worker?	**2574**	
Yes		996 (38.7)
How many children do you have in Alachua County Public Schools?	**2591**	1.7 ± 0.8 [Min: 1.0, Max: 6.0]
What age children do you have:*	**2620**	
Pre-K/Kindergarten		376 (14.4)
Elementary (1st – 5th grade)		1390 (53.1)
Middle School (6th – 8th grade)		941 (35.9)
High School (9th – 12th grade)		998 (38.1)
School Attendance	**2595**	
In-person Only		1562 (60.2)
Digital Only		677 (26.1)
Some of each (In-person & Digital)		356 (13.7)
School Poverty Level	**2562**	
Mid-Low Poverty (25.1–50.0 % FRPL†)		1694 (66.1)
Mid-High Poverty (50.1–75.0 % FRPL)		813 (31.7)
High Poverty (75.1 %+ FRPL)		55 (2.2)
Does your child/children attending school have any chronic medical conditions?	**2613**	
Yes		319 (12.2)
Among those Responding [yes] to any chronic medical conditions, identify which:	**319**	
Obesity		23 (7.2)
Asthma		159 (49.8)
Heart Disease		20 (6.3)
Diabetes		20 (6.3)
Immunocompromised		44 (13.8)
Cancer		1 (0.3)
Neurologic Disorder		32 (10.0)
Any of the above 7 conditions		242 (75.9)
Other Chronic Conditions		78 (24.5)

*Question presented as: check-all-that-apply.
†FRPL: Free or Reduced Price Lunch, presented as the highest level among all schools attended per family. Ratings determined by: U.S. Department of Education, National Center for Education Statistics. Alachua County Schools FRPL rates provided by the District.

received the COVID-19 vaccine, 65.2 % reported their (eligible) child had not received the vaccine, and 3.3 % reported their child was scheduled for the vaccine. A majority of parents (60.9 %) reported they planned to vaccinate all of their children once the COVID-19 vaccine was available for their children's age, while 22.0 % reported they did not plan to vaccinate their children against COVID-19 and 17.1 % were unsure (Table 2).

Factors associated with COVID-19 vaccine acceptance and intent to vaccinate: Self-COVID-19 vaccination rates were higher among parents who identified as Hispanic (79.4 %), and White (78.9 %) compared to Black parents (58.7 %; rates determined from data presented in Table 2). Self-COVID-19 vaccination rates were higher amongst parents in mid-low poverty schools (77.7 %) compared to high poverty schools (52.3 %; rates determined from data presented in Table 2). Parents who received the COVID-19 vaccine were overwhelmingly more likely to have children 16 years + who were already vaccinated compared to parents not yet vaccinated for COVID-19 (43.5 %, 1.3 %, respectively) and intended to vaccinate all of their children once the vaccine was available for all ages (77.8 %, 3.1 %, respectively; Table 2).

Logistic models were used to evaluate independent associations of key parent or child characteristics and the vaccination status of age-eligible children and the intent to vaccinate for COVID-19 as it becomes available for younger children (Table 3). Compared to parents 30–39 years of age, the odds of having an age-eligible child 16 years +, who has received or been scheduled for a COVID-19 vaccine were greater among older parent populations (OR: 4.07, 7.80, 7.60; respectively). Hispanics were less likely to have vaccinated or scheduled age-eligible children (OR: 0.64 [0.43, 0.94]); however, statistically significant differences were not seen among other races compared to white parents. There were no significant differences in age-eligible children vaccine acceptance attributable to parental education, school poverty level, receipt of the flu vaccine by either child or parent this past season. Parents of children with chronic medical conditions had slightly higher odds of COVID-19 vaccination for current age-eligible children (OR: 1.46 [1.00, 2.12]), compared to those without. The greatest predictor of vaccine acceptance among age-eligible children is parental receipt of the COVID-19 vaccine (OR: 37.90 [18.94, 75.84]).

There was no statistically significant difference in the intent to vaccinate all children for COVID-19 when the vaccine becomes available for their child's age, among parents 30–39 years, compared to parents 18–29 years. However, similar to vaccine acceptance among age-eligible children, among parents aged 40 and higher, there are significant increasing odds in the intent to vaccinate children when they become age-eligible (OR: 2.88, 4.53, 5.60, respectively). Compared to White parents, there is a significantly higher odds of intent to vaccinate among parents of 'other' race/ethnicities who do not identify as either Black or Hispanic (OR: 1.53 [1.04, 2.26]). In contrast, there were no significant differences seen among parents who identify as Hispanic, or non-Hispanic Black, compared to White.

