

Primary and Secondary Attack Rates by Vaccination Status after a SARS-CoV-2

B.1.617.2 (Delta) Variant Outbreak at a Youth Summer Camp — Texas, June 2021

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Article Summary Line

Vaccination can limit SARS-CoV-2 transmission among youth in congregate settings and can be used with mitigation measures to decrease secondary transmission.

Abstract

Children are capable of initiating COVID-19 transmission into households, but many questions remain about the impact of vaccination on transmission. Data from a COVID-19 Delta variant outbreak at an overnight camp in Texas during June 23–27, 2021 were analyzed. The camp had 451 attendees, including 364 youths aged <18 years and 87 adults. Detailed interviews were conducted with 92 (20.4%) of consenting attendees and 117 household members of interviewed attendees with COVID-19. Among 450 attendees with known case status, the attack rate was 41%, including 42% among youths; attack rates were lower among vaccinated (13%) than among unvaccinated youths (48%). The secondary attack rate was 51% among 115 household contacts of 55 interviewed index patients. Secondary infections occurred in 67% of unvaccinated household members and 33% of fully or partially vaccinated household members. Analyses suggested that household member vaccination and camp attendee masking at home protected against household transmission.

Keywords: SARS-CoV-2, COVID-19, vaccination, youth, household transmission

Background

Children are capable of transmitting SARS-CoV-2, the virus that causes COVID-19, to household members^{1,2}. COVID-19 vaccines result in significant reductions in symptomatic disease in children³, but the role of vaccines in limiting forward transmission is poorly understood. In theory, COVID-19 vaccines can affect transmission by preventing initial infection, reducing viral replication and shedding, inducing milder symptoms⁴, and altering individual behaviors. Defining the role of vaccination on primary and secondary transmission is critical for public health guidance in youth congregate settings and in households with youth members. In the past, youth summer camps and subsequent household transmission studies have provided key metrics on the role of children in SARS-CoV-2 transmission^{1,5,6}, but data incorporating vaccination status on transmission are scarce.

On May 10, 2021, the BNT162b2 vaccine against SARS-CoV-2 was authorized for use in adolescents 12-15 years in the United States⁷ at a time when steady declines in COVID-19 cases were being observed. However, by June 26, 2021, the highly transmissible B.1.617.2 (Delta) variant of SARS-CoV-2 became the predominant lineage circulating in the United States⁸ leading to a rapid rise in cases, hospitalizations, and deaths among children and adolescents nationally³. Reports of COVID-19 cases after a youth summer camp at the end of June 2021 prompted the current public health investigation. The objectives of this investigation were to describe primary COVID-19 attack rates by vaccination status among attendees at a youth summer camp where mitigation measures were unenforced and to quantify secondary household attack rates for camp attendees who returned home from camp with COVID-19.

Methods:

Setting

During June 23–27, 2021, youths and their adult supervisors and staff members from one Texas church attended an overnight camp for youths aged 10–17 years. Camp attendees traveled to and from the camp in buses and resided in approximately 15 cabins. The cabin configurations varied, including some with multiple rooms and entrances. The camp was largely staffed by adults from the church, including nurses who assisted with acute illness/injury and administration of chronic medications to children; routine temperature or health screenings were not conducted. Employees of the campsite were not included in this analysis. Camp attendees had opportunities to congregate with persons outside their cabins during indoor meals, daily indoor camp-wide assembly/worship services, and sports and games (indoors and outdoors). Mitigation measures (e.g. masking and physical distancing) and prearrival COVID-19 testing were not enforced. COVID-19 testing on site was not available and isolation of symptomatic individuals was not reported. One day after the camp ended (June 28), positive COVID-19 test results among attendees were reported to church leadership by multiple persons or families who independently sought testing; all camp attendees were informed about possible exposure and were encouraged but not required to be tested. Any positive test results reported to church leadership were recorded but reporting was not required.

Data collection

Church leadership provided an anonymized line list of all camp attendees which included basic demographic information, COVID-19 vaccination status, and the date of passive reporting of post-camp COVID-19 to the church. Officials from the county health district then worked with church leadership to verify vaccination history and positive

COVID-19 test records (when available) recorded in the National Electronic Disease Surveillance System for Texas through July 25, 2021.

