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Where are children ages 5–17 years receiving their COVID-19 vaccinations? Variations over time and by sociodemographic characteristics, United States

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ABSTRACT

Background: Knowing the settings where children ages 5–17 years received COVID-19 vaccination in the United States, and how settings changed over time and varied by socio-demographics, is of interest for planning and implementing vaccination programs.
Methods: Data from the National Immunization Survey-Child COVID-19 Module (NIS-CCM) were analyzed to assess place of COVID-19 vaccination among vaccinated children ages 5–17 years. Interviews from July 2021 thru May 2022 were included in the analyses for a total of n = 39,286 vaccinated children. The percentage of children receiving their COVID-19 vaccine at each type of setting was calculated overall, by sociodemographic characteristics, and by month of receipt of COVID-19 vaccine.
Results: Among vaccinated children ages 5–11 years, 46.9 % were vaccinated at a medical place, 37.1 % at a pharmacy, 8.1 % at a school, 4.7 % at a mass vaccination site, and 3.2 % at some other non-medical place. Among vaccinated children ages 12–17 years, 35.1 % were vaccinated at a medical place, 47.9 % at a pharmacy, 8.3 % at a mass vaccination site, 4.8 % at a school, and 4.0 % at some other non-medical place. The place varied by time among children ages 12–17 years but minimally for children ages 5–11 years. There was variability in the place of COVID-19 vaccination by age, race/ethnicity, health insurance, urbanicity, and region.
Conclusion: Children ages 5–17 years predominantly received their COVID-19 vaccinations at pharmacies and medical places. The large proportion of vaccinated children receiving vaccination at pharmacies is indicative of the success in the United States of expanding the available settings where children could be vaccinated. Medical places continue to play a large role in vaccinating children, especially younger children, and should continue to stock COVID-19 vaccine to keep it available for those who are not yet vaccinated, including the newly recommended group of children < 5 years.

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1. Introduction

The types of places, or settings, where people receive vaccinations has been shown to vary by the age of the person, by the vaccine type, and by demographic and socio-demographic variables; this has been the case for influenza vaccination of adults and for influenza vaccination and other recommended vaccinations for children.[1,2] Knowing where vaccinations are received helps those who plan vaccination programs ensure the vaccine supply is sufficient at the places where people are getting the vaccine and helps them to know if expansion to additional settings is

Abbreviations: NIS-CCM, National Immunization Survey-Child COVID Module; SVI, Social Vulnerability Index.

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needed. Prior to the rollout of the COVID-19 vaccination program for children ages < 5 years, program officials used place of COVID-19 vaccination information for children ages 5–11 years to help inform planning.[3] Currently, there are no published nationally representative data on place of COVID-19 vaccination among children ages 5–17 years, how it may have varied by sociodemographic variables such as race, ethnicity and income, and how it changed over the course of the pandemic.

COVID-19 vaccination for children ages ≥ 16 years was recommended on December 12, 2020, and then expanded to include children ages 12–15 years on May 12, 2021.[4,5] A COVID-19 vaccine recommendation for children ages 5–11 years was made on November 2, 2021, and then on June 18, 2022 expanded to include children ages 6 months–4 years.[6,7] COVID-19 vaccination coverage for children as of May 2022 shows that 33.0 % of children ages 5–11 years had received at least one dose and 61.7 % of children ages 12–17 had received at least one dose. [8,9].

We report where children ages 5–17 years received COVID-19 vaccination in the United States based on data from a large, ongoing national survey collected July 22, 2021–May 28, 2022. We examined variation in place of vaccination by socio-demographic characteristics and over time.

2. Methods

The National Immunization Survey-Child COVID Module (NIS-CCM) is an ongoing random-digit-dial cellular telephone survey of households with children ages 6 months through 17 years. The NIS-CCM began on July 22, 2021 to estimate vaccination coverage, place of vaccination, and intent to vaccinate for children ages 13–17 years. In October 2021 it was expanded to children ages 12 years, on November 2, 2021, it was again expanded to children ages 5–11 years, and finally, on June 20, 2022, it was expanded to children ages 6 months–4 years. The NIS-CCM utilizes the same NIS sampling frame used for the NIS-Child, NIS-Teen, and NIS-Flu, and the flow of the telephone interviews can include the completion of more than one of these surveys. The respondent to a NIS survey is a parent or guardian who said they were knowledgeable about the child's vaccination history (hereafter referred to as parent). Only one child per household is randomly selected for the NIS-CCM. More details about the NIS family of surveys are available.[10,11].

During the NIS-CCM survey, respondents were asked if their child had received a COVID-19 vaccination and, if so, during which month and year the first dose was received. For this analysis, children were considered vaccinated if they were reported to have received at least one dose of COVID-19 vaccine. COVID-19 vaccination coverage estimates for children ages 5–11 years and 12–17 years based on May 2022 interviews were 33.0 % and 61.7 %, respectively.[8] For children who received a COVID-19 vaccination, respondents were asked "At what kind of place did [child's name] get his/her most recent COVID-19 vaccination?" Responses were coded by the interviewer into the following categories, which appeared on their computer screen during the interview: 1) doctor's office, 2) health department, 3) clinic or health center, 4) hospital, 5) other medically related place, 6) mass vaccination site, 7) pharmacy or drug store, 8) workplace, 9) elementary/middle/high school, or 10) other non-medically related place. Place of vaccination was grouped into the following categories for analyses: 1) Medical place (doctor's office, clinic or health center, hospital, health department, or other medical place), 2) mass vaccination site, 3) pharmacy, 4) school, and 5) other non-medical place (including workplace). Children for whom place of vaccination was not reported (n = 391) were excluded from the study.