There were no significant differences seen in the intent to vaccinate children for COVID-19 when they become age-eligible attributable to parental education, school poverty level, parental receipt of the flu vaccine last season or chronic medical condition status of children. Parents of children who had received the flu vaccine this past season had higher odds of intent to vaccinate (OR: 1.64 [1.20, 2.23]). However, the strongest predictor of intent to vaccinate all children when the COVID-19 vaccine becomes available to them, was parental uptake of the COVID-19 vaccine. Vaccinated parents had 106.45 times greater odds of intent to vaccinate their children for COVID-19 (95 % CI [60.78, 186.44]), compared to their unvaccinated counterparts.

Influences on COVID-19 vaccine acceptance: Parents who plan to vaccinate their child against COVID-19 when they are age eligible (60.9 %) overwhelmingly believe the vaccine is the best way to protect their child from COVID-19 (95.3 %) and the best way to protect others like their teachers, family, and friends (89 %) (Table 4). Other determinants of vaccine acceptance included the belief that vaccination will slow the pandemic (61.7 %) and a recommendation by a health professional (31.2 %). Roughly a fifth of parents reported that insurance coverage or free vaccination influenced their decision to vaccinate their child. School, church, and athletic organization messages were infrequently listed as messages that would make parents more likely to vaccinate their children.

Vaccine hesitancy: Among those who plan not to vaccinate their children when they are age eligible or are unsure (39.1 %), the most

Table 2
Factors Associated with Parent COVID-19 Vaccination Status.

	Responses & Overall Distributions n (%)	Parent has Not received the COVID-19 Vaccine	Parent has received the COVID-19 Vaccine	p-value*
(n)	**2613**	**585 (22.4)**	**2028 (77.6)**	
Age Distribution:	**2395**	**525**	**1867**	**<0.0001**
18–29 years	37 (1.5)	17 (3.2)	20 (1.1)	
30–39 years	708 (29.6)	223 (42.5)	484 (25.9)	
40–49 years	1164 (48.6)	216 (41.1)	948 (50.8)	
50–59 years	421 (17.6)	60 (11.4)	361 (19.3)	
60+	65 (2.7)	9 (1.7)	54 (2.9)	
Race/Ethnicity	**2620**	**585**	**2028**	**<0.0001**
Black	172 (6.6)	71 (12.1)	101 (5.0)	
Hispanic	247 (9.4)	51 (8.7)	196 (9.7)	
White	1901 (72.6)	399 (68.2)	1499 (73.9)	
Other	300 (11.5)	64 (10.9)	232 (11.4)	
Highest level of Education	**2609**	**583**	**2023**	**<0.0001**
High school or less	98 (3.8)	54 (9.3)	43 (2.1)	
Some college or technical degree	264 (10.1)	117 (20.1)	147 (7.3)	
College or technical degree	990 (38.0)	256 (43.9)	733 (36.2)	
Graduate degree	1257 (48.2)	156 (26.8)	1100 (54.4)	
Do you consider yourself a frontline worker?	**2574**	**571**	**2000**	**0.0029**
Yes	996 (38.7)	252 (44.1)	743 (37.2)	
School Poverty Level	**2562**	**569**	**1990**	**0.2757**
Mid-Low Poverty (25.1–50.0 % FRPL†)	1694 (66.1)	375 (65.9)	1317 (66.2)	
Mid-High Poverty (50.1–75.0 % FRPL)	813 (31.7)	171 (30.1)	641 (32.2)	
High Poverty (75.1 %+ FRPL)	55 (2.2)	23 (4.0)	32 (1.6)	
If your child 16 or older, has he or she received the COVID-19 vaccine?	**1859**	**528**	**1331**	**<0.0001**
Yes	586 (31.5)	7 (1.3)	579 (43.5)	
No	1212 (65.2)	2 (0.4)	59 (4.4)	
Scheduled	61 (3.3)	519 (98.3)	693 (52.1)	
Will you vaccinate all of your children for COVID-19 when it becomes available?	**2601**	**583**	**2018**	**<0.0001**
Yes	1585 (60.9)	18 (3.1)	1567 (77.8)	
No	571 (22.0)	439 (75.3)	132 (6.5)	
Unsure	445 (17.1)	126 (21.6)	319 (15.8)	
Have you or your child/children gotten COVID-19 disease documented by a test?	**2613**	**585**	**2028**	**<0.0001**
Yes	331 (12.7)	109 (18.6)	222 (11.0)	
No	2255 (86.3)	467 (79.8)	1788 (88.2)	
Unsure	27 (1.0)	9 (1.5)	18 (0.9)	
Did you as a parent get a flu vaccine this season?	**2611**	**585**	**2026**	**<0.0001**
Yes	1608 (61.6)	157 (26.8)	1451 (71.6)	
No	995 (38.1)	425 (72.7)	570 (28.1)	
Unsure	8 (0.3)	3 (0.5)	5 (0.3)	
Are your child's/children's routine vaccinations up to date?	**2611**	**585**	**2026**	**<0.0001**
Yes	2556 (97.9)	559 (95.6)	1997 (98.6)	
No	39 (1.5)	23 (3.9)	16 (0.8)	
Unsure	16 (0.6)	3 (0.5)	13 (0.6)	
Did your child/children get a flu vaccine this season?	**2607**	**585**	**2022**	**<0.0001**
Yes	1754 (67.3)	217 (37.1)	1537 (76.0)	
No	821 (31.5)	363 (62.1)	458 (22.7)	
Unsure	32 (1.2)	5 (0.9)	27 (1.3)	

