Looking ahead: Caregivers' COVID-19 vaccination intention for children 5 years old and younger using the health belief model

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ABSTRACT

COVID-19 vaccine hesitancy is a significant public health issue. While vaccines are not yet available for children, clinical trials are underway, and children will likely be an important factor in the U.S. reaching herd immunity. However, little research has been conducted to examine parents' intention to vaccinate their young children for COVID-19.
Method: An online survey with a national U.S. sample of 682 primary caregivers of children under age six assessed variables associated with intention to accept the COVID-19 vaccine for their children from November 13, 2020, to December 8, 2020.
Results: Caregivers whose child received a recent influenza vaccine, as well as those with previous experience COVID-19, were more likely to express COVID-19 vaccination intention for their young child. Identifying as female was associated with lower COVID-19 vaccination intention, while identifying as Hispanic or Latino was associated with higher intention. Health Belief Model variables of perceived severity of COVID-19 for their child, as well as vaccine confidence, were positive predictors of COVID-19 vaccine intention and mediated the relationship between prior behavior, demographic variables, and intention.
Conclusions: The findings highlight the importance of early, proactive COVID-19 vaccination education efforts directed at caregivers, including those with young children. Vaccines for young children will likely become a necessary part of ending the pandemic's impact in school settings. Operationally, COVID-19 vaccination may also become a part of childhood vaccination schedules. Understanding the beliefs and intentions of caregivers of young children before vaccinations are recommended for children will enable public health officials and medical practitioners to prepare in advance.

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1. Introduction

The public health crisis wrought by SARS-CoV-2 and the associated Coronavirus Disease 2019 (COVID-19) has devastated the world in the past year, with over 200 million estimated infections and 5 million deaths as of late October 2021 [1]. In the United States, one of the worst-hit countries in the outbreak, confirmed cases have exceeded 45 million with an estimated 735,000 deaths [2]. The promise of multiple effective vaccines developed over a historically short timeframe is an incredible feat of science [3], but as of January 3, 2022, only 62% of people in the U.S. were fully vaccinated [4]. It is also the case that in the U.S., youth under age 18 account for 22% of the U.S. population [5] and as such, are now a critical part of efforts to prevent serious COVID-19 illness and impede transmission of the virus. Currently, vaccines for COVID-19 are available for children ages 5 to 17, with vaccine trials for children under age 5 underway [6]. As of September 2021, 43% of vaccine-eligible children between the ages of 12 and 17 remained unvaccinated against COVID-19 [4]. Pediatric hospitalization for COVID-19 increased in summer 2021, largely due to the Delta variant, low vaccination rates among adolescents, and lack of vaccinations for children under age 12 [7]. Though children are less likely to have severe illness from COVID-19 infection compared to adults [8], some of those who do get infected are at risk for severe and/or long-term adverse health consequences [9]. The hospitalization rate for unvaccinated adolescents is ten times higher than the rate for fully vaccinated adolescents [10]. Further, in December 2021, the New York State Department of Health

reported that hospitalizations among children had a four-fold increase from December 5 to the week starting on December 19, with the vast majority unvaccinated, including because they were too young [11]. In addition to the direct health risks for children, in-person schools and gatherings have the potential to exacerbate virus transmission and disease outbreaks in communities if mitigation strategies are not followed, including widespread vaccination of students and staff [12]. Aside from disease risk, which surveillance data as of December 2021 indicates is lower for children compared to adults [8], many municipalities require or recommend isolation and quarantines for positive cases. These measures can result in lost work time and lost wages for caregivers who must then take on child care responsibilities during those times. For example, multiple elementary schools in the Boston public school system were closed to all students for 10 days following increasing COVID-19 cases in the schools [13].

Given that caregiver hesitancy exists with respect to COVID-19 vaccination recommendations for children 5 to 17 years [14], it is essential to undertake research with caregivers of the final group of children for whom COVID-19 vaccination is likely to be recommended. Understanding these caregivers' beliefs and intentions in advance of vaccination recommendations provides helpful early insights for policy makers, public health programs, and others involved in COVID-19 vaccination efforts. As such, this study examined the COVID-19 vaccination-related beliefs and intentions of caregivers of children 5 years old and younger.

To date, published studies have mostly focused on COVID-19 vaccination behaviors, intentions, and hesitancy among caregivers of older children, with some exceptions [15–17]. It is, however, the case that recently published surveys with caregivers of children ages 5 and older provide a foundation for this study. For example, a set of April 2021 surveys by the U.S. Centers for Disease Control and Prevention (CDC), one with 13–17 years old, the other with caregivers of children 12–17 year old, foreshadowed moderately high acceptance along with barriers to acceptance [18]. Just over a quarter (27.6%) of caregivers whose adolescents were vaccine-eligible (i.e., 16 and 17 year olds) reported their child had received at least one COVID-19 vaccination dose, while just over 50% of caregivers of unvaccinated 12–17 year-olds reported "definitely" or "probably" receiving vaccination. The surveys indicated caregivers identifying as female or Hispanic, or who had an education lower than a bachelor's degree having the lowest reported and intended COVID-19 vaccination. Similarly, a survey of caregivers with children under the age of 18 years in Chicago, found that COVID-19 vaccine hesitancy was higher among non-Hispanic Black compared to non-Hispanic White participants, and that lower income and public insurance were associated with greater vaccine hesitancy [19]. They also found that the more people sought information about the vaccines, the less likely they were to report hesitancy. Another nationally representative study in the US found that caregivers were more likely to intend to vaccinate older children than younger, and caregiver vaccine acceptance for themselves, caregiver political affiliation, and caregiver education were all predictors of intention [14]. The present study extends this previous work by focusing on caregivers of children 5 years old and under, for most of whom no vaccines are yet available, using key elements of the Health Belief Model.