Church leadership contacted all attendees to notify them of the epidemiologic investigation and to identify those willing to be interviewed. A total of 92 attendees agreed to be contacted by CDC. Persons within this subset were interviewed about possible exposure before, during, and after camp; vaccination history; COVID-19 testing (type, date, result); and signs and symptoms. To quantify the risk of onward transmission, household members of interviewed camp attendees with laboratory-confirmed or probable COVID-19 cases were also interviewed. A household member was defined as any person who spent at least one night in the same house as the index case camp attendee within 2 weeks of camp ending (June 27, 2021 through July 11, 2021).

Case definitions

Among interviewed camp attendees, a confirmed COVID-19 case was defined as receipt of a positive SARS-CoV-2 test result between the day of arrival at camp and 2 weeks⁹ after camp ended (June 27-July 11, 2021). A positive SARS-CoV-2 test included any reported positive viral tests, including antigen tests and polymerase chain reaction (PCR) tests, reported during an interview or identified in the state surveillance system. A probable case in a camp attendee was defined as the presence of symptoms consistent with COVID-19 during the same period but without testing confirmation. Possible symptoms included any COVID-19 symptoms outlined by the Council of State and Territorial Epidemiologists¹⁰ unless the symptoms were specifically mentioned as being typical at baseline for the person (e.g., symptoms due to allergies).

Confirmed household cases were defined as receipt of a positive SARS-CoV-2 test result in a household member of a camp attendee index patient within 4 weeks of camp ending (through July 25, 2021). This four-week period was selected to account for the

potential latent period for the index case camp attendee and subsequent latent period for household members. A probable household contact case was defined as COVID-19-compatible symptoms within 4 weeks of the conclusion of camp in a household member with documented close contact (<6 ft for a cumulative total of 15 minutes or more) with the index patient within 2 weeks of camp ending, but without laboratory confirmation. Persons with a negative COVID-19 viral test and unknown symptom status were considered not to meet the case definition.

Among 359 non-interviewed camp attendees, all who passively reported having COVID-19 or who had a positive test within the Electronic Disease Surveillance System for Texas in the 2 weeks after camp were considered to have a camp-associated COVID-19 case.

SARS-CoV-2 B.1.617.2 (Delta) variant detection

A convenience sample of 13 diagnostic samples that tested positive by PCR at the University of Texas Medical Branch at Galveston were screened for variants by RT-PCR amplification of the spike gene and sequencing of amplicons to identify variants present. Nasopharyngeal swab samples were inactivated with Trizol (ThermoFisher, Waltham, MA) and RNA extracted according to the manufacturer's protocol. RT-PCR amplification of the spike gene involved 21521_F (TGTTATTTCTAGTGATGTTCTTG) and 23865_R (GTAAAGCACGGTTTAATTGTG) with the Platinum™ SuperFi™ RT-PCR kit (ThermoFisher), and 40 cycles with 10 sec at 98°C, 58°C for 10 sec, and 72°C for 2 min. Amplicons were visualized on agarose gels and sequenced using the Sanger method with the BigDye kit (Applied Biosystems, ThermoFisher) and an ABI3500 instrument. Sequences were compared with derived sequences with the GISAID database (<https://www.gisaid.org/>).

Statistical analysis and vaccination definition

Attack rates (ARs) were calculated for all camp attendees, the subset of attendees interviewed, and household members of interviewed case camp attendees by dividing the number of confirmed and probable cases by the total number of persons in the stratum.

A logistic regression model was fit to identify risk factors for COVID-19 among household members. The unit of observation was each household member, and the outcome was whether the household member met the case definition. All factors found to be associated with household case status in unadjusted analyses (using an $\alpha = 0.10$ threshold) were included in the model to estimate adjusted odds ratios (ORs). A random intercept was included to account for clustering within households. Analyses were conducted using R statistical software (version 4.0.3) and the *lme4* package.

