

Symptomatic SARS-CoV-2 Transmission in Youth and Staff Attending Day Camps

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abstract

BACKGROUND AND OBJECTIVES: As schools reopen nationwide, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection in youth settings remains a concern. Here, we describe transmission of SARS-CoV-2 among >6800 youth and staff at YMCA of the Triangle day camps in North Carolina (March to August 2020).

METHODS: We performed a retrospective analysis of deidentified SARS-CoV-2 cases reported by YMCA day camps in 6 counties (Chatham, Durham, Johnston, Lee, Orange, Wake) over 147 days. Inclusion criteria were youth and staff who enrolled or worked in camps during the study period. Individual-level youth and staff demographics (age, sex, race and ethnicity) were self-reported and linked to SARS-CoV-2 case data by using unique identifiers.

RESULTS: Youth ($n = 5344$; 66% white, 54% male, mean age 8.5 years) had a mean camp attendance rate of 88%; staff ($n = 1486$) were 64% white and 60% female (mean age 22 years). Seventeen primary SARS-CoV-2 infections occurred during the study period among 9 youth (mean age 9.7 years) and 8 staff (mean age 27 years) who were linked to 3030 contacts present in-person during the week before positive cases. Only 2 secondary infections (1 youth and 1 staff) were linked to primary cases. SARS-CoV-2 primary case attack rate was 0.6% (17/3030), and secondary case transmission rate was 0.07% (2/3011).

CONCLUSIONS: Extremely low youth and staff symptomatic SARS-CoV-2 attack and transmission rates were observed over a 147-day period across 54 YMCA camps from March to August 2020, when local coronavirus disease 2019 prevalence peaked. These findings suggest that the benefit of in-person programming in recreation settings with appropriate mitigation may outweigh the risk of viral transmission.

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Dr D'Agostino conceived of the study, prepared all sections of the text and performed all analyses; Drs Permar and Akinboyo conceived of the study, revised it critically for important intellectual content, and supervised all aspects of the manuscript preparation; Dr Armstrong conceived of the study and revised the manuscript critically for important intellectual content; Ms Humphreys, Ms Coffman, and Mr Sinclair collected and managed the study data and revised the manuscript critically for important intellectual content; and all authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

DOI: <https://doi.org/10.1542/peds.2020-042416>

Accepted for publication Jan 13, 2021

WHAT'S KNOWN ON THIS SUBJECT: Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infections among youth remain a pressing concern. Many schools are holding virtual or hybrid classes, increasing reliance on community recreation settings to support youth with in-person programs. However, recent reports reveal limited SARS-CoV-2 transmission among children in congregated settings.

WHAT THIS STUDY ADDS: During peak regional coronavirus disease 2019 incidence, extremely low symptomatic SARS-CoV-2 attack and transmission rates were observed across 54 day camps in North Carolina. Despite high community incidence, SARS-CoV-2 transmission can be mitigated in recreation settings with appropriate adherence to mitigation protocols.

To cite: D'Agostino EM, Armstrong SC, Humphreys L, et al. Symptomatic SARS-CoV-2 Transmission in Youth and Staff Attending Day Camps. *Pediatrics*. 2021;147(4):e2020042416

As of October 2020, the novel severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) caused >41 million infections and >1 million deaths globally.¹ Black and Hispanic youth have accounted for 75% of SARS-CoV-2-associated pediatric deaths and are hospitalized with coronavirus disease 2019 (COVID-19) at a rate 5 to 8 times higher than white youth.^{2,3} These youth and their families also face language and health access barriers that may interfere with their ability to follow complex and rapidly changing prevention and mitigation advice, which may lead to downstream effects on COVID-19 transmission.

The pandemic also has had significant local impact in North Carolina (NC), with >253 000 laboratory-confirmed cases of COVID-19 by October 2020.^{4,5} Because of the early and prolonged switch to remote learning in the United States since March 2020, SARS-CoV-2 infection and transmission data from public school settings are limited. During the summer season, local rates of pediatric cases (ie, among children <18 years) in Durham, NC measured as the proportion of all positive cases increased from 9% in May to 17% in August. Given limited regional testing for children in March to April 2020 and that most local public schools were not in-session or in-person until September 2020, this was a marker of rampant ongoing community transmission in the region.