Information on the following sociodemographic characteristics was included in this study: child's age at time of interview, child's race/ethnicity, household income/poverty level, mother's education level, number of children in the household, health insurance status, Metropolitan Statistical Area (MSA) status (urban, suburban, rural), the Social Vulnerability Index (SVI) of the county of child's residence, and HHS region. The income/poverty level variable was defined based on total family income in the past calendar year and the U.S. Census poverty thresholds for that year specified for the applicable family size and number of children < 18 years. The CDC/ATSDR Social Vulnerability Index was developed to help officials identify communities that may need support; categorization of NIS-CCM data into a SVI level was based on zip code of residence reported by the respondent.[12].

NIS-CCM interviews from July 22, 2021 thru May 28, 2022, were used for analyses. The cumulative response rate was 17.4 %. Months of data were combined; however, vaccination data for children ages 5–11 years were not collected until November 2021 when vaccinations for this age group began. Data for children ages < 5 years were not yet available and so they are not included in this study. The total sample for the analyses included 39,286 vaccinated children with complete place of vaccination information. For the sub-analyses by month of vaccination receipt, the sample size was n = 34,199 due to 5,087 children not having a reported month/year of vaccination. We calculated the percentage of children receiving their most recent COVID-19 vaccination at each place. Additionally, these percentages were stratified by the sociodemographic variables. Differences in setting of vaccination by sociodemographic groupings were tested using t-tests for proportions to compare to a referent category. For the examination of changes over the months of vaccination, each time period was compared to the previous time period by pair-wise t-tests. Due to decreases in the number of vaccinations received in March–May 2022 for children ages 5–11 years and in January–May 2022 for children ages 12–17 years, these months were combined for the monthly comparison analyses of place of vaccination. A two-sided significance level of 0.05 was adopted for all statistical tests. Comparisons reported as being increases or decreases were statistically significant, while comparisons that were not statistically significant are reported as not being different. Reported percentages and corresponding 95 % confidence intervals (95 % CI) were weighted, while reported sample sizes were unweighted. The NIS-CCM survey weights adjust for non-response and households without cellular telephones and were calibrated to match counts of children with one or more doses of COVID-19 vaccine by sex and age group within each state, using vaccine administration data reported to CDC by jurisdictions.[13] Analyses were conducted using SAS release 9.4 (SAS Inc., Cary, NC) and SUDAAN release 11.0.3 (Research Triangle Institute, Research Triangle Park, NC) statistical software to account for the complex survey design. The NIS-CCM used in this study was approved by both the CDC and NORC Institutional Review Boards.

3. Results

Among vaccinated children ages 5–11 years, the percentage vaccinated at a medical place was 46.9 % (23.8 % doctor's office, 12.3 % clinic/health center, 5.9 % hospital, 3.5 % health department, 1.4 % other medical place), 37.1 % at a pharmacy, 8.1 % at a school, 4.7 % at a mass vaccination site, and 3.2 % at some other non-medical place (Fig. 1). Among vaccinated children ages 12–17 years, 35.1 % were vaccinated at a medical place (10.5 % doctor's office, 4.8 % health department, 12.3 % clinic/health center, 6.1 % hospital, 1.4 % other medical place), 47.9 % at a pharmacy, 8.3 % at a mass vaccination site, 4.8 % at a school, and 4.0 % at some other non-medical place.