For the purposes of this analysis, both fully and partially vaccinated persons were considered vaccinated. Full vaccination was defined as completion of the primary vaccination series (i.e., two doses of one of the mRNA COVID-19 vaccines [Pfizer-BioNTech or Moderna] or a single dose of the Janssen [Johnson & Johnson] COVID-19 vaccine) two or more weeks before the first day of camp (for camp attendees) or the day camp ended (for household members). Partial vaccination was defined as receipt of only one dose of the mRNA COVID-19 vaccines or completion of the primary vaccination series less than two weeks before the first day of camp (for camp attendees) or the day camp ended (for household members). Persons who had received no vaccine were considered unvaccinated.

This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy (45 C.F.R. part 46.102(l)(2), 21 C.F.R. part 56; 42 U.S.C. Sect. 241(d); 5 U.S.C. Sect. 552a; 44 U.S.C. Sect. 3501 et seq)

Results

All camp attendees

A total of 451 persons attended the camp, including 364 (81%) youths and 87 (19%) adults; 257 attendees (57%) were female. One quarter of camp attendees were fully (19%, 84/451) or partially (6%, 26/451) vaccinated, including 61 (17%) youths and 49 (56%) adults. Among youths, 20% (71/361) were age-ineligible for vaccination; age eligibility was unable to be determined for three youths. Overall, 186 COVID-19 cases were identified among all camp attendees (Figure 1). Among the 450 attendees with known case status (case status was unknown for one camp attendee), the overall AR was 41%, with lower ARs among vaccinated attendees (20%, 22/110) than among unvaccinated attendees (48%, 164/340, $p < 0.01$) (Figure 2). Among vaccinated youths and adults, ARs were 13% (8/61) and 29% (14/49, $p = 0.02$), respectively. The SARS-CoV-2 B.1.617.2 (Delta) variant was identified in all 13 specimens available from camp attendees for sequencing.

Interviewed camp attendees

Interviews with 92 (20%) of consenting camp attendees were conducted during September 6–30, 2021. In comparison to the entire group of camp attendees, COVID-19 vaccination coverage was higher among those interviewed (34%, 31/92 vs. 24%, 110/450, $p = 0.03$) and a higher percentage of those who were interviewed met the confirmed or probable COVID-19 case definition (65%, 60/92 vs. 41%, 186/450, $p < 0.01$).

Interviewed attendees were predominantly non-Hispanic White (90%, 83/92) (Table 1). Youth camp attendees ranged in age from 10–17 years (mean = 13 years). Most camp attendees (89%, 82/92) reported that they never wore a mask at camp. Nearly all (96%, 88/92) engaged in indoor activities, such as worship and sports, with persons outside their

cabin. A total of 67 camp attendees (73%) reported being tested for SARS-CoV-2 following camp, 21 of whom reported negative test results. Symptoms were reported by 63 (68%, 63/92) interviewed camp attendees; the median symptom duration was 7 days among youths and 9 days among adults. Among vaccine-eligible youths, primary attack rates were lower in vaccinated persons (25%, 4/16) than in unvaccinated persons (81%, 34/42) ($p < 0.01$). (Figure 2).

Transmission among household members

Household contact data were available for 117 household members of 55 interviewed camp attendee index patients from 38 households. Household member data were not available for two households. A total of 80 (68%) household members reported being tested for SARS-CoV-2 following camp. Fifty-nine secondary cases, including 47 confirmed and 12 probable cases, occurred in 23 (61%) households. Three (2.5%) household members with COVID-19 were hospitalized.

The overall secondary AR among 115 household members with known case status was 51%. Of the 109 household members with known vaccination status, 42 of 63 (67%) unvaccinated household contacts and 15 of 46 (33%) fully or partially vaccinated household contacts (Figure 2) were cases. In households in which the index patient was a youth, the secondary AR was 52% (54/103).

The secondary AR was higher among household members exposed to unvaccinated index patients (58%, 59/102) than among those exposed to vaccinated index patients (17%, 3/18, $p < 0.01$). Importantly, these categories are not mutually exclusive. Three households (including 5 household members in total) had two or more index cases with discordant vaccination status; household members from these households are included in the denominator of both categories. Approximately one third of household members exposed to

unvaccinated index patients were vaccinated (36%, 35/98), whereas three quarters (75%, 12/16) of those exposed to vaccinated index patients were vaccinated. All COVID-19 cases among household members exposed to vaccinated index cases resided in households that had both a vaccinated and unvaccinated index case. There was no known transmission from infected camp attendees to household members in the six households where all index patients were fully vaccinated.