Despite ongoing transmission, virtual and hybrid school classrooms have necessitated increased reliance on community congregate care (youth afterschool, camp, recreation) settings that provide adult supervision, supplemental technology access, academic support, and wellness resources.⁶ Children who identify as racial or ethnic minorities are also more likely to be negatively impacted by COVID-19 restrictions limiting in-person school compared with white children. These

youth are not only disproportionately suffering from the COVID-19 pandemic's direct impact on their peers, families, and communities, but are also affected by indirect effects of COVID-19 because estimated learning losses, mental health disruptions, and dropout rates are much higher in children from diverse racial or ethnic backgrounds and children from low-income homes.^{7,8} In this sense, ongoing school closures and limited access to safe recreation settings for group interactions among children are disproportionately affecting Black and Hispanic youth.

Community recreation programs, such as the YMCA of the Triangle (YMCA) in NC, offer a critical resource during times of natural disaster, particularly for minority and low-income youth.⁹ The YMCA has served >11 000 Black and Hispanic youth across 163 sites since 2014 and has successfully used Centers for Disease Control and Prevention (CDC)-recommended COVID-19 symptom screening strategies to prevent site-based transmission.¹⁰ Research has shown that diligent adherence to "multilayered" strategies, including precamp quarantining, pre- and postarrival testing and/or symptom screening, face coverings, hand hygiene, environmental cleaning and disinfecting, maximal outdoor programming, and maintaining small cohorts, was successful in mitigating SARS-CoV-2 transmission in 4 overnight summer camps.¹¹ Despite recent contrasting reports describing SARS-CoV-2 transmission among children in congregate care settings,^{12,13} the YMCA remained safely open in 31 NC sites, offering 54 indoor and outdoor day camps from March to August 2020. In this article, we describe SARS-CoV-2 infection rates and transmission among >6800 youth and staff at YMCA day camps during a time of regional rising SARS-CoV-2 incidence.

METHODS

YMCA Day Camp COVID-19 Mitigation Protocols

Consistent with the CDC guidelines for congregate care settings, the YMCA followed locally mandated SARS-CoV-2 mitigation recommendations for children attending day camps.¹⁰ These mitigation protocols included exposures and symptoms screening, daily temperature checks, masks for all staff and attendees, frequent hand hygiene (hand-washing indoors and hand sanitizer in outdoor settings), physical distancing (>6 ft), small cohorts (≤10 youth and 1 adult), scheduled site cleanings, and staff COVID-19 education and workplace training.¹⁰ Specifically, participants' parents and/or guardians and staff were asked to immediately report COVID-19 symptoms or diagnosis to the YMCA. Intake staff took an initial report shared with direct supervisors and the Risk Department to determine recommended quarantine or isolation duration per CDC guidelines. For all reported cases, the Risk Department alerted Human Resources, Communications, and Facilities to trigger planned responses, including tracing potential contacts in collaboration with local health departments and performing enhanced cleaning of facilities where the infected camper or staff was present. If individuals became symptomatic at home, strict protocols were followed, per CDC guidelines, before permitting on-site return. If a child became ill with symptoms while in attendance at camp, personal protective equipment (gloves and surgical facemasks) was used to care for the child.