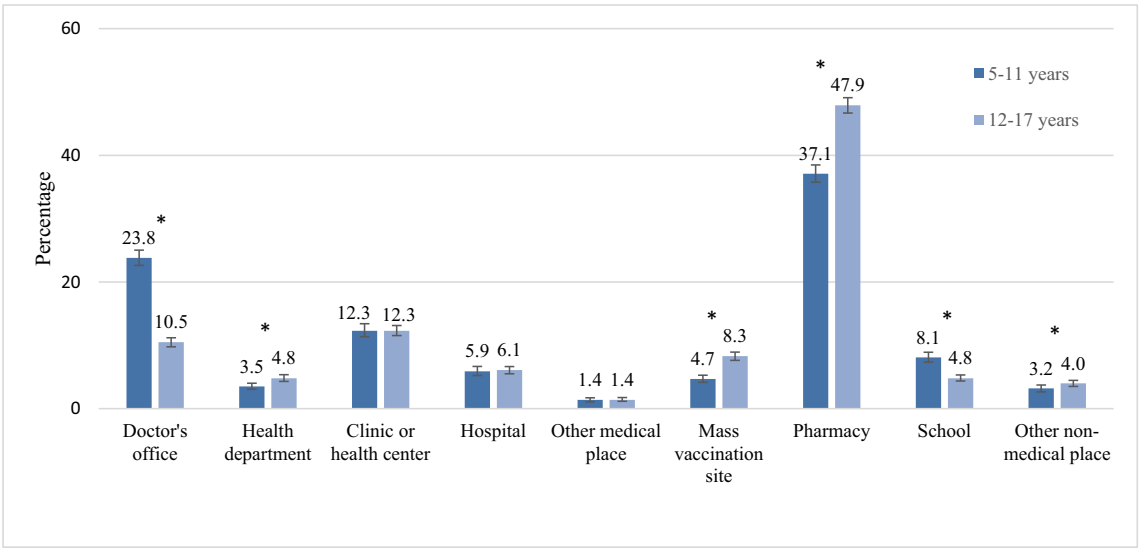

Fig. 1. Reported place of COVID-19 vaccination, detailed categories, by age group, children ages 5–17 years, United States, National Immunization Survey-Child COVID-19 Module (NIS-CCM), Survey Interviews July 2021–May 2022[a]. * Statistically significant difference between the age groups by *t*-test for proportions at P < 0.05. [a] Vaccinations for children ages 5–11 years began in November.

When the distribution of place of COVID-19 vaccination was examined by the month received, the place varied by time among children ages 12–17 years but minimally for children ages 5–11 years. For vaccinated children ages 12–17 years, the percentage receiving their vaccination at a medical place increased from September 2021 (33.0 %) to October 2021 (43.4 %) (Fig. 2). The percentage vaccinated at mass vaccination sites decreased from April 2021 (14.2 %) to May 2021 (10.7 %) and decreased further in July 2021 (5.0 %). The percentage of children ages 12–17 years vaccinated at pharmacies increased from April 2021(38.6 %) to May 2021 (45.9 %) and then again from June 2021 (49.2 %) to July 2021 (56.3 %) and then decreased from September 2021 (55.6 %) to October 2021 (46.7 %). The percentage vaccinated at schools increased from April 2021 (4.6 %) to May 2021 (6.8 %) and then decreased in June 2021 (4.8 %) and then again in July 2021 (2.5 %). For children ages 5–11 years (Fig. 3), the only variation over

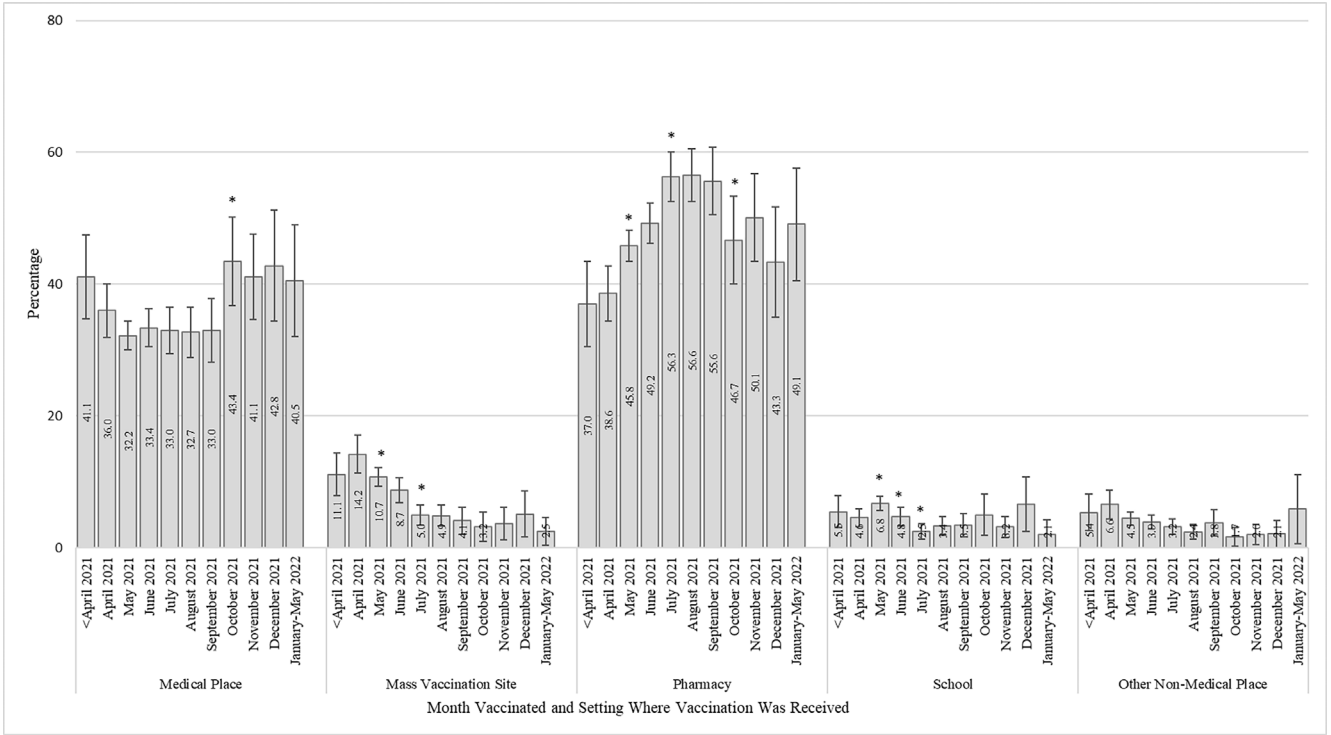

Fig. 2. Reported place of COVID-19 vaccination by month of vaccination receipt, children ages 12–17 years, United States, National Immunization Survey-Child COVID-19 Module (NIS-CCM), Survey Interviews July 2021–May 2022 * Statistically significant difference compared to the previous time point by *t*-test for proportions. Estimates that did not meet NCHS reliability criteria for proportions are not shown as data labels, although the bars are plotted. Some parents reported a month prior to the recommendation and could have been in a clinical trial so those were not deleted; however, the parents could also have not remembered the month correctly.