The logistic regression model included sex, age and vaccination status of the household member, whether or not the camp attendee reported cough as a symptom, and whether or not the camp attendee wore a mask in the household (Table 2). In adjusted analyses, household member risk was increased for unvaccinated household members (OR = 3.5, 95% CI = 0.9–13.0), when camp attendees reported having a cough (OR = 2.3, 95% CI = 0.6–9.3), and when camp attendees reported never wearing a mask in the home (OR = 1.9, 95% CI = 0.5–6.7).

Discussion

This investigation provided a unique opportunity to examine SARS-CoV-2 transmission coinciding with relaxation of COVID-19 mitigations measures, vaccine eligibility for adolescents ⁷, and the beginning of the U.S. SARS-CoV-2 Delta variant surge. The ARs estimated from this outbreak illustrate the efficiency with which the SARS-CoV-2 Delta variant can spread in youth congregate settings, the role of youth in secondary transmission, and the strong association between vaccination and COVID-19 among individuals and their household members. These data suggest that SARS-CoV-2 vaccination for youth aged 12–17 years can decrease the spread of COVID-19 in congregate settings and minimize further secondary household transmission.

The transmission among camp attendees and secondary transmission to household contacts from camp attendees adds to existing evidence for the role of youths in ongoing household and community transmission^{5,11,12}. These data also provide evidence supporting that, in the absence of COVID-19 mitigation measures, SARS-CoV-2 Delta variant transmission in youth congregate settings is high and leads to efficient secondary transmission among household contacts. The overall AR of 41% among camp attendees and 51% among household members was comparable to that observed in other outbreaks among youth^{5,11,13}, emphasizing the need for multicomponent mitigation measures to reduce transmission in youth congregate settings¹⁴.

We found the AR was lower among vaccinated household members exposed to vaccinated index cases compared to unvaccinated index cases. These findings align with some prior studies reporting reduced household transmission when index cases had received at least one COVID-19 vaccine dose.^{15,16} Importantly, small sample size (due to the small proportion of camp attendees who participated in interviews) and discordant vaccination status of index cases in some households limited our ability to cleanly stratify the data. We were therefore unable to attribute the observed difference in AR solely to the vaccination status of the index cases. It is likely that transmission depends on a variety of individual⁴, household and viral variant-related¹⁷ factors, including behavioral differences, adherence to public health guidelines, and SARS-CoV-2 strain.

Nonetheless, COVID-19 vaccination is an important tool to protect against not only severe disease, but also against transmission¹⁶. The combination of ARs across two transmission generations within households observed in this investigation illustrates the importance of collective vaccination to limit ongoing transmission. Within a household, each vaccinated member not only reduces their individual risk of symptomatic infection, but also importantly, reduces the overall risk for COVID-19 introduction and transmission within the

household¹⁸. Among age-eligible youth in congregate settings, vaccination is an important prevention and mitigation tool for COVID-19. Transmission within the household can be further reduced with additional mitigation measures, such as masking among index patients.

Our findings are subject to several limitations. First, the overall AR is likely underestimated as not all camp attendees were tested for SARS-CoV-2, and the State Electronic Surveillance System data might be incomplete. Cases with symptoms starting after the median incubation period may have been secondary cases or due to non-camp related exposures, but this includes a limited number of cases and is unlikely to change the overall conclusions. It is also possible that symptoms observed among probable cases could have been due to infections other than SARS-CoV-2. Second, it was not possible to systematically identify asymptomatic infections as testing for all camp attendees was not systematically done. Third, the voluntary nature of interviews is subject to selection bias and could result in an over- or underestimation of ARs. Individuals who became ill, households with higher ARs or those more receptive to public health recommendations might have been more likely to participate. Fourth, the quality of interview data may have been reduced since they were collected approximately 3 months after the outbreak. Fifth, combining fully and partially vaccinated persons into one group for analysis limited our ability to detect the benefit of complete vaccination. Relatedly, this analysis did not account for underlying health conditions which could impact protection by COVID-19 vaccines and risk for disease. The relatively small proportion of youth who were vaccinated (potentially due to the short duration of time between approval of SARS-CoV-2 vaccines for adolescents and the start of camp) and small number of infections among vaccinated youths limited more extensive analyses and resulted in wide confidence intervals for ARs throughout. Finally, this analysis was conducted prior to emergence of the Omicron variant of SARS-CoV-2 and may not be applicable to variants other than Delta.

