

CORRESPONDENCE

Household Transmission of SARS-CoV-2 from Children and Adolescents

TO THE EDITOR: Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection in children is often asymptomatic or results in only mild disease.¹ Data on the extent of transmission of SARS-CoV-2 from children and adolescents in the household setting, including transmission to older persons who are at increased risk for severe disease, are limited.² After an outbreak of coronavirus disease 2019 (Covid-19) at an overnight camp,³ we conducted a retrospective cohort study involving camp attendees and their household contacts to assess secondary transmission and factors associated with household transmission (additional details are provided in the Methods section in the Supplementary Appendix, available with the full text of this letter at NEJM.org).

We interviewed 224 index patients who were 7 to 19 years of age and for whom there was evidence of SARS-CoV-2 infection on the basis of molecular or antigen laboratory testing. A total of 198 of these campers (88%) were symptomatic; symptoms developed in 141 of these 198 children or adolescents (71%) after they returned home from camp.

Of 526 household contacts of these index patients, 377 (72%) were tested for SARS-CoV-2, and 46 (12%) of those who were tested had positive results. An additional 2 secondary cases of infection were identified according to clinical and epidemiologic criteria.⁴ A total of 38 of the 48 secondary cases (79%) occurred in households where the index patient had become symptomatic after returning home from camp; the median serial interval (i.e., the interval between the onset of symptoms in the index patient and the onset of symptoms in the household contacts infected by that patient) was 5.0 days (95% confidence interval [CI], 4.0 to 6.5). Transmission occurred in 35 of 194 households (18%); in these households, the secondary attack rate was 45% (95% CI, 36 to 54) (48 of 107 households). Among the household contacts who became infected and who were at least 18 years of age, 4 of 41 (10%) were hospitalized (length of hospital

stay, 5 to 11 days); none of the 7 persons with a secondary case of infection who were younger than 18 years were hospitalized.

Of the index patients who responded to our question regarding preventive measures, 146 of 217 (67%) reported that they had maintained physical distancing and 73 of 216 (34%) reported that they had always worn masks around contacts during the infectious period after they returned home. In a univariable logistic-regression model, among the index patients who were 18 years of age or younger, the increasing use of physical distancing and masks was associated with the older age of the patient (with age as a continuous variable, odds ratio for physical distancing, 1.4; 95% CI, 1.2 to 1.5; odds ratio for mask use, 1.4; 95% CI, 1.2 to 1.6). In a multivariable regression model, the risk of a secondary case of infection among household contacts was lower among contacts of index patients who had practiced physical distancing than among contacts of index patients who did not (adjusted odds ratio, 0.4; 95% CI, 0.1 to 0.9) (Table 1). Household members who had close or direct contact with the index patient had a higher risk of infection than those who had minimal to no contact (adjusted odds ratio with close contact, 5.2; 95% CI, 1.2 to 22.5; and adjusted odds ratio with direct contact, 5.8; 95% CI, 1.8 to 18.8). We excluded missing data from the regression models, and confidence intervals were not adjusted for multiplicity.

This retrospective study showed that the efficient transmission of SARS-CoV-2 from school-age children and adolescents to household members led to the hospitalization of adults with secondary cases of Covid-19. In households in which transmission occurred, half the household contacts were infected. The secondary attack rates in this study were probably underestimates because test results were reported by the patients themselves and testing was voluntary. In addition, a third of the index patients returned home from camp after the onset of symptoms, when they were presumably not as infectious as they were

Table 1. Unadjusted and Adjusted Odds Ratio for a Secondary Case of SARS-CoV-2 Infection among Household Contacts.*

Variable	Univariable Model	Multivariable Model
	Unadjusted Odds Ratio (95% CI)	Adjusted Odds Ratio (95% CI)
Index patients†		
Age — yr		
7–10	2.3 (0.7–7.0)	0.7 (0.2–2.9)
11–15	1.1 (0.5–2.8)	0.7 (0.3–1.6)
16–19	1.0 (reference)	1.0 (reference)
Covid-19 symptom status		
Symptomatic	5.5 (0.8–40.7)	5.5 (0.8–38.1)
Asymptomatic	1.0 (reference)	1.0 (reference)
Maintained physical distancing		
Yes	0.3 (0.1–0.6)	0.4 (0.1–0.9)
No	1.0 (reference)	1.0 (reference)
Always wore a mask around household contacts		
Yes	0.2 (0.1–0.6)	0.5 (0.2–1.3)
No	1.0 (reference)	1.0 (reference)
Household contacts‡		
Contact with index patient‡		
Direct contact	8.2 (2.7–24.7)	5.8 (1.8–18.8)
Close contact	5.4 (1.4–20.9)	5.2 (1.2–22.5)
Minimal to no contact	1.0 (reference)	1.0 (reference)

* A generalized-estimating-equation approach with an exchangeable correlation structure was used to account for intra-household correlation. For the multivariable analysis, key characteristics of the index patients (i.e., age, the presence of coronavirus disease 2019 [Covid-19] symptoms, isolation from other persons, and mask use) and the level of contact between the household member and the index patient were selected. The model was fitted after calculation of variance inflation factors to evaluate the resulting design matrix for multicollinearity; all the variance inflation factor values were below 2, which indicated minimal correlation among the model variables. Confidence intervals were not adjusted for multiplicity. Households with more than one index patient were excluded from the univariable and multivariable models. CI denotes confidence interval, and SARS-CoV-2 severe acute respiratory syndrome coronavirus 2.

† An index patient was defined as a camp attendee for whom evidence of SARS-CoV-2 infection on molecular or antigen testing was reported and who had the earliest date of onset of Covid-19 in the household. A household contact was defined as a person who stayed in the household for at least 1 night during the period when the index patient was infectious (i.e., from 2 days before the date of onset of Covid-19 until 10 days after the date of onset of Covid-19).

‡ Direct contact included being a caregiver of the index patient, having face-to-face contact with the index patient, being within 6 ft of the index patient while the patient is coughing or sneezing, or having physical contact with the index patient. Close contact included being within 6 ft of the index patient for at least 15 minutes and sharing a bedroom, meals, or a vehicle.

before and during the onset of symptoms,⁵ and two thirds adopted physical distancing because of a known exposure at camp; both of these factors probably reduced the transmission of SARS-CoV-2 in the household. When feasible, children and adolescents with a known exposure to SARS-CoV-2 or a diagnosis of Covid-19 should remain at home and maintain physical distance from household members.

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