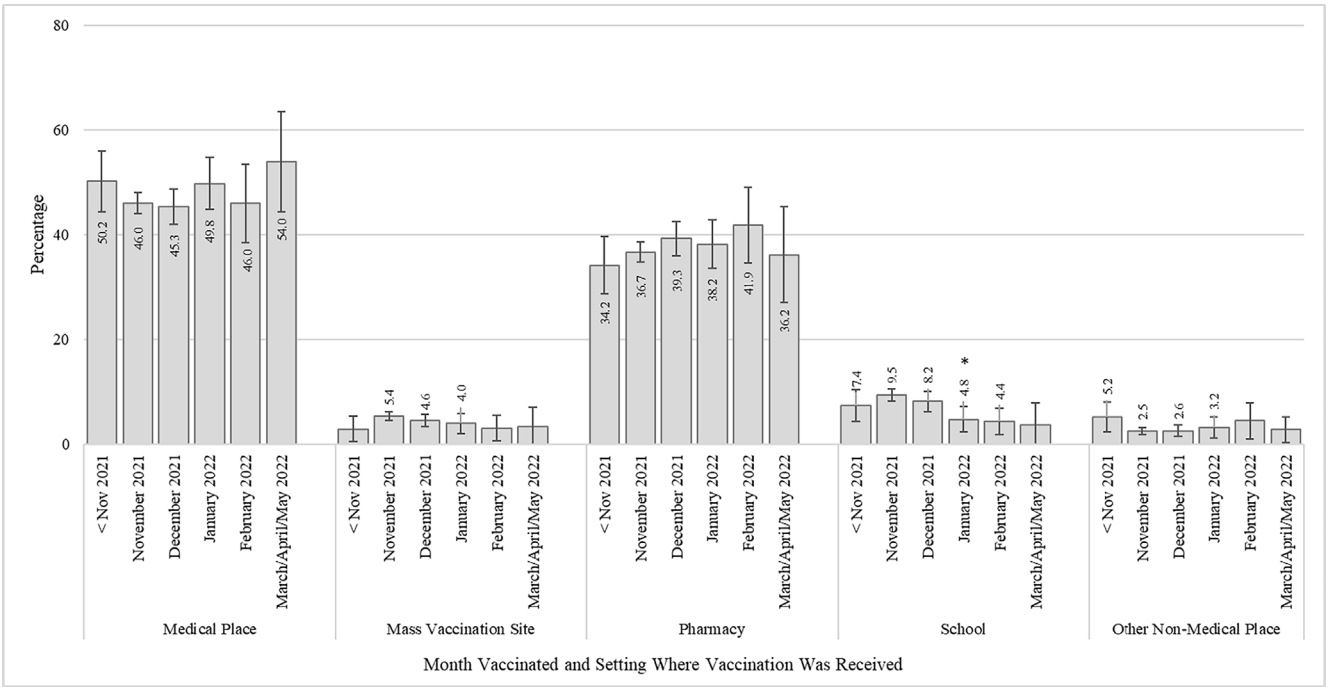

Fig. 3. Reported place of COVID-19 vaccination by month of vaccination receipt, children ages 5–11 years, United States, National Immunization Survey-Child COVID-19 Module (NIS-CCM), Survey Interviews November 2021–May 2022 * Statistically significant difference compared to the previous time point by *t*-test for proportions. Estimates that did not meet NCHS reliability criteria for proportions are not shown as data labels, although the bars are plotted. [a] Vaccinations for children ages 5–11 years began in November, some parents reported a month prior to November and could have been in a clinical trial so those were not deleted; however, the parents could also have not remembered the month correctly.

time in the place of vaccination was for the school setting; the percentage receiving vaccination at schools decreased from December 2021 (8.2 %) to January 2022 (4.8 %).

There was variability in the place of COVID-19 vaccination by age, race/ethnicity, health insurance, MSA, HHS region, and other variables (Table 1). By age groups, a higher percentage of children ages 12–17 years were vaccinated at a pharmacy (47.9 %) or mass vaccination site (8.3 %) than were children ages 5–11 years (37.1 % and 4.7 %, respectively, Table 1). A lower percentage of children ages 12–17 years were vaccinated at a medical place (35.1 %) or school (4.8 %) than were children ages 5–11 years (46.9 % and 8.1 %, respectively). A higher percentage of Hispanic children (40.0 %), non-Hispanic Black children (40.8 %), and non-Hispanic other/multiple races children (40.6 %) were vaccinated at a medical place compared to non-Hispanic White children (36.6 %). A smaller percentage of Black children (5.0 %) were vaccinated at mass vaccination sites than White children (7.7 %) and a smaller percentage of Hispanic children (42.2 %) were vaccinated at pharmacies compared to White children (46.8 %). A higher percentage of children whose mothers have higher education levels were vaccinated at mass vaccination sites and pharmacies as compared to children of mothers with lower education levels. Children of mothers with lower education levels were more often vaccinated at a medical place (Table 1). By MSA status, the proportion of children vaccinated in a medical place was higher in rural areas (48.5 %) compared to urban areas (38.0 %), while there was a smaller proportion vaccinated at mass vaccination sites (5.2 %) in rural areas compared to children in urban areas (8.3 %). The other associations of place of vaccination with sociodemographic variables are shown in Table 1.