This outbreak investigation demonstrates that SARS-CoV-2 outbreaks among youth in congregate settings contribute to community transmission. Vaccination, including among youth 12-17 years of age, can limit the spread of SARS-CoV-2 and can be used in combination with other mitigation measures including masking to decrease the likelihood of primary and secondary transmission. Further research describing SARS-CoV-2 spread across multiple transmission generations and by vaccination status are needed to continue building an evidence base for guiding appropriate public health measures as the COVID-19 pandemic continues to evolve.

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Conflicts of Interest

No reported conflicts of interest.

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Disclaimer

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

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Table 1. Detailed demographics, vaccination and case status of interviewed camp attendees (N = 92) and household members of interviewed index case camp attendees (N = 117) at an overnight youth camp — Texas, June 2021

Characteristic	No. (%)			
	Youth camp attendees (n = 73)	Adult camp attendees (n = 19)	Household members (n = 117)	Total (n = 209)
Demographics and household characteristics				
Sex				
Male	35 (47.9)	7 (36.8)	54 (46.2)	96 (45.9)
Female	38 (52.1)	12 (63.2)	61 (52.1)	111 (53.1)
Unknown	0 (0.0)	0 (0.0)	2 (1.7)	2 (1.0)
Age group, yrs*				
<12	15 (20.5)	0 (0.0)	30 (25.6)	45 (21.5)
12–17	58 (79.5)	0 (0.0)	10 (8.5)	68 (32.5)
≥18	0 (0.0)	19 (100.0)	76 (65.0)	95 (45.5)
Unknown	0 (0.0)	0 (0.0)	1 (0.9)	1 (0.5)
Race/ethnicity				
Non-Hispanic White	66 (90.4)	17 (89.5)	88 (75.2)	171 (81.8)
Other/unknown	7 (9.6)	2 (10.5)	29 (24.9)	38 (18.2)
COVID-19 vaccination, testing, symptoms and hospitalization				
Vaccination status[†]				
Vaccinated	16 (21.9)	15 (78.9)	46 (39.3)	77 (36.8)
Fully [‡]	7 (9.6)	15 (78.9)	42 (35.9)	64 (30.6)
Partially	9 (12.3)	0 (0.0)	4 (3.4)	13 (6.2)
Unvaccinated	57 (78.1)	4 (21.1)	64 (54.7)	125 (59.8)
Unknown	0 (0.0)	0 (0.0)	7 (6.0)	7 (3.3)
Tested after camp				
Yes	54 (74.0)	13 (68.4)	80 (68.4)	147 (70.3)
No	19 (26.0)	6 (31.6)	36 (30.8)	61 (29.2)
Unknown	0 (0.0)	0 (0.0)	1 (0.9)	1 (0.5)
Positive test after camp				
Yes	36 (49.3)	10 (52.6)	47 (40.2)	93 (44.5)
No	37 (50.7)	9 (47.4)	69 (59.0)	115 (55.0)
Unknown	0 (0.0)	0 (0.0)	1 (0.9)	1 (0.5)
Symptomatic during or after camp				
Yes	51 (69.9)	12 (63.2)	55 (47.0)	118 (56.5)
No	22 (30.1)	7 (36.8)	52 (44.4)	81 (38.8)
Unknown	0 (0.0)	0 (0.0)	10 (8.5)	10 (4.8)
Duration of symptoms among cases (days)				
Median (IQR)	7.0 (3.0–10.0)	9.0 (7.5–27.5)	5.0 (2.0–10.0)	6.0 (3.0–10.0)
Was person hospitalized				
Yes	0 (0.0)	0 (0.0)	3 (2.5)	3 (1.4)
No	72 (98.6)	19 (100.0)	101 (86.3)	192 (91.0)
Unknown	1 (1.4)	0 (0.0)	16 (13.7)	17 (8.1)
Case status[¶]				