The Health Belief Model (HBM) [20] provides a theoretical framework to guide the inclusion of psychological variables into research on health decision making. The HBM has been used successfully to predict intentions and behaviors in a wide variety of health contexts, including caregiver vaccination decisions [21,22]. The major constructs of the HBM are perceived susceptibility and perceived severity [20]. Perceived susceptibility is the perception that one is susceptible to the disease or other negative health outcomes. Perceived severity is the perception that if one does get infected or become ill, potentially serious health consequences are likely. In the context of COVID-19, these would be the perception that one is likely to be infected by SARS-CoV-2 and develop COVID-19 symptoms (susceptibility) and that those symptoms are likely to be severe and/or lead to serious negative outcomes such as hospitalization, long term health problems, or death (severity). A qualitative study consisting of 25 interviews with U.S. mothers found that most mothers perceived COVID-19 as a significant and serious health threat, but that perception was not uniformly associated with willingness to accept a COVID-19 vaccine for themselves or their children, and as such, highlighted the need for further research [23]. The present study thus quantitatively examined whether caregiver demographics, prior childhood vaccination behavior, and prior COVID experience were correlated with susceptibility and severity perceptions (i.e., HBM constructs). This included examining whether the HBM constructs mediated the relationships between demographics, childhood vaccination behavior, and COVID-19 experience with COVID-19 vaccination intentions.

2. Method

2.1. Participants

Respondents were 682 adults living in the United States who were caregivers of at least one child aged 5 years or under. They were recruited from Dynata's national online panel. Dynata operates an opt-in panel that can recruit samples representative of national U.S. population demographics. Participants were recruited as part of a larger study on early childhood vaccinations, which purposefully oversampled parents and caregivers who do not follow the CDC recommended schedule for their child's vaccinations. Detailed demographic information can be found in Table 1.

2.2. Design and procedure

Data were collected in an online survey via Qualtrics.com from November 13, 2020, to December 8, 2020. This was after Pfizer announced the promising results of their Stage-III clinical trial for their COVID-19 vaccine on November 9, 2020 [24], but before the FDA announced emergency use authorization on December 11, 2020. Participants provided online informed consent and then determined eligibility by indicating whether they were the parent or guardian of at least one child age 5 or younger for whom they make at least 25% of the medical decisions. After indicating their child's name (or a nickname/code name), they were asked about their prior vaccination decisions and intentions and for the child's demographics. They then answered questions regarding vaccination for COVID-19 and provided their demographic information. Participants were debriefed about the purpose of the survey before exiting and receiving compensation from Dynata. The procedures were approved by the Institutional Review Board at Michigan State University.

2.3. Measures

Details on central tendency and frequencies can be found in Table 1.

Intention to vaccinate for COVID-19. Participants responded on a scale from 1 (extremely unlikely) to 7 (extremely likely) to the following prompts: "How likely is it that you will get the COVID-19 vaccine for yourself as soon as you are allowed to get it?", "How likely is it that you will get the COVID-19 vaccine for yourself eventually, but after some waiting period?", "How likely is it that you will get the COVID-19 vaccine for [child_name] as soon as they

Table 1

Central tendency and frequency statistics for all variables. Sample total n = 682. All scales range from 1 to 7.

	M or n	SD or %[1]
Demographics		
Child sex		
Female	325	47.7
Male	340	49.9
Other	16	2.4
Child birth year (2020 = 1, 2014 = 7)	4.29	1.8
Relationship to child		
Parent	649	95.2
Grandparent/other	33	4.8
Participant sex		
Female	422	61.9
Male	239	35.0
Non-binary/Own terminology/Prefer not to disclose	19	2.8
Participant age	32.80	8.3
Participant race/ethnicity		
White	447	65.5
Black	114	16.7
Asian	36	5.3
Hispanic	26	3.8
Multiracial	40	5.9
Other/Prefer not to disclose[2]	19	2.8
Education		
High school or less	158	23.2
Some college/trade/associate degree	187	27.4
College degree	167	24.5
Advanced degree	165	24.2
Income		
Less than $50,000/year	264	38.7
$50,000 to $109,999/year	234	34.3
$110,000 or more/year	182	26.7
Child Vaccination Measures		
Vaccination status		
Full vaccination	262	38.4
Delayed vaccination	261	38.3
Partial vaccination	98	14.4
No vaccination	61	8.9
Child received 2020 influenza shot		
Yes	361	52.9
No but plan to	146	21.4
No and do not plan to	171	25.1
COVID vaccine confidence scale	4.49	1.6
COVID susceptibility	4.38	1.8
COVID severity	4.15	1.8
Prior COVID experience		
Yes (self and/or child)	215	31.7
No	464	68.3
COVID vaccine intention ASAP (self)	4.36	2.1
COVID vaccine intention ASAP (child)	4.20	2.1
COVID vaccine intention wait (self)	4.32	2.1
COVID vaccine intention wait (child)	4.32	2.0
COVID vaccine total intention (self)	4.33	1.9
COVID vaccine total intention (child)	4.27	1.9