4. Discussion

This study found that, between the start of availability of COVID-19 vaccine for children through May 28, 2022, the most common places of COVID-19 vaccination for children ages 5–17 years were pharmacies. Slightly less than one-half of vaccinated children ages 12–17 years and more than one-third of vaccinated children ages 5–11 years received their vaccinations at pharmacies. A previous study examining vaccinations for children ages 5–11 years through January 2022 found that nearly half (46.4 %) were vaccinated at pharmacies.[14] Prior to the COVID-19 pandemic, during the 2010–11 and the 2018–19 influenza seasons, pharmacies were not common places of influenza vaccination among children ages 6 months–17 years, with between 2.6 % and 6.6 % of vaccinated children receiving their influenza vaccine at a pharmacy.[2,15] The percentages were slightly higher for older children; for example, in the 2018–19 influenza season, 12.4 % of children ages 13–17 years and 6.5 % of children ages 5–12 years were vaccinated at pharmacies.[15].

As part of the U.S. federal government strategy to ensure access to COVID-19 vaccine, the Federal Retail Pharmacy Program (FRPP) for COVID-19 Vaccination was implemented, in which participating retail pharmacies nationwide receive COVID-19 vaccine supply directly from the federal government, and then provide vaccinations to eligible individuals at no cost.[16] Another significant factor contributing to the increase in availability of pharmacy vaccination for children was The Public Readiness and Emergency Preparedness (PREP) Act.[17] The PREP Act "authorizes the Secretary of Health and Human Services to issue a Declaration to provide liability immunity to certain individuals and entities (Covered Persons) against any claim of loss caused by, arising out of relating to, or resulting from the manufacture, distribution, administration, or use of medical countermeasures, except for claims involving 'willful misconduct' as defined in the PREP Act".

Table 1
Reported place of COVID-19 vaccination by select socio-demographic characteristics, children ages 5–17 years, United States, National Immunization Survey-Child COVID-19 Module (NIS-CCM), Survey Interviews July 2021–May 2022.[a]