*Column Percentages Reported. Cochran-Armitage test for trend used in ordered categories: Age, Education, SES; All else reported using Cochran Manel Haenszel General Association.
†FRPL: Free or Reduced Price Lunch, presented as the highest level among all schools attended per family. Ratings determined by: U.S. Department of Education, National Center for Education Statistics. Alachua County Schools FRPL rates provided by the District.

commonly reported reason why a parent chose not to have their child vaccinated against COVID-19 is concern about long–term negative side effects (75.7 %; Table 4). Other common factors associated with vaccine non-acceptance included concern about a negative reaction (56.5 %), belief that COVID-19 disease is not severe enough for child to need vaccination (33.6 %), and that children's natural immune system offers sufficient protection against COVID-19 (32.6 %). Among those who chose not to have their child vaccinated or were unsure, they would be more likely to choose to vaccinate if their child's healthcare provider recommended the vaccine (32.3 %) or if a national pediatric organization recommended the vaccine (19.8 %).

Trusted sources of information: Among all parents, the most trusted sources of information were medical providers (52.9 %)

Table 3
Odds of COVID-19 Vaccination for Children 16 years + and Parent Intent to Vaccinate.

If your child is 16 or older, has he/she received the COVID-19 vaccine? **(Modeled: YES or SCHEDULED) N = 1623**	**Point Estimate**	**95 % Confidence Limits**
Age *(REF: 30–39 years)***		
40–49 years	**4.07**	**(2.85, 5.81)**
50–59 years	**7.80**	**(5.19, 11.73)**
60+	**7.60**	**(3.63, 15.91)**
Race/Ethnicity *(REF: White)*		
Black	0.60	(0.34, 1.05)
Hispanic	**0.64**	**(0.43, 0.94)**
Other	0.86	(0.59, 1.26)
Highest level of Education *(REF: College or technical degree)*		
High school or less	1.01	(0.44, 2.33)
Some college or technical degree	1.13	(0.70, 1.81)
Graduate degree	1.15	(0.89, 1.49)
School Poverty Level *(REF: Mid-Low Poverty (25.1–50.0 % FRPL†))*		
Mid-High Poverty (50.1–75.0 % FRPL)	1.03	(0.79, 1.34)
High Poverty (75.1 %+ FRPL)	0.20	(0.05, 0.72)
Child *(REF: Did Not receive a flu vaccine this season)*		
Received a flu vaccine this season	1.12	(0.80, 1.57)
Unsure	0.99	(0.33, 3.06)
Parent *(REF: Did Not receive a flu vaccine this season)*		
Received a flu vaccine this season	1.03	(0.75, 1.42)
Unsure	10.33	(0.64, 167.08)
Parent of *(REF: Child(ren) without Chronic Medical Conditions)*		
Child(*ren*) with Chronic Medical Conditions	**1.46**	**(1.00, 2.12)**
Parent *(REF: Did Not receive a COVID-19 Vaccine)*		
Received a COVID-19 vaccine	**37.90**	**(18.94, 75.84)**
Will you vaccinate all of your children for COVID-19 when it becomes available for their age? (Modeled: YES) **N = 2326**		
Age *(REF: 18–29 years)*		
30–39 years	2.40	(0.94, 6.13)