Confirmed	36 (49.3)	10 (52.6)	47 (40.2)	93 (44.5)
Probable	13 (17.8)	1 (5.3)	12 (10.3)	26 (12.4)
Not a case	24 (32.9)	8 (42.1)	56 (47.9)	88 (42.1)
Unknown	0 (0.0)	0 (0.0)	2 (1.7)	2 (1.0)

* Age at the start of camp (camp attendees) or end of camp (household members)

† Fully vaccinated is defined as ≥ 2 weeks after completion of the primary vaccination series (i.e., 2 doses of one of the mRNA COVID-19 vaccines [Pfizer-BioNTech or Moderna] or single dose of the Janssen [Johnson & Johnson] COVID-19 vaccine). Partially vaccinated is defined as having only one dose of the mRNA COVID-19 vaccines or being < 2 weeks after completing the primary vaccination series.‡ Among fully vaccinated camp attendees and household members, 6 received the Johnson & Johnson vaccine.

¶ Confirmed camp attendee cases were defined as persons with a positive SARS-CoV-2 test from the day of arrival at camp to 2 weeks after camp ended. A probable case in a camp attendee was defined as symptoms consistent with COVID-19 during the same period but a negative or unknown test result. Confirmed household cases were defined as a positive SARS-CoV-2 test result from the date of initial exposure to the index case until 4 weeks after to capture secondary cases through the index patient's potential infectious period. A probable household case was defined as documentation of close contact exposure to the index patient and symptoms compatible with COVID-19 during the following 4 weeks.

Table 2. Adjusted odds ratio and 95% confidence intervals describing the association between camp attendee and household member characteristics and household member COVID-19 case status at an overnight youth camp — Texas, June 2021

Camp attendee or household member characteristic	Adjusted OR (95% CI)
Household member sex	
Male	1.0 (ref)
Female	2.2 (0.8-6.4)
Household member age (years*)	
<12	1.0 (ref)
12–17	0.4 (0.1-2.9)
≥18	0.5 (0.1-2.0)
Household member vaccination status	
Fully or partially vaccinated	1.0 (ref)
Unvaccinated	3.5 (0.9-13.0)
Camp attendee symptoms included cough	
No	1.0 (ref)
Yes	2.3 (0.6-9.3)
Camp attendee wore mask at home	
Yes	1.0 (ref)
No	1.9 (0.5-6.7)

* Age at the end of camp

† Fully vaccinated is defined as ≥2 weeks after completion of the primary vaccination series (i.e., 2 doses of one of the mRNA COVID-19 vaccines [Pfizer-BioNTech or Moderna] or single dose of the Janssen [Johnson & Johnson] COVID-19 vaccine). Partially vaccinated is defined as having only one dose of the mRNA COVID-19 vaccines or being <2 weeks after completing the primary vaccination series.

Figure 1. Legend.

*Date of specimen collection used in lieu of symptom onset date for asymptomatic interviewed camp attendees and household members. For camp attendees who were not interviewed, the date of specimen collection was used, if available. If no testing record was available from the state surveillance system, the date the case was reported to the church was used.

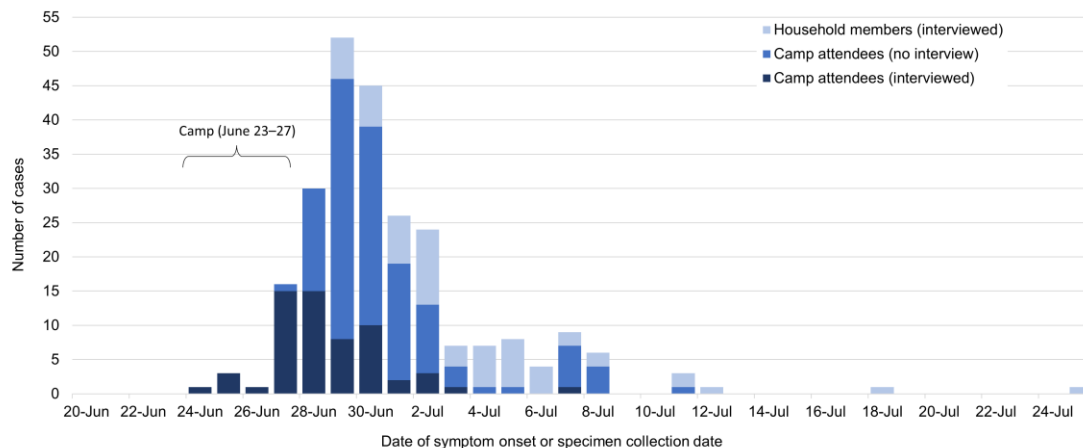
Figure 2. Legend.