		Medical Place		Mass Vaccination Site		Pharmacy		School		Other Non-Medical Place	
	n[b]	%	95 % CI	%	95 % CI	%	95 % CI	%	95 % CI	%	95 % CI
Overall	39,286	38.3	(37.4–39.2)	7.3	(6.8–7.8)	45.0	(44.0–45.9)	5.7	(5.3–6.1)	3.7	(3.4–4.1)
Age Groups											
5–11 years (Referent)	19,531	46.9	(45.5–48.4)	4.7	(4.2–5.3)	37.1	(35.7–38.5)	8.1	(7.3–8.9)	3.2	(2.6–3.7)
12–17 years	19,755	*35.1	(33.9–36.2)	*8.3	(7.6–8.9)	*47.9	(46.7–49.1)	*4.8	(4.4–5.3)	*4.0	(3.5–4.5)
5–6 years (Referent)	4,569	51.5	(48.4–54.5)	5.2	(4.1–6.6)	32.1	(29.4–35.0)	7.4	(6.1–8.9)	3.8	(2.5–5.6)
7–8 years	5,260	*47.3	(44.5–50.1)	5.0	(3.8–6.3)	*36.2	(33.5–38.9)	8.6	(7.1–10.4)	2.9	(2.0–4.1)
9–11 years	9,702	*45.1	(43.1–47.1)	4.4	(3.7–5.1)	*39.5	(37.5–41.4)	8.1	(7.0–9.3)	3.0	(2.4–3.8)
12–15 years	14,086	*34.9	(33.5–36.3)	*6.9	(6.2–7.7)	*49.5	(48.0–51.0)	*5.1	(4.5–5.8)	3.6	(3.1–4.2)
16–17 years	5,669	*35.4	(33.4–37.4)	*10.5	(9.3–11.8)	*45.2	(43.1–47.3)	*4.3	(3.7–5.1)	4.6	(3.7–5.6)
Child's Race/Ethnicity[c]											
Hispanic	8,055	*40.0	(37.8–42.1)	7.6	(6.5–8.8)	*42.2	(40.0–44.4)	5.7	(4.8–6.7)	*4.6	(3.8–5.6)
Black, non-Hispanic	3,652	*40.8	(38.1–43.6)	*5.0	(3.8–6.3)	44.4	(41.6–47.2)	5.6	(4.5–6.9)	4.2	(3.1–5.5)
White, non-Hispanic (Referent)	21,493	36.6	(35.4–37.8)	7.7	(7.0–8.4)	46.8	(45.6–48.1)	5.8	(5.2–6.3)	3.1	(2.7–3.7)
Asian, non-Hispanic	2,626	37.6	(33.6–41.7)	7.7	(5.9–9.8)	45.6	(41.5–49.8)	5.3	(3.9–7.1)	3.8	(2.5–5.6)
Multiple races/other, non-Hispanic	3,460	*40.6	(37.0–44.3)	7.1	(5.4–9.1)	*42.5	(38.8–46.3)	5.8	(4.3–7.7)	3.9	(2.8–5.3)
Household Income/Poverty Level											
>Poverty, >$75,000/year (Referent)	20,176	37.2	(35.9–38.5)	7.8	(7.1–8.5)	45.9	(44.5–47.3)	5.4	(4.9–6.0)	3.7	(3.2–4.3)
>Poverty, ≤$75,000/year	7,447	*39.8	(37.6–41.9)	*6.0	(5.0–7.1)	44.9	(42.7–47.1)	5.4	(4.6–6.3)	4.0	(3.2–5.0)
At or below poverty level	3,319	39.9	(36.8–43.0)	6.8	(5.2–8.7)	42.9	(39.8–46.2)	6.4	(4.9–8.2)	4.0	(2.9–5.4)
Income not reported	8,344	38.4	(36.3–40.4)	7.9	(6.7–9.1)	44.0	(41.9–46.2)	6.3	(5.4–7.4)	3.4	(2.8–4.2)
Mother's Education Level											
< High school (Referent)	1,583	42.4	(38.4–46.5)	5.7	(3.9–8.0)	37.6	(33.6–41.7)	8.2	(6.1–10.8)	6.0	(4.4–8.0)
High school or equivalent	4,881	42.0	(39.5–44.6)	6.2	(5.1–7.5)	*42.9	(40.4–45.5)	*5.0	(4.1–6.1)	*3.8	(2.9–5.0)
Some college	8,186	*37.4	(35.6–39.3)	6.5	(5.6–7.5)	*47.2	(45.2–49.2)	*5.4	(4.6–6.3)	*3.5	(2.8–4.2)
≥ College degree	24,636	*36.9	(35.7–38.1)	*8.3	(7.6–9.0)	*45.7	(44.4–47.0)	*5.6	(5.1–6.1)	*3.5	(3.0–4.0)
Number of Children Under 18 in house											
1 child (Referent)	15,766	35.2	(33.7–36.8)	8.4	(7.5–9.3)	46.9	(45.3–48.6)	5.1	(4.5–5.8)	4.4	(3.7–5.1)
2 children	21,668	*39.9	(38.6–41.1)	*6.8	(6.2–7.4)	*44.0	(42.8–45.3)	5.8	(5.3–6.4)	*3.5	(3.0–4.0)
3 + children	1,851	*41.2	(37.5–44.9)	*5.8	(4.1–8.0)	*42.4	(38.6–46.2)	*7.6	(5.8–9.8)	*3.0	(1.9–4.4)
Health Insurance[d]											
Medicaid	7,538	*40.1	(38.0–42.1)	*6.2	(5.2–7.3)	43.4	(41.3–45.4)	6.2	(5.3–7.3)	4.2	(3.4–5.1)
Private, IHS, Military, CHIP (Referent)	28,886	37.7	(36.6–38.8)	7.9	(7.3–8.6)	45.4	(44.2–46.5)	5.6	(5.1–6.0)	3.5	(3.0–4.0)
Uninsured	997	35.1	(29.7–40.8)	*3.3	(1.6–5.8)	50.8	(44.7–56.8)	7.0	(4.4–10.5)	3.9	(2.2–6.3)
Urban-Rural Residence											
Urban (MSA, central city) (Referent)	13,041	38.0	(36.4–39.6)	8.3	(7.4–9.2)	42.9	(41.2–44.5)	6.1	(5.4–6.9)	4.7	(4.0–5.5)
Suburban (MSA, non-central city)	18,539	36.5	(35.2–37.7)	*6.9	(6.2–7.6)	*47.8	(46.5–49.1)	5.6	(5.1–6.2)	*3.2	(2.8–3.7)
Rural (non-MSA)	4,759	*48.5	(45.5–51.5)	*5.2	(3.9–6.7)	*38.4	(35.5–41.4)	5.2	(4.1–6.6)	*2.7	(1.8–3.9)
SVI of County of Residence											
Low SVI (Referent)	14,217	39.6	(38.1–41.0)	7.4	(6.6–8.2)	43.8	(42.4–45.3)	6.0	(5.4–6.7)	3.1	(2.7–3.7)
Moderate SVI	12,756	37.9	(36.3–39.5)	7.5	(6.7–8.4)	45.3	(43.6–47.0)	5.4	(4.8–6.1)	3.8	(3.2–4.6)
High SVI	8,700	*37.1	(35.2–39.0)	6.7	(5.7–7.7)	*46.3	(44.4–48.3)	5.9	(5.0–6.8)	*4.1	(3.4–4.9)
HHS Region											
Region I: CT,ME,MA,NH,RI,VT (Referent)	4,986	34.7	(32.4–37.1)	11.1	(9.4–13.0)	39.0	(36.5–41.6)	11.8	(10.3–13.4)	3.4	(2.6–4.4)
Region II: NJ,NY,PR,VI	4,673	*39.6	(36.9–42.3)	11.4	(9.7–13.3)	39.6	(36.9–42.3)	*3.8	(2.9–4.9)	*5.6	(4.3–7.1)
Region III: DE,DC,MD,PA,VA,WV	6,382	36.5	(34.4–38.6)	*8.3	(7.2–9.5)	*43.2	(41.1–45.4)	*8.6	(7.5–9.8)	3.4	(2.7–4.2)
Region IV: AL,FL,GA,KY,MS,NC,SC,TN	4,255	31.8	(29.4–34.2)	*6.0	(4.8–7.4)	*56.4	(53.9–58.9)	*2.9	(2.2–3.8)	2.9	(2.1–3.9)
Region V: IL,IN,MI,MN,OH,WI	4,396	*41.7	(39.4–44.0)	*6.1	(5.0–7.4)	41.8	(39.5–44.1)	*7.2	(6.1–8.4)	3.2	(2.5–4.2)
Region VI: AR,LA,NM,OK,TX	4,172	35.0	(32.8–37.4)	*5.6	(4.4–7.0)	*49.8	(47.3–52.2)	*6.0	(4.8–7.3)	3.6	(2.7–4.7)
Region VII: IA,KS,MO,NE	1,959	*39.9	(36.4–43.5)	*3.5	(2.3–5.1)	*50.4	(46.7–54.0)	*4.1	(3.0–5.5)	2.1	(1.3–3.3)
Region VIII: CO,MT,ND,SD,UT,WY	2,896	*52.2	(49.1–55.3)	*6.9	(5.4–8.5)	*32.1	(29.3–35.1)	*3.7	(2.7–4.9)	5.1	(3.6–7.2)
Region IX: AZ,CA,HI,NV,GU	3,308	*38.9	(35.7–42.2)	*6.5	(5.0–8.2)	*45.9	(42.5–49.3)	*4.9	(3.7–6.5)	3.8	(2.6–5.3)
Region X: AK,ID,OR,WA	2,259	*49.8	(46.4–53.3)	10.5	(8.3–13.0)	*27.5	(24.5–30.5)	*6.9	(5.3–8.9)	*5.3	(3.8–7.1)