40–49 years	**2.88**	**(1.12, 7.42)**
50–59 years	**4.53**	**(1.68, 12.23)**
60+	**5.60**	**(1.59, 19.73)**
Race/Ethnicity *(REF: White)*		
Black	0.91	(0.55, 1.52)
Hispanic	1.40	(0.94, 2.07)
Other	**1.53**	**(1.04, 2.26)**
Highest level of Education *(REF: College or technical degree)*		
High school or less	1.21	(0.54, 2.73)
Some college or technical degree	1.11	(0.71, 1.74)
Graduate degree	1.08	(0.85, 1.38)
School Poverty Level *(REF: Mid-Low Poverty (25.1–50.0 % FRPL†))*		
Mid-High Poverty (50.1–75.0 % FRPL)	1.27	(0.99, 1.63)
High Poverty (75.1 %+ FRPL)	1.33	(0.56, 3.15)
Child *(REF: Did Not receive a flu vaccine this season)*		
Received a flu vaccine this season	**1.64**	**(1.20, 2.23)**
Unsure	0.97	(0.38, 2.46)
Parent *(REF: Did Not receive a flu vaccine this season)*		
Received a flu vaccine this season	1.28	(0.96, 1.72)
Unsure	0.81	(0.10, 6.94)
Parent of *(REF: Child(ren) without Chronic Medical Conditions)*		
Child(*ren*) with Chronic Medical Conditions	1.17	(0.81, 1.69)
Parent of *(REF: 1 + vaccine-eligible child based upon age)*		
No age-based vaccine-eligible child(*ren*)	**0.55**	**(0.43, 0.71)**
Parent *(REF: Did Not receive a COVID-19 Vaccine)*		
Received a COVID-19 vaccine	**106.45**	**(60.78, 186.44)**

*Bolded 95 % Confidence Limit indicates statistical significance p-value < 0.05.
**Due to the outcome requirement of being a parent to a child 16 + years of age, we have removed the parent age group of 18–29 years, due to a very small number of qualifying parents under age 30 with high school age children eligible for COVID-19 vaccination at the time of survey administration.
†FRPL: Free or Reduced Price Lunch, presented as the highest level among all schools attended per family. Ratings determined by: U.S. Department of Education, National Center for Education Statistics. Alachua County Schools FRPL rates provided by the District.

and the Center for Disease Control and Prevention or World Health Organization (40.6 %; Table 5). Many parents reported mistrust of social media (77 %), mass media (42.2 %), pharmaceutical companies (25.7 %) and government/ health agencies (20.1 %; Supplemental Table B.). Parents who had not received the COVID-19 vaccine were more likely to trust online information than parents who had received the COVID-19 vaccine. Parents with a high school degree or less were more likely to trust medical providers than those with higher levels of education.

4. Discussion

With the landscape of the acceptance of the COVID-19 vaccine shifting constantly, a real-time understanding of parents' COVID-19 vaccine hesitancy and determinants of vaccine acceptance during the rollout of COVID-19 vaccination by age is necessary to implement successful vaccination interventions amongst children in the United States. To date, the majority of studies assessing

Table 4
COVID-19 Vaccination Influences and Messaging.