During camp, universal mask wearing was enforced by staff for all indoor activities (including contact sports), and also for outdoor activity if participants were unable to remain physically distanced (6 ft or more). Youth were required to wear masks when getting out of a car during drop off and were reminded to keep masks

on at all times. Mask wearing was prioritized by YMCA administrators and staff on the basis of advice from a medical expert advisory panel assembled early in the pandemic. Per internal audit, in accordance with the state mandate issued on June 24, 2020,¹⁴ there was >95% mask compliance among campers and staff. Youth and staff cohorts were maintained such that there were ≤ 2 consistent exposure groups that each included up to 10 youth and 1 staff (total 22 individuals) permitted to play together but also to avoid contact with other groups. No large group engagements were permitted per NC state governor mandate issued on March 14, 2020.¹⁵

All participant and staff data including participant and staff demographics, enrollment and work assignments, attendance, number of positive SARS-CoV-2 testing with linked symptom onset dates, close contacts, cleaning and disinfecting response, and contact with the health department were collected by the YMCA, deidentified, and shared with Duke University through a data use agreement. This study was approved by the Duke Health Institutional Review Board (Pro00106484).

Study Sample

Deidentified data for symptom screening and self-reported cases were retrospectively obtained from the YMCA prospectively collected database. Data were included for youth and staff who attended or were staffed at YMCA youth indoor, outdoor, and split indoor and outdoor camps ($n = 54$) in 6 NC counties (Chatham, Durham, Johnston, Lee, Orange, and Wake) during the study period (March 30 to August 24, 2020). Any youth who attended YMCA camps during the study period from March to August were captured for the period that they attended camp by the YMCA's data tracking tool. Campers and staff attended or were assigned to only 1 camp session

per week. Contacts were defined as any youth or staff present in-person on campsite during the week before identification of positive case.

Analysis

Descriptive statistics were computed to summarize sample characteristics across age, race, and sex for youth and staff. Camp characteristics (number of youth and staff, sites, and camps) were also computed. Means and SDs were generated for age of youth and staff, attendance (percentage of days attended/total days eligible to attend based on camp duration) and camp duration (total days) overall, and camp location (primarily indoor, primarily outdoor, and split indoor and outdoor).

Next, primary campsite attack rate and campsite-related secondary case transmission rate were calculated. Calculations accounted for all campers and staff who were present on-site at the same camp during the study period. Primary cases were defined as index youth or staff reporting COVID-19 infection without any known exposure at camp; secondary cases were defined as cases from potential exposures within camp. A symptomatic SARS-CoV-2 case was defined as a self-reported (camper or staff) positive viral SARS-CoV-2 polymerase chain reaction test from a specimen collected or reported to the health department or other testing center. A contact was defined as any individual who had close contact (<6 ft for 15 minutes or more) on-site with primary cases during camp week of infection with or without masks in accordance with local and state health department policies.¹⁶ Primary case attack rate was calculated as the number of new primary cases during the camp week of infection/number of participants on-site at the same camp during the week of infection. Secondary case transmission rate was calculated as the number of symptomatic secondary cases among contacts of

primary cases/(number of contacts – number of primary cases). Statistical analyses were performed by using SAS v.9.4 (SAS Institute, Inc, Cary, NC).

RESULTS

Youth were 66% white, 54% male, and had a mean age of 8.5 years, with mean attendance rate of 88% ($n = 5344$). Staff were 64% white, 60% female, and had a mean age of 22 years ($n = 1486$, Table 1). Twenty-nine (54%) camps were primarily outdoors. Thirty-nine percent and 38% of youth attended indoor and outdoor camps, respectively, whereas 23% of youth attended split indoor and outdoor camps. The percentage of all youth identifying as racial or ethnic minorities by camp setting was 23% and 25% for indoor and split indoor and outdoor camps, respectively, compared with 18% for outdoor camps. Mean camp cohort size and duration were 20 youth, 6 staff, and 5 total days (typically 7:30 AM to 6 PM). Staff completion rate for 3 COVID-19 virtual training sessions before the beginning of camp was 67%. Seventeen primary symptomatic SARS-CoV-2 infections occurred during the study period among 9 youth (mean age 9.7 years) and 8 staff (mean age 27 years, Table 2) who were linked to 3030 contacts present in person during the week before positive cases and only 2 symptomatic secondary infections (1 youth and 1 staff) linked to primary cases. Symptomatic SARS-CoV-2 primary case attack rate was 0.6% (17 of 3030), and secondary case transmission rate was 0.07% (2 of 3011). The most common reported symptoms (for youth and staff combined) were fever (55%) and cough (45%). No hospitalizations were reported. Attack rates per campsite can be found in Supplemental Table 3. Moreover, no COVID-19 case clusters (locally defined as <5 related cases) occurred in these camps.¹⁷