[1] Total percent may not sum to 100% in each category due to missing values.
[2] Among the "other" category included Native American (*n* = 9), Pacific Islander (*n* = 1), participant-specified other (*n* = 1), and prefer not to disclose (*n* = 8).

are allowed to get it?", "How likely is it that you will get the COVID-19 vaccine for [child name] eventually, but after some waiting period?" Analyses were conducted on these items separately to understand whether getting the vaccine immediately or after a waiting period mattered. We also created an average of the two items referred to as "ultimate intention" for the child (*r* = 0.73) and the self (*r* = 0.75).

Prior child vaccination status. Participants were asked to select "which of the following best described the decision you have made regarding [child name] receiving vaccines. For example, diptheria, tetanus, pertussis (DTaP), Polio (IPV), Measles, Mumps, Rubella (MMR), Chickenpox (Varicella), Hepatitis A and B, H influenza (Hib), Pneumococcal (PCV13)." Response options were "[child

name] has received all vaccinations recommended for their age on the standard schedule", "[child name] has received all vaccinations recommended for their age on a delayed schedule", "[child name] has received at least one, but not all vaccinations recommended for their age", and "[child name] has never received a vaccination."

Prior influenza vaccination. Participants who indicated their child had received one or more vaccines (*n* = 619) were asked "Has [child name] received a flu shot this year?", with response options to say "yes", "no, but I plan to have them get it", and "no and I do not plan to have them get it."

Prior COVID-19 experience. Participants were asked "Have you or your child/children ever been diagnosed as positive for COVID-19?", with the following response options: "yes, I have tested positive but my child/children have not", "yes, at least one of my children has tested positive but I have not", "both myself and at least one of my children have tested positive", "no, but I strongly suspect I and/or my children have had it", and "no, and I do not suspect either myself or my children have had it." For purposes of analysis the responses were dichotomized into "prior COVID-19 experience" (*n* = 215, 31.7%) and "no prior COVID-19 experience" (*n* = 464, 68.3%). This item was included due to the recent CDC statements that those who have recovered from COVID-19 should still receive a vaccine [25], despite many believing that it is unnecessary.

Belief and confidence variables. The two major constructs that predict behavioral intention or behavior in health contexts are perceived susceptibility, the perception that one is susceptible to the disease or other negative health outcomes, and perceived severity, the perception that if one does get the disease or other outcome, it could have potentially serious consequences [20,26]. Perceived susceptibility was measured with "My child/ren is/are susceptible to getting COVID-19 in the future", and perceived severity was measured with "if my child/children get COVID-19 it will be severe" (both scales from 1 – strongly disagree to 7 – strongly agree).

A four-item vaccine confidence scale developed and used by Larson et al. [27] was modified by incorporating the term "COVID-19" in each of the items "[COVID-19] vaccines are important for children to have", "overall I think [COVID-19] vaccines are safe", "overall I think [COVID-19] vaccines are effective", and " [COVID-19] vaccines are compatible with my religious beliefs" (scale from 1 – strongly disagree to 7 – strongly agree). Cronbach α was not acceptable in the initial scale attempt (α = 0.66); item analysis indicated dropping the religion item would make it acceptable, so that item was removed from the scale and the remaining items were averaged (new α = 0.85).

2.4. Statistical analysis

Initial difference tests were conducted comparing intentions to receive the COVID-19 vaccine for their child and for themselves by topic (paired samples t-tests). A path model using GSEM in Stata 14.0 was used to examine relationships between child and care-giver demographics, prior childhood vaccination behavior, prior COVID-19 experience, and three belief variables (perceived severity, perceived susceptibility, confidence). Path modeling was also used to assess the relationships between those variables and care-givers' intention to have their child receive a COVID-19 vaccine. With respect to this analysis, the three belief variables were included as mediators of the relationships between demographics and prior behavior with intention. Therefore, the demographic and behavior variables were exogenous variables predicting the belief variables of perceived severity, perceived susceptibility, and vaccine confidence). The error terms of the three belief variables were allowed to covary to account for the variables' correlations. The

three belief variables then predicted COVID-19 vaccination intention. Indirect effects tests for the influence of each background variable on intention through each of the three belief mediators were conducted using the nlcom command in Stata 14.0 and 5,000 bias-corrected bootstrap samples.

3. Results

Table 1 provides the respondent profile. As Table 1 shows, respondents were primarily mothers. Overall, 38.4% self-reported full adherence to the childhood immunization schedule without delay or refusal of any vaccine, and over half said their child had received a flu vaccination in 2020. Approximately one in three reported that they or their child had been diagnosed with COVID-19. COVID-19 vaccination intention averaged slightly above the scale mean for both the self and the child, indicating caregivers were overall slightly positive toward vaccination. We will next present information describing vaccination intentions for caregivers and their child who was 5 years old or younger, and then present the results of a path model analysis that examined associations between demographic and psychological variables that are hypothesized to influence caregivers' COVID-19 vaccination intention.