Among those who choose for their child/children to get the COVID 19 vaccine: What factors will influence your decision for them to be vaccinated?	N = 1588 **n (%)**
I believe the vaccine is the best way to protect my child from COVID-19	1514 (95.3)
I believe the vaccine is the best way to protect others like their teachers, family members and friends	1413 (89.0)
Someone I know had COVID-19 and I want to protect my child	395 (24.9)
I saw a news report on the importance of getting vaccinated	309 (19.5)
It was recommended by a health professional	496 (31.2)
A friend encouraged me	83 (5.2)
A parent or relative encouraged me	116 (7.3)
I have been taught about the importance of vaccines to slow the pandemic	979 (61.7)
I will only get the vaccine if it is required for my child	11 (0.7)
The vaccine is covered by insurance/or is free.	312 (19.7)
Among those who choose for their child/children not to get the COVID-19 vaccine, or indicated 'Unsure': What factors will influence your decision not to get them vaccinated?	N = 1016
I do not believe it will be effective	159 (15.7)
I believe my child will contract COVID-19 from the vaccine	21 (2.1)
I am concerned about a negative reaction or side effects	574 (56.5)
I am concerned about a long-term negative effect	769 (75.7)
I do not believe COVID 19 is severe enough for them to need to receive a vaccine	341 (33.6)
It will be inconvenient for me to help them get the vaccine	1 (0.1)
I choose for them not to receive any vaccines	46 (4.5)
I believe their natural immune system offers sufficient protection against COVID 19	331 (32.6)
It depends on how long the protection from the vaccine lasts	156 (15.4)
Among those who choose for their child/children not to get the COVID-19 vaccine or indicated 'Unsure': What messages would make you more likely to choose to vaccinate?	N = 1016
My child's healthcare provider recommends the vaccine	328 (32.3)
The government recommends the vaccine	26 (2.6)
National pediatric organizations recommend the vaccine	201 (19.8)
My child's school recommends the vaccine	16 (1.6)
My church recommends the vaccine	12 (1.2)
My child's athletic organization recommends the vaccine	6 (0.6)
I see someone I know get the vaccine	32 (3.2)
I see that the vaccine helps my community	135 (13.3)

*Row percentages reported, these questions were presented as: check-all-that-apply.

COVID-19 vaccine hesitancy have focused on the adult population, or asked about their children before they were eligible to receive a vaccine. [8,11–12,17–21] While adults are often the medical decision makers for children, perspectives on vaccination of oneself may differ from parent perspectives on child vaccination. Our study found decreased COVID-19 vaccine acceptance amongst age-eligible children compared to parent reported intent early in the pandemic, which suggests increased vaccine hesitancy amongst parents during the pediatric vaccine rollout and it specifically highlights the need for greater understanding of vaccine hesitancy within the Hispanic community. [8,12,21] Lastly, our findings suggest that targeted parental COVID-19 vaccination campaigns, with the family unit in mind, could be an effective public health initiative to increase parent and youth COVID-19 vaccination rates.

Parents remain notably hesitant about their children receiving the COVID-19 vaccine, even in a highly educated, mostly White sample population. Approximately-one third of parents reported that their eligible children ages 16 years + had received or were scheduled to receive the COVID-19 vaccine, which is significantly lower than that predicted in studies completed prior to COVID-19 vaccine availability that found parents' likelihood of vaccinating their children was as high as 73 %. [8,12,21] This may reflect decreasing vaccine acceptance as the pandemic progresses, however, it also highlights that vaccination intent may not reflect true vaccination rates, at least not during the initial rollout phases. Similarly, reported vaccination intent for younger children in our study was 60.9 %, which is substantially higher than national vaccine uptake for ages 12–15 years as of October 2021 (40 %). Lastly, roughly a fifth of parents were unsure about whether or not they planned to vaccinate their child, highlighting an opportunity for medical providers to engage with parents and discuss benefits of vaccination.

This study documents clear variation in COVID-19 vaccination rates by parent demographics and by personal vaccination choices. For example, vaccine acceptance in children ages 16 years + and intent to vaccinate younger children were higher amongst older parents compared to younger parents. Black and Hispanic parents were less likely to vaccinate their age eligible children compared to White parents, though a statistical difference was only seen amongst Hispanic parents. Increased vaccine hesitancy amongst Black Americans may reflect deep-rooted distrust of the healthcare system, often traced to the Tuskegee syphilis study and other historical traumas. [31–32] Consistent with recent studies, the greatest predictor of child COVID-19 vaccine acceptance was parent COVID-19 vaccine acceptance. [33–37] Therefore, increased outreach to promote adult COVID-19 vaccination, including collaboration between pediatric and adult healthcare providers, may be an effective strategy to increase youth COVID-19 vaccination. Although children ages 16 years + with a chronic medical condition were more likely to be vaccinated against COVID-19 compared to those without a chronic condition, there was no difference amongst intent to vaccinate younger children with chronic medical conditions. This finding is unexpected and highlights an important opportunity for pediatricians to discuss the risk of severe COVID-19 infection in high risk individuals. Unlike previous H1N1 and

Table 5
Trusted Sources of Information about COVID-19 and Vaccines.