CI = Confidence Interval; SVI = Social Vulnerability Index.
* Statistically significant at P < 0.05 compared to the referent group.
[a] Vaccination receipt data for children ages 5–11 began in November 2021.
[b] Sample sizes, n, are unweighted but percentages are weighted as described in the methods. NCHS criteria for the reliability of proportions implemented.
[c] Race of child was reported by parent/guardian respondent. Children of Hispanic ethnicity might be of any race. Children identified as multiple races had more than one race category selected. Other race included American Indian/Alaska Native and Native Hawaiian/other Pacific Islander.
[d] Non-Medicaid insurance includes Private, Child Health Insurance Program (CHIP), Indian Health Service (IHS), Military, or any other insurance and could not be ungrouped due to the nature of the survey questions.

[17] The PREP act Declarations and Amendments includes pharmacists who order and administer vaccines that the Advisory Committee on Immunization Practices (ACIP) recommends to persons ages 3–18 years according to ACIP's standard immunization schedule or FDA authorized or FDA licensed COVID–19 vaccines to persons ages three years or older.[17] This authorization preempts state requirements that would otherwise prohibit, or effectively prohibit, these providers from administering the vaccine.

Prior to the PREP Act Declarations, authority for pharmacy providers to administer vaccines to children varied widely by state. According to a pre-pandemic, January 2019 pharmacy association survey, pharmacists were able to administer influenza vaccine to patients of any age (adults and children) in 27 states/territories,

to children with varying minimal patient age limits in another 20 states/territories, and only to adults ages > 18 years in 6 states/territories.[18] Thus, the PREP act declaration in 2020 greatly increased access to COVID-19 vaccination for children by allowing vaccination at pharmacies, and the positive consequence of this is seen by the results of our study of the large proportion of children receiving their COVID-19 vaccination at pharmacies. The PREP act Declaration includes all ACIP recommended vaccines. Therefore, the Act may also have a positive effect of increasing influenza and other routinely recommended vaccination for children by expanding convenient access to vaccination; however, the PREP Act is set to expire October 1, 2024.

Our study found that the second most common type of place for COVID-19 vaccination of children overall ages 5–17 years was medical places. Slightly less than half of vaccinated children ages 5–11 years and a little more than one-third of vaccinated children ages 12–17 years received their vaccinations at medical-related places. For children ages 5–11 years, medical places were more common that pharmacies. By specific type of medical place, children ages 5–11 had a higher percentage receiving COVID-19 vaccine at a doctor's office (23.5 %) compared to children 12–17 years (10.5 %). These percentages are much lower than what was seen pre-COVID-19 pandemic for influenza vaccination of children as well as for other routinely recommended childhood vaccines.[2,15] For the 2018–19 influenza season, 58.7 % of children ages 13–17 years and 65.2 % of children ages 5–12 years were vaccinated at a medical place.[15] A child's medical home has historically been promoted as the best place for children to receive their recommended vaccines.[19–21] The medical home has been encouraged because there the trusted healthcare provider can not only keep track of and administer recommended vaccinations but also perform the various health screenings that children are recommended to receive throughout their development.[22] For influenza vaccination, as the recommended child age groups expanded in the years 2004 through 2008, there was concern about capacity of the medical home to administer influenza vaccine to all children in the short window of the influenza season.[23,24] Thus, alternate influenza vaccination settings such as pharmacies were utilized, but mostly for older children while the youngest children continued to receive their influenza vaccine predominantly at medical places.[2] With the expansion of the COVID-19 vaccination recommendations to include children ages 6 months–4 years, an age at which children are otherwise visiting pediatrician offices for routine vaccinations, doctor's offices will likely play a large role in vaccinating these younger children.[6] It is important that doctor's offices and other medical places continue to stock COVID-19 vaccine, especially for young children. Following vaccine recommendations, COVID-19 could be co-administered with other recommended vaccines during a medical visit to increase protection for children against these diseases.[25].