3.1. Intention to vaccinate for COVID-19

One aspect of interest was whether caregivers would be more likely to intend to get the COVID-19 for themselves compared to for their 5-year-old or younger child, as well as the timing of each vaccination (as soon as the vaccine is available to them or after some waiting period). Paired samples t-tests suggested that caregivers had stronger intention to vaccinate themselves for COVID-19 immediately ($M = 4.36$, $SD = 2.10$) compared to vaccinating their child immediately ($M = 4.20$, $SD = 2.12$), $t(668) = 2.72$, $p < .01$. Intention to vaccinate their child immediately was slightly lower compared to after a waiting period ($M = 4.32$, $SD = 2.03$), but did not reach statistical significance, $t(678) = -1.94$, $p = .052$. These results suggest caregivers would seek COVID-19 vaccination shortly after vaccines were available but prefer to wait when it came to vaccination becoming available for their child. Ultimately, however, they intended to vaccinate themselves and their child at similar rates. Given this consistency, a measure of ultimate intention to vaccinate their child was created by averaging the immediate and waiting period items (Pearson's $r = 0.73$), and this measure was used for subsequent intention analyses.

3.2. Path model for health belief model analysis

Full statistical results for the path model can be found in Table 2. This path analysis examined whether demographic variables and prior COVID-19 experiences were associated with perceived susceptibility, perceived severity, and COVID-19 vaccine confidence, and whether those constructs were, in turn, associated with COVID-19 vaccination intention for their young child, in a multiple mediation model. All references to significance are referring to statistical significance ($p < .05$).

In terms of perceived severity of COVID-19, female participants reported significantly lower perceived severity of COVID-19 for their 5-year-old or younger child ($M = 3.83$, $SD = 1.81$) compared to male participants ($M = 4.68$, $SD = 1.73$). Those respondents who had previous experience with COVID-19 for themselves and/or their child reported significantly greater perceived severity for their child ($M = 4.85$, $SD = 1.68$) compared to those respondents who had not had prior experience ($M = 3.82$, $SD = 1.82$). Those who reported not vaccinating their child for flu in 2020, and with

no plans to do so, reported significantly lower perceived COVID-19 severity ($M = 3.30$, $SD = 1.90$) compared to those whose child had already received a flu vaccine ($M = 4.48$, $SD = 1.78$). Greater acceptance of childhood vaccinations was significantly linearly associated with higher perceived severity of COVID-19.

Also, with respect to perceived susceptibility to COVID-19 for children, participants who identified as Black reported significantly lower perceived susceptibility to COVID-19 for their child ($M = 3.84$, $SD = 1.87$) compared to those who identified as White ($M = 4.53$, $SD = 1.81$). Among all participants, greater income and greater compliance with childhood vaccinations were both significantly linearly associated with increased perceived susceptibility to COVID-19. Those with a prior COVID-19 experience reported significantly higher perceived susceptibility ($M = 4.82$, $SD = 1.66$) compared to those who did not ($M = 4.19$, $SD = 1.88$). Those who reported not vaccinating their child for flu in 2020 with no plans to do so reported significantly lower perceived susceptibility ($M = 3.68$, $SD = 1.87$) compared to those who already had their child receive a flu vaccine ($M = 4.70$, $SD = 1.85$).

With respect to COVID-19 vaccine confidence, parents had significantly lower COVID-19 vaccine confidence ($M = 4.46$, $SD = 1.64$) compared to non-parents (e.g., grandparents, $M = 5.01$, $SD = 1.42$), as did female participants ($M = 4.16$, $SD = 1.60$) compared to male participants ($M = 5.12$, $SD = 1.45$). Greater educational attainment and greater compliance with childhood vaccinations were both significantly linearly associated with increased vaccine confidence. Those who reported not vaccinating their child for flu in 2020 with no plans to do so reported significantly lower vaccine confidence ($M = 3.27$, $SD = 1.66$) compared to those who already had their child receive a flu vaccine ($M = 5.06$, $SD = 1.43$).

Finally, when intention to vaccinate their child for COVID-19 was the target outcome, perceived severity of COVID-19 for their child and COVID-19 vaccine confidence were both significantly associated with increased intention to have their child receive a vaccine for COVID-19. There were also significant direct effects on intention with demographic variables. Intention was associated with child age, such that intention was higher as child age increased. Female participants reported significantly lower intention ($M = 3.79$, $SD = 1.89$) compared to male participants ($M = 5.15$, $SD = 1.65$), while participants who identified as Hispanic or Latino reported significantly higher intention ($M = 4.96$, $SD = 1.33$) compared to participants who identified as White ($M = 4.31$, $SD = 2.03$). Those who reported not vaccinating their child for flu in 2020 reported significantly lower intention compared to those who already had their child receive a flu vaccine ($M = 4.98$, $SD = 1.67$), for both those who still planned to have their child receive the flu vaccine ($M = 4.23$, $SD = 1.63$) and for those who did not ($M = 2.77$, $SD = 1.83$).