Among All Parents	**N = 2454 n (%)**			
Medical Provider	1297 (52.9)			
Parents	15 (0.6)			
Friends	15 (0.6)			
News Media	22 (0.9)			
Social Media	2 (0.1)			
Online Information	84 (3.4)			
A Politician's Endorsement	2 (0.1)			
The CDC or WHO	996 (40.6)			
Faith Organization	21 (0.9)			
Stratified by Parent COVID Vaccination Status	**Parent has Not received the COVID-19 Vaccine, n = 444**		**Parent has received the COVID-19 Vaccine, n = 2006**	
Medical Provider	284 (64.0)		1009 (50.3)	
Parents	8 (1.8)		7 (0.4)	
Friends	11 (2.5)		4 (0.2)	
News Media	4 (0.9)		18 (0.9)	
Social Media	0 (0.0)		2 (0.1)	
Online Information	51 (11.5)		33 (1.7)	
A Politician's Endorsement	1 (0.2)		1 (0.1)	
The CDC or WHO	68 (15.3)		928 (46.3)	
Faith Organization	17 (3.8)		4 (0.2)	
Stratified by Parent Education	**High school or less, n = 85**	**Some college or technical degree, n = 233**	**College or technical degree, n = 917**	**Graduate degree, n = 1212**
Medical Provider	56 (65.9)	131 (56.2)	498 (54.3)	608 (50.2)
Parents	5 (5.9)	3 (1.3)	4 (0.4)	3 (0.3)
Friends	1 (1.2)	1 (0.4)	9 (1.0)	3 (0.3)
News Media	0 (0.0)	4 (1.7)	11 (1.2)	7 (0.6)
Social Media	0 (0.0)	0 (0.0)	2 (0.2)	0 (0.0)
Online Information	1 (1.2)	12 (0.2)	35 (3.8)	36 (3.0)
A Politician's Endorsement	0 (0.0)	0 (0.0)	0 (0.0)	2 (0.2)
The CDC or WHO	21 (24.7)	78 (33.5)	349 (38.1)	546 (45.1)
Faith Organization	1 (1.2)	4 (1.7)	9 (1.0)	7 (0.6)

*Column Percentages Reported.

COVID-19 studies, there was no significant association between parent and child influenza vaccine acceptance and age-eligible COVID-19 vaccine acceptance, though there was a slight increase in vaccination intent. [12,20,23,35] These findings present real-time understanding of an on-going variation by groups, providing a local map of how to begin to address hesitancy.

Despite measurable variations in hesitancy, all groups cited that the most common reasons for COVID-19 vaccine acceptance were the beliefs that the vaccine is the best way to protect their child and others, such as teachers, family, and friends from infection. These findings are consistent with prior studies that found "protection of the child" and "protection of others" as common themes in individual's motivation to vaccinate. [12,20,38] Belief that the vaccine will slow the pandemic was another common motivation for vaccine acceptance, which may reflect parents' desire for their children to return to pre-pandemic routine, including in-person school and extracurricular activities. Interestingly, although parents reported that medical providers were their number one trusted source of information, only a third of parents cited recommendation by a health professional as a factor associated with their decision to vaccinate their child. Lastly, free vaccination was an important factor for a fifth of parents, which is important to highlight to ensure free COVID-19 vaccinations remain a national priority. These motivating factors need further testing in specific groups where hesitancy remains the majority.