† One youth with unknown case status was excluded.

* Differences in attack rates between unvaccinated and vaccinated individuals were statistically significant ($p < 0.05$) using a two-sided Fisher's exact test

‡ Subsets not mutually exclusive. Three households had ≥ 2 camp attendees with discordant vaccination status; household members ($n=5$) from these households are included in the denominator for both exposure categories. All COVID-19 cases among household members in the "exposed to vaccinated camp cases" category resided in households that had both a vaccinated and unvaccinated case camp attendee. No cases occurred among household members exposed to a single vaccinated case camp attendee.

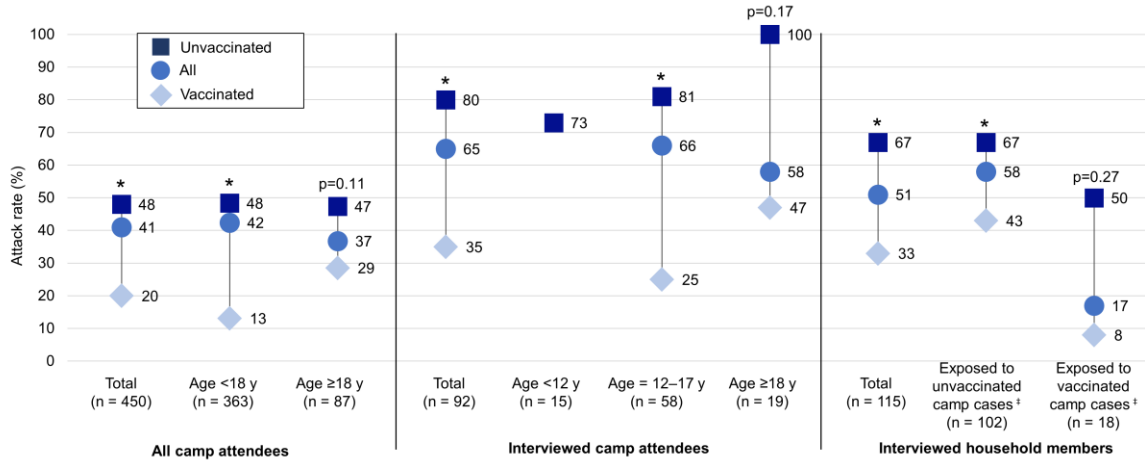
FIGURE 1. Confirmed and probable COVID-19 cases associated with an outbreak in an overnight youth camp, by date of symptom onset or specimen collection* and camp attendee versus household member status — Texas, June 2021



*Date of specimen collection used in lieu of symptom onset date for asymptomatic interviewed camp attendees and household members. For camp attendees who were not interviewed, the date of specimen collection was used, if available. If no testing record was available from the state surveillance system, the date the case was reported to the church was used.

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FIGURE 2. COVID-19 attack rates among all (N = 450) and interviewed (N = 92) camp attendees[†] at a large overnight youth camp and 115 household members of persons with confirmed or probable cases by age group, vaccination status, and exposure status of household contacts — Texas, June 2021



[†] One youth with unknown case status was excluded.

* Differences in attack rates between unvaccinated and vaccinated individuals were statistically significant ($p < 0.05$) using a two-sided Fisher's exact test

[‡] Subsets not mutually exclusive. Three households had ≥2 camp attendees with discordant vaccination status; household members (n=5) from these households are included in the denominator for both exposure categories. All COVID-19 cases among household members in the "exposed to vaccinated camp cases" category resided in households that had both a vaccinated and unvaccinated case camp attendee. There was no known transmission from infected camp attendees to household members in the six households where all index patients were fully vaccinated.

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