3.2.1. Indirect effects tests for mediation

Significant indirect effects of behavior and demographic variables can be found in Table 3. Perceived severity of COVID-19 for children was associated with prior vaccination status (positive), prior influenza vaccination (positive), prior COVID-19 experience (positive), and identifying as female (negative). The analyses indicated that respondents who adhered to the childhood vaccination schedule, had already had their child vaccinated for influenza in 2020, and they or their child previously experienced COVID-19, they perceived COVID-19 as likely to be more severe if their child were to contract it. This perception, in turn, was associated with significantly increased intention to have their child receive a vaccination for COVID-19. However, female respondents reported significantly lower perceived severity of COVID-19 compared to male respondents, and this was significantly associated with reduced intention to have their child receive a vaccine (see Tables 4 and 5).

Table 2
Ordinary Least Squares regression results predicting perceived severity, perceived susceptibility, vaccine confidence, and ultimate intention to vaccinate child for COVID-19. Regression coefficients reported are unstandardized. For ease of interpretation relationships that are significant at p < .05 are bolded.

	Perceived Severity		Perceived Susceptibility		COVID Vaccine Confidence		Ultimate Intention	
	b	95% CI	b	95% CI	b	95% CI	b	95% CI
Participant sex (Male = comparison)								
Female	**−0.39**	**−0.72, −0.06**	0.14	−0.20, 0.47	**−0.38**	**−0.64, −0.11**	**−0.45**	**−0.69, −0.21**
Other/prefer not to disclose	0.05	−1.06, 1.15	0.38	−0.74, 1.50	−0.11	−0.87, 0.64	−0.55	−0.85, 0.62
Participant race and ethnicity (White = comparison)								
Black	0.03	−0.36, 0.42	**−0.57**	**−0.97, −0.17**	−0.26	−0.57, 0.06	0.11	−0.18, 0.40
Asian	−0.26	−0.85, 0.32	−0.55	−1.15, 0.04	0.17	−0.30, 0.64	0.21	−0.21, 0.63
Hispanic	−0.17	−0.86, 0.52	−0.25	−0.95, 0.45	−0.09	−0.64, 0.45	**0.51**	**0.02, 1.01**
Multiracial	−0.13	−0.71, 0.44	0.12	−0.46, 0.70	0.09	−0.36, 0.55	0.14	−0.27, 0.55
Other/prefer not to disclose	0.03	−0.84, 0.90	−0.26	−1.14, 0.63	−0.13	−0.81, 0.54	0.09	−0.54, 0.71
Participant age	−0.00	−0.02, 0.01	0.01	−0.01, 0.02	−0.00	−0.02, 0.01	−0.01	−0.02, 0.01
Education	0.02	−0.13, 0.17	0.06	−0.09, 0.21	**0.18**	**0.06, 0.30**	0.07	−0.04, 0.18
Income	0.04	−0.17, 0.25	**0.24**	**0.03, 0.45**	0.15	−0.02, 0.31	0.03	−0.12, 0.18
Past COVID experience	**0.84**	**0.53, 1.14**	**0.70**	**0.38, 1.01**	0.10	−0.14, 0.35	−0.09	−0.32, 0.14
Child birth year	0.02	−0.06, 0.09	−0.05	−0.12, 0.03	0.06	−0.00, 0.12	**0.07**	**0.02, 0.13**
Child sex (Male = comparison)								
Female	−0.18	−0.46, 0.10	0.04	−0.25, 0.33	−0.10	−0.33, 0.13	−0.06	−0.27, 0.14
Other/prefer not to disclose	**−0.99**	**−1.96, −0.01**	−0.30	−1.32, 0.72	−0.11	−0.87, 0.64	−0.12	−0.85, 0.62
Parent (yes = 1)	−0.03	−0.71, 0.64	−0.46	−1.14, 0.23	**−0.85**	**−1.38, −0.31**	0.24	−0.25, 0.72
Childhood vaccination status	**0.27**	**0.12, 0.43**	**0.39**	**0.23, 0.55**	**0.32**	**0.20, 0.45**	0.04	−0.08, 0.16
Flu vaccine in 2020 (received = comparison)								
No but plan to	0.02	−0.33, 0.38	−0.01	−0.37, 0.35	−0.25	−0.53, 0.03	**−0.32**	**−0.57, −0.07**
No and do not plan to	**−0.57**	**−0.94, −0.19**	**−0.42**	**−0.80, −0.04**	**−1.17**	**−1.46, −0.87**	**−0.70**	**−0.98, −0.42**
Susceptibility (child)	–	–	–	–	–	–	0.05	−0.02, 0.11
Severity (child)	–	–	–	–	–	–	**0.08**	**0.01, 0.15**
COVID-19 vaccine confidence	–	–	–	–	–	–	**0.66**	**0.59, 0.72**
R^2	0.16		0.15		0.33		0.62	

Table 3
Significant indirect effects of behavioral and demographic variables through mediators perceived severity and vaccine confidence. Coefficients reported are unstandardized. 95% bias-corrected confidence intervals were obtained with 5,000 bootstrap samples.