Barriers to vaccination were commonly cited. Concern about long-term negative side effects and negative reactions from the COVID-19 vaccine were the most commonly reported reasons why parents chose not to vaccinate their children. These findings are consistent with previous studies. [8,11–12,20] Though concern about COVID-19 vaccine safety has been magnified due to the novelty of mRNA technology and speed of vaccine production, parents instead voice concerns about adverse effects which is the most common reason for vaccine refusal of routine childhood vaccines. [39,7] Other common factors associated with vaccine non-acceptance is the belief that COVID-19 infection is not severe enough for a child to need vaccination and that a child's natural immune system offers sufficient protection. These beliefs likely stem from early pandemic reports which found that COVID-19 infection was less common and severe in children compared to adults. Given the increased frequency of infection in children with the emergence of the Delta and Omicron variants, it is essential that medical providers discuss the acute and long-term risks of COVID-19 infection with patients and parents. [40].

To overcome these barriers, understanding who parents trust as sources of information is fundamental in developing effective COVID-19 vaccine-acceptance messaging. Our study found that among all parents, medical providers were the most trusted source of information and that parents were more likely to vaccinate if their child's healthcare provider recommended the vaccine. Importantly, parents who had not received the COVID-19 vaccine more commonly reported medical providers as the most trusted source of information compared to parents who received the COVID-19 vaccine, revealing a potential avenue for future conversations about receiving the vaccine. Additionally, those with high school degrees or less were more likely to trust medical providers than those with a college or graduate degree. The second most trusted source of information amongst all parents was the Center for Disease Control or World Health Organization, which suggests that despite media- amplified voiced frustration regarding frequently changing recommendations regarding masks and social distancing, parents still trust national and international health organizations.

Similar to previous studies, many parents reported mistrust of pharmaceutical companies and government/ health agencies. [13–15] The majority of parents mistrust social media, which is an unexpected finding given the prominent role of social media in information sharing in the 21st century. Overall, government, school, and church recommendations played little role in parental vaccine acceptance.

The limitations of this study merit discussion. This study was performed within a single county and public-school system in one state. The majority of parents were White with graduate degrees, thus results may not be generalizable to other populations. However, worth noting, Alachua county, has one of the highest concentrations of adults with a college degree or higher in the state of Florida; 44.1 % of all adults aged 25 + years, not limited to parents, nearly 50 % higher than the proportion of college or graduate educated adults across the state of Florida as a whole (30.5 %). Further, the official statistics for Alachua county indicate 60.6 % of residents are Non-Hispanic White, compared to our 72.6 % of responding adults with school-aged children. Though our predominantly White sample is a limitation to the generalizability to many nationwide populations, the proportion of White respondents is not disproportionally high compared to county-level statistics where this survey was administered. [41–42] Thus, we urge every school system to perform regional analyses to further understand local vaccine hesitancy. Furthermore, the study did not include parents of the 2,000 home-schooled children (7 % of total school-aged children in Alachua County), further limiting the study's generalizability. Given the voluntary nature of the survey, there is risk of ascertainment bias and those who replied may be more inclined to vaccinate than the general public. This would underestimate our findings. Further, parents anonymously self-reported vaccination status prohibiting verification of health records. Because the surveys were anonymous, without identifiers to IP address, it is possible that individuals could complete the survey more than once or that two parents could answer the survey instead of just one per household. Though not a limitation of the study itself, it is worth noting that the survey was completed prior to FDA EUA of ages 5–12 years old, full FDA approval for ages 16 years +, and the local surge of the Delta and Omicron variants, all of which may influence vaccination perspectives.

In conclusion, this study demonstrates decreased COVID-19 vaccine acceptance amongst children ages 16 years + during the early pediatric vaccine rollout compared to vaccination intent reported early in the pandemic, suggesting increasing vaccine hesitancy. Thus, real-time data during the vaccine rollout may help guide public health interventions, targeting populations with increased hesitancy, such as the Hispanic community measured in this study. Lastly, child COVID-19 acceptance and intent to vaccinate younger children were highly associated with parent COVID-19 acceptance highlighting an opportunity to implement dual parent and child public health interventions. Our data show that medical providers are the most trusted sources of information, thus it is essential that pediatricians partner with family medicine, internal medicine, and obstetrics-gynecology providers to increase vaccinations in the family unit. As the vaccine rollout progresses, this study provides a snapshot insight into determinants of vaccine acceptance, vaccine hesitancy, and trusted sources of information that can be used to implement targeted interventions to increase youth COVID-19 vaccination.

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.

Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.vaccine.2022.09.090.

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