In the effort to quickly vaccinate people, many jurisdictions, health departments, and other entities implemented mass-vaccination sites.[26] Our study found that 8.3 % of children ages 12–17 years were vaccinated at a mass-vaccination site, with the highest proportion being in April 2021 and then declining. Mass-vaccination sites were not a common place of vaccination for younger children, possibly because most mass-vaccination sites had ceased to operate by November 2021 when the vaccine was recommended for children ages 5–11 years or these sites did not offer vaccine to children, and/or parental preference for other vaccination settings. Regardless, these mass-vaccination sites played an important role in conveniently making vaccine available for adults and children and were an essential component in getting vaccine to as many people as quickly as possible.[26].

School located vaccination (SLV) also played a role in getting COVID-19 vaccine to children, primarily for younger children, with 8.1 % of vaccinated children ages 5–11 years vaccinated in school. Decisions to offer COVID-19 SLV are made at the local level because the feasibility and appropriateness vary.[27] The timing of the COVID-19 recommendations for children ages 12–17 years, coming towards the end of the school year, likely limited the ability to offer SLV. During the 2009 H1N1 influenza pandemic, SLV played a large role in vaccinating school-aged children.[28] During that pandemic, one-third of 2009 H1N1 vaccinated school-aged children ages 5–17 years were vaccinated at school.[28].

For children ages 5–11 years, there was no change over the months of the vaccination program in the distribution of place of vaccination. For children ages 12–17 years, there were changes over time in the place distribution of vaccinations. The percentage of children in this age group vaccinated at pharmacies continued to increase through September 2021 and then dropped in October 2021. This drop coincided with an increase in vaccination at a medical place, possibly because COVID-19 vaccine recommendations were expanded to include children ages 5–11 years and medical providers were encouraged to stock COVID-19 vaccine to vaccinate the younger children. The decreases in place reported as mass-vaccination sites and schools were to be expected due to site closures over time and children being out of school for the summer. These decreases also correspond to the increased percentage reporting medical-related place, although confidence intervals around these estimates are wide.

Several other of the sociodemographic differences in the places where children received their COVID-19 vaccine warrant discussion. Analysis by HHS region revealed large differences in the percentages of children vaccinated at a medical place (31.8 %–52.2 %), pharmacy (27.5 %–56.4 %), and school (2.9 %–11.8 %). These differences are likely related to state-level differences in pediatric COVID-19 vaccine program approach and other factors, such as the local availability of FRPP pharmacies. We could not obtain reliable state-level estimates due to small sample size in the NIS-CCM. We also found that children with mothers with higher education levels were vaccinated at mass-vaccination sites to a greater extent; high vaccination intent has been found to be associated with higher education level, therefore, these parents possibly took their child to get vaccinated soon after recommendations were made while the mass vaccination sites were still operating more widely. Children in rural areas were more likely vaccinated in medical places and less likely to be vaccinated in pharmacies than were children in urban areas. Reduced access to pharmacies in rural areas could be a factor.[29] Additionally, fewer rural pharmacists received COVID-19 vaccination training according to one study.[30] Differences in place of receipt of vaccination by sociodemographic factors underscore the need to make vaccine available at a variety of locations to ensure equitable access to vaccination.

This study is subject to at least six limitations. First, the month and year of vaccination was asked for the first dose of vaccine while place was asked regarding their most recent vaccine; we assumed that the child went to the same type of place for their 1st and 2nd dose. Second, the response rate was low (17 %), and bias in estimates might remain after weighting. Survey weights were therefore calibrated to the COVID-19 vaccine administration data by region, age group, and sex to mitigate possible bias from incomplete sample frame and nonresponse. Third, vaccination status and place of vaccination were parent-reported and subject to recall bias and social desirability bias. Fourth, many parents did not remember the month/year of the child's vaccination and so were excluded from part of the analyses looking at trends over time. Fifth, the survey is cross-sectional, so cause and effect relationships cannot be determined. Lastly, these data provide information on the distribution of reported place of vaccination and differences in these distributions over time or across subgroups could vary because of different availability of covid vaccine provi-

ders, access to available providers, and parental choice/preference of place to take child among available covid vaccine providers.

5. Conclusions

Children ages 5–17 years predominantly received their COVID-19 vaccinations at pharmacies and medical places. The large proportion of children receiving COVID-19 vaccination at pharmacies is indicative of the success in the United States of expanding available venues where children could be vaccinated during the COVID-19 pandemic. Medical places continue to play a key role in vaccinating children, especially younger children, and should continue to stock COVID-19 vaccine for those who are not yet vaccinated, including children 6 months–4 years who were recently recommended for COVID-19 vaccination.

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Data availability

The NIS-CCM data are not available as a public use dataset but can be accessed within an NCHS Research Data Center.

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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