	Mediator			
	Perceived Severity of COVID-19		COVID-19 Vaccine Confidence	
	b	CI	b	CI
Childhood vaccination status	0.02	0.002, 0.06	0.21	0.13, 0.31
Flu vaccination status (0 = received, 1 = plan to receive, 2 = no plan)	−0.02	−0.06, −0.001	−0.34	−0.47, −0.21
Participant sex (0 = male, 1 = female)	−0.04	−0.10, −0.004	−0.27	−0.46, −0.08
Prior COVID	0.07	0.004, 0.15	–	–
Education	–	–	0.12	0.03, 0.21
Parent	–	–	−0.56	−0.91, −0.24

Additionally, COVID-19 vaccine confidence was associated with prior vaccination status (positive), prior influenza vaccination (positive), education level (positive), identifying as female (negative), and status as a parent (negative). Therefore, when respondents adhered more closely to the childhood vaccination schedule, had already had their child vaccinated for influenza in 2020, and reported more formal education, the more confident they felt in COVID-19 vaccines, and this confidence was associated with significantly increased intention to have their child receive a vaccination for COVID-19. Again, however, female respondents reported significantly lower vaccine confidence compared to male respondents. In addition, caregivers who were the child's parent reported significantly lower vaccine confidence compared to non-parent respondents (e.g., grandparents). This was therefore associated with significantly lower intention to vaccinate in these two groups.

4. Discussion

The results of this study indicate that many caregivers, particularly mothers, were somewhat to significantly hesitant to accept,

particularly quickly, COVID-19 vaccination for children ages 5 and under should vaccines become recommended and available. Further, acceptance is likely to be lower – and hesitancy greater – among caregivers who do not fully adhere to the recommended childhood immunization schedule, whose 5-year-old and younger child has not received recommended influenza vaccinations, and who identify as Black. In line with findings from vaccination hesitancy research with caregivers related to recommended childhood vaccines [21,22], these caregivers do not perceive COVID-19 as a serious health threat to their child and have less confidence in the safety and effectiveness of recommended vaccines. It is thus imperative that public health agencies, health care providers, and others involved in early childhood immunization advocacy initiate the development and assessment of COVID-19 vaccination provider and caregiver education materials in the months before a COVID-19 vaccine is authorized and recommended for children under 5 years old.

Importantly, when it comes to developing COVID-19 vaccine education materials and activities to foster high uptake and reduce hesitancy among parents and guardians of children 5 years old and young, this study's findings provide helpful insights into vaccine acceptance. First, while the caregivers in this survey reported a

Table 4

Means of health belief model variables and ultimate intention to vaccinate child for COVID-19 by categorical predictor variable categories.

	Perceived Severity		Perceived Susceptibility		COVID Vaccine Confidence		Ultimate Intention	
	M	SD	M	SD	M	SD	M	SD
Participant sex								
Male	4.68	1.74	4.60	1.79	5.12	1.45	5.15	1.65
Female	3.84	1.81	4.25	1.85	4.16	1.60	3.79	1.89
Other/prefer not to disclose	4.32	2.11	4.42	2.14	4.09	1.96	3.89	2.00
Participant race and ethnicity								
White	4.18	1.87	4.53	1.81	4.57	1.70	4.31	2.03
Black	4.13	1.75	3.84	1.87	4.06	1.55	3.91	1.73
Asian	4.19	1.83	4.28	1.91	5.10	1.15	4.96	1.33
Hispanic	3.92	1.71	4.24	1.74	4.37	1.08	4.50	1.37
Multiracial	3.85	1.76	4.46	1.92	4.38	1.55	4.16	1.97
Other/prefer not to disclose	4.50	2.07	4.44	1.89	4.25	1.47	4.05	1.67
Participant age (quantiles)								
18–26	4.01	1.77	4.11	1.81	4.11	1.52	3.94	1.69
27–33	4.14	1.92	4.44	1.81	4.29	1.59	4.08	2.04
34–38	4.19	1.78	4.43	1.80	4.88	1.60	4.65	1.89
39+	4.23	1.87	4.55	1.95	4.71	1.71	4.41	2.00
Education								
High school or less	3.77	1.90	3.85	1.89	3.73	1.64	3.41	1.85
Some college/trade/assoc. degree	4.02	1.76	4.24	1.75	4.22	1.53	3.91	1.82
College degree	4.35	1.80	4.82	1.74	4.91	1.46	4.66	1.89
Advanced degree	4.46	1.83	4.61	1.87	5.13	1.52	5.14	1.69
Income								
<$50,000/year	3.92	1.79	3.97	1.80	4.02	1.53	3.68	1.80
$50,000 to $109,999/year	4.03	1.88	4.47	1.88	4.44	1.65	4.24	1.99
>$110,000	4.63	1.77	4.85	1.74	5.26	1.45	5.18	1.66
Past COVID experience								
Yes	4.85	1.68	4.82	1.66	4.82	1.45	4.70	1.70
No	3.83	1.82	4.19	1.88	4.35	1.68	4.07	2.00
Child birth year								
2014–2015	3.90	1.75	4.33	1.77	4.20	1.66	3.72	1.94
2016–2017	4.11	1.76	4.39	1.83	4.36	1.56	4.14	1.85
2018–2019	4.25	1.85	4.42	1.86	4.63	1.67	4.51	1.96
2020	4.27	2.07	4.25	1.95	4.87	1.52	4.65	1.84
Child sex								
Male	4.30	1.88	4.40	1.80	4.62	1.58	4.44	1.91
Female	4.01	1.79	4.39	1.87	4.36	1.68	4.09	1.94
Other/prefer not to disclose	3.73	1.83	3.86	2.07	4.67	1.31	4.31	1.91
Parent status								
Parent	4.14	1.84	4.37	1.85	4.46	1.64	4.26	1.93
Grandparent/other	4.31	1.84	4.61	1.68	5.01	1.42	4.38	1.90
Childhood vaccination status								
Full vaccination	4.36	1.78	4.80	1.86	5.00	1.48	4.81	1.84
Delayed vaccination	4.34	1.75	4.45	1.68	4.50	1.45	4.32	1.71
Partial vaccination	3.71	1.84	3.92	1.74	4.00	1.65	3.71	2.03
No vaccination	3.15	2.03	3.03	1.80	3.02	1.85	2.57	1.84
Flu vaccine in 2020								
Yes	4.48	1.78	4.70	1.85	5.06	1.43	4.98	1.67
No but plan to	4.32	1.61	4.40	1.57	4.51	1.27	4.23	1.63
No and do not plan to	3.30	1.90	3.68	1.87	3.27	1.66	2.77	1.83