TABLE 1 Participant (*N* = 6830) Characteristics for YMCA Camps, North Carolina, March 30 to August 24, 2020

Characteristic	All Camps	Primarily Indoor Camps	Primarily Outdoor Camps	Split Indoor and Outdoor
Youth				
Age, mean (SD), y	8.5 (2.5)	8.5 (2.7)	8.4 (2.2)	8.5 (2.5)
Race and ethnicity, ^{a,b} %				
Non-Hispanic Black	15	22	6	16
Hispanic	9	17	4	5
Non-Hispanic white	66	49	80	69
Other	11	13	9	10
Sex, ^{a,b} %				
Male	54	53	55	53
Female	46	47	44	47
Staff				
Age, mean (SD), y	22.4 (9.4)	23.4 (10.2)	19.2 (4.4)	22.1 (9.0)
Race and ethnicity, ^{a,b} %				
Non-Hispanic Black	22	23	18	25
Hispanic	6	7	6	4
Non-Hispanic white	64	61	69	64
Other	8	9	7	7
Sex, ^{a,b} %				
Male	40	40	38	40
Female	60	60	62	60
Camps				
No. youth ^a	5344	2083	2018	1243
No. staff ^a	1486	714	288	357
No. sites	31	16	8	7
No. camps	54	10	29	15
Percentage of days attended (SD)	88 (25)	88 (26)	92 (21)	86 (27)
Mean camp duration, ^c days	5 (2)	5 (1)	7 (4)	5 (0)

^a *n*_{youth missing race} = 3528, *n*_{youth missing sex} = 22, *n*_{staff missing indoor/outdoor} = 127.

^b Percentages may not sum to 100 because of rounding.

^c Based on all weeks during study period.

DISCUSSION

Extremely low youth and staff symptomatic SARS-CoV-2 attack and transmission rates were observed during a 147-day period across 54 YMCA camps from March to August 2020, a period when COVID-19 prevalence in NC was at its first peak.⁴ Comparatively, during this period, COVID-19 incidence rate in NC was 200 new cases per 10 000 population per day.⁴ Low symptomatic SARS-CoV-2 attack and transmission rates also contrast with previous reports for youth ages 6 to 19 who attended an overnight camp in Georgia, where a 44% attack rate also based on symptomatic testing was reported.¹³ However, differences in mitigation practices were reported between the overnight camp in Georgia and the YMCA camps,

including in the Georgia camp a lack of adherence to both masking practices and physical distancing, indoor singing or shouting while unmasked, and reliance on tests within 12 days of camp (versus days before infection to avoid re-exposure).¹³ Instead, our findings correspond to data from other reports of congregated care settings based on symptomatic testing of contacts, including Rhode Island child care programs (median age 5 years), indicating limited secondary transmission of SARS-CoV-2 in congregated care settings with adherence to mitigation protocols.¹² Similarly, some reports have revealed that transmission among youth returning to schools after reopening has been low,^{18,19} and outbreaks in these settings have been attributed to lack of adherence to both masking

and physical distancing,^{20,21} suggesting that reinforcing mitigation strategies with youth and families is imperative. Future work should identify SARS-CoV-2 screening and education protocols for promoting adherence to guidelines in congregated care settings to allow children, particularly those from vulnerable groups, to safely return to school, child care, and recreation settings.

Importantly, during a period of rapid regional increase in SARS-CoV-2 incidence rates, there were only 19 COVID-19 cases among 6830 youth and staff. The majority of participant and staff cases were primary cases, likely reflecting community or household transmission. Also, although minority youth were more likely to attend indoor camps (where expected transmission risks may be increased), we did not observe higher transmission rates in these settings. This finding may be particularly relevant to school and other congregated care settings where the majority of time has to be spent indoors because of weather or learning conditions.