Table 5

Pairwise Pearson correlations for all continuous variables in the model. Note: ***p < .001, **p < .01, *p < .05.

	1	2	3	4	5	6	7	8
1. Perceived Severity	–							
2. Perceived Susceptibility	0.54***	–						
3. COVID Vaccine Confidence	0.48***	0.48***	–					
4. Ultimate Intention	0.44***	0.41***	0.74***	–				
5. Caregiver age	0.01	0.08*	0.10**	0.08*	–			
6. Education	0.13**	0.18***	0.30***	0.30***	0.19***	–		
7. Income	0.14***	0.21***	0.32***	0.32***	0.26***	0.57***	–	
8. Child Birth Year	0.07	0.00	0.13**	0.16***	0.12**	0.15***	0.15***	–

higher intention to get themselves vaccinated as soon as possible than doing so with their young children, this does not appear to be an indicator of resistance to COVID-19 vaccination. Given that ultimate intention to receive COVID-19 vaccination was similar, this finding serves as a reminder that as was seen with adult uptake, many caregivers of children ages 5 and under will take a "wait-and-see" approach. This is good news in that it suggests a significant portion of the caregiver population is supportive and favorably predisposed to COVID-19 vaccination for young children. More importantly, it highlights the need for public health agencies

and childhood immunization providers to get prepared to quickly provide "wait-and-see" caregivers with information that can foster sooner, rather than later, COVID-19 vaccination.

Along those lines, this study's findings suggest that public health COVID-19 vaccination education efforts should anticipate some hesitancy even among caregivers who otherwise exhibit high childhood vaccine acceptance. This is based on our results indicating that 23.2% of those who accept all routine vaccines for their children on schedule indicated intention to vaccinate for COVID-19 below the midpoint of the scale, and only 16.0% reported the highest intention. Thus, there is still some hesitancy even among those who otherwise accept childhood vaccines. That said, our study also found evidence of potential COVID-19 vaccination for young children even among respondents who reported refusing all or some vaccines. Over half of otherwise no vaccination caregivers indicated intention higher than zero, and over 80% of caregivers who refused some childhood vaccines did the same. Thus, the issue of COVID-19 vaccination for young children is likely to give rise to a variety of positions among caregivers irrespective of their self-reported routine childhood vaccination behaviors to date. Some caregivers who are usually in favor of vaccines for their children will express reluctance to comply with a COVID-19 vaccination recommendation, while some who are usually vaccine hesitant may be at least slightly open to COVID-19 vaccination, particularly if they associate infection with potentially severe symptoms or illness.

Along this line, the findings here affirm that belief variables such as perceived severity of COVID-19 for children and COVID-19 vaccine confidence are important mediators of the prior behavior and demographic variables. This provides information about the mechanisms by which those variables are likely influencing vaccine intention. Information-based COVID-19 vaccination educational campaigns, especially those intended to correct misinformation, are unlikely to be successful by exclusively relying on the provision of facts and statistics [28,29]. Instead, there will need to be a concerted effort to make prominent COVID-19 vaccination benefits that resonate with caregivers who have reluctance or hesitancy. As this survey found, many caregivers perceive the likelihood of their young child experiencing severe COVID-19 illness to be small, with much surveillance data to date providing support for that perception. Education efforts that highlight the benefits of keeping young children healthy for both the child and caregivers, using real-life examples and stories, will likely be more effective in motivating vaccination. There is a decades-long history of successful interventions based in changing susceptibility and severity beliefs through persuasive campaigns based in the Health Belief Model in a variety of health contexts [30]. In particular, narrative messaging may be especially effective at overriding preexisting misinformation and counterarguing, as well as changing perceptions related to perceived low susceptibility [28,31]. The results of the present study suggest that this type of persuasive narrative messaging would be especially helpful if it focuses on perceived severity if their child were to contract COVID-19, as well as non-disease related risks such as mandatory quarantines leading to lost wages. This is especially the case when targeting caregivers who do not always vaccinate on time for other childhood vaccines, who refuse the influenza vaccines, and potentially when targeting mothers.

Our results also reaffirm that previous experiences with influenza vaccination and with COVID-19 infection also matter in predicting likelihood of vaccine acceptance for young children. Caregivers who reported having vaccinated their young child against influenza had much higher COVID-19 vaccination intentions for their child. Given influenza and COVID-19 are both respiratory illnesses common among young children, it is worth exploring the value of co-promotion of influenza and COVID-19

vaccination. The CDC has stated that COVID-19 and influenza vaccines can be given at the same time [32], but caregiver acceptance of that recommendation remains unclear. Interestingly, those who have personal experience with COVID-19 reported higher intention to have their child receive a vaccine. This suggests these caregivers want more protection against future COVID-19 illness than natural immunity can provide, and that public health messaging about the risk of re-infection from COVID-19 and the need for those who have had the disease to still be vaccinated [33] has likely been effective. Future research should look at this group in more detail to identify their motivations and beliefs.

Finally, in terms of demographic differences, hesitancy about COVID-19 vaccination of young children may be higher in women and among Black caregivers, which has also been demonstrated in other research [34]. In the case of the former, this is particularly important given that mothers are often the primary decision-makers for child vaccines [35]. In the case of the latter, it is crucial for future research and for vaccination efforts to continue to consider the importance of race and ethnicity, as well as intersectionality of race/ethnicity and socioeconomic status, during the effort to encourage vaccine acceptance.[1] Black and Hispanic people in the United States have experienced both the worst outcomes of the disease itself and the economic impacts of the pandemic on income and employment [36,37]. As documented by the U.S. CDC, COVID-19 has helped bring existing racial and social injustices to the forefront of public health conversations, including those involving vaccines [38]. As such, the shadows of historical medical mistrust (e.g., Tuskegee experiment and its long-term impacts on the Black community, including present-day discrimination in the medical system [39]; forced sterilization of Mexican women [40]) have surfaced during the COVID-19 health crisis. Given the central role that trust plays in vaccine acceptance, these shadows will need to be addressed in public health efforts to encourage COVID-19 vaccination in many U.S. communities. Fortunately, many community leaders, organizations, and public health officials are already working with Black, Hispanic, and low-income communities to address COVID-19 vaccine hesitancy [38]. That said, there are already clear disparities in COVID-19 vaccine distribution by race and ethnicity in adults [41], and without better targeted efforts to reach communities that have thus far been left behind, those disparities will continue in children.

4.1. Limitations and future research

This study has notable limitations. First, it is cross-sectional, meaning that causality cannot be determined; however, there is strong theoretical reasoning from the HBM to expect directionality as modeled here. Additionally, actual COVID-19 vaccination behavior was not assessed because COVID-19 vaccines were not authorized or available for adults or young children when the survey was conducted. As such, intentions were assessed. However, decades of previous research suggest a medium-to-large effect size in the relationship between behavioral intention and behaviour [42]. Intentions are more likely to turn into actual behavior under certain circumstances that COVID-19 vaccination education efforts can utilize [43]. These include providing concrete opportunities to engage in the behavior (e.g., vaccine drives at workplaces, schools,

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[1] An exploratory analysis was conducted with this dataset to test the statistical interaction between participant racial identity and income in predicting the HBM variables and intention. The statistical output is available in the supplemental files. In short, for White respondents, perceived severity, vaccine confidence, and vaccine intention all increased as income increased. For Black respondents, all three variables decreased with income. For Asian respondents, confidence and intention decreased as income increased. And for respondents reporting "other racial identity" or no answer, severity and confidence decreased as income increased. Future research should look at these relationships more closely with a larger sample of non-White respondents.

and community hubs), helping monitor goal progress (e.g., apps and reminders to make appointments), and encouraging people to make action plans (e.g., ask people to indicate which vaccination locations they would visit) [43].

4.2. Conclusion

There is a great need to understand how to best use public health communication to increase COVID-19 vaccine acceptance, with the very real likelihood that young children under the age of 5 will need to be vaccinated for COVID-19 in the future [44,45]. This study suggests that, similar to what has been seen with adults, many caregivers will welcome COVID-19 vaccines becoming available for their young children, some will see little need or value, and a large number will be hesitant but open to vaccination. It is thus essential to use the time prior to COVID-19 vaccines becoming available for young children to undertake education and outreach efforts that will address concerns and foster high and rapid uptake. In addition, the information gleaned from the present study will be applicable to future novel vaccine acceptance. There is nearly always an initial hesitancy when a novel vaccine is introduced for pediatric patients (for example, see the history of acceptance for the relatively recent varicella [46] and HPV [47] vaccines), and the COVID-19 vaccine is similar. Should young children need to be vaccinated against COVID-19, whether urgently or eventually, it is crucial to look ahead to lay the groundwork with caregivers' beliefs to maximize vaccine acceptance.

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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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