It may be hypothesized that basic infection control protocols including masking, hand-washing, physical distancing, thorough staff training, and organizational resources dedicated to COVID-19 mitigation successfully reduced transmission within recreation settings for children. Additionally, the near absence of secondary transmission within YMCA camps may have been due to judicious application of public health guidance, small-sized cohorts, and emphasis of safe practices for both youth and staff in and out of camp. YMCA allocated resources to detailed contact tracing, audited COVID-19 mitigation protocol adherence, and accessed advice from a medical board with pediatrics, epidemiology, and infectious diseases expertise, all of which may have contributed to the limited on-site transmission.

TABLE 2 Confirmed Symptomatic SARS-CoV-2 Cases (*n* = 19), YMCA, North Carolina, March 30 to August 24, 2020

Participants	Sites with Cases			
	All	Primarily Indoor	Primarily Outdoor	Split Indoor and Outdoor
Youth				
Total No. cases ^a	10	6	1	3
Cases per site	0.8	1.0	0.3	1.0
Staff				
Total No. cases	9	2	3	4
Cases per site	0.7	0.3	0.8	1.3
All				
Total No. sites	13	6	4	3
Total No. cases	19	8	4	7
Cases per site	1.5	1.3	1.0	2.3
No. contacts ^b	3030	1309	391	1330
No. cases among contacts	2	0	0	2
Primary case attack rate, ^c %	0.6	0.5	1.0	0.2
Secondary case transmission rate, ^d %	0.07	0	0	0.15

^a A SARS-CoV-2 case was defined as a positive viral SARS-CoV-2 test result from a specimen collected or reported to health department.

^b Contact refers to on-site with symptomatic primary cases during camp week of infection.

^c Primary case attack rate refers to number of new symptomatic primary cases during camp week of infection/number of participants on-site at the same camp during the week of infection.

^d Secondary case transmission rate refers to number of symptomatic secondary cases among contacts of primary cases/(number of contacts – number of primary cases).

Study limitations include potential underestimated attack and transmission rates due to missed asymptomatic cases, reliance on a convenience sample with self-report for identifying positive cases, and limited reporting on staff compliance with trainings because of technology limitations. However, authors of previous reports of SARS-CoV-2 transmission in congregate care settings similarly drew from self-report data and convenience samples.^{12,13} The state of testing that was available in the first 6 to 8 months of the pandemic, which this report covers, included very limited asymptomatic, standardized, or randomized testing, especially for children; therefore, prospective testing was not available at YMCA camps. Data confirming daily mask wearing and distancing compliance were not available.

Despite these limitations, this work reveals that SARS-CoV-2 transmission can be mitigated in congregate care settings during times of high community incidence, suggesting that the benefit of in-person programming for supporting youth learning, mental health, and school retention, particularly for vulnerable populations, outweighs the risk of viral spread. There are few formal data on transmission of SARS-CoV-2 in school, child care, and recreation settings. Thus, these data reflect an important contribution for school systems and child care settings as they navigate this exceedingly difficult time to promote the wellbeing of children and primary caregivers. Future research should address feasible and effective COVID-19 protocols in school, child care, and recreation settings, particularly among disproportionately affected racial

and ethnic groups, to inform best practices for reducing immediate and long-term impacts of COVID-19 on youth and their families.

ACKNOWLEDGMENTS

We thank Charlene Wong, Jillian Hurst, Katherine Barrett, Doug McMillan, Kim Keith, Leah Devlin, Anna Goodmon, Kirk Newman, Sallie Ransom, and John Rusher for their valued insight, which informed the preparation of this manuscript.

ABBREVIATIONS

COVID-19: Coronavirus Disease 2019

NC: North Carolina

SARS-CoV-2: Severe acute respiratory syndrome coronavirus 2

YMCA: YMCA of the Triangle

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PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

FINANCIAL DISCLOSURE: The authors have indicated they have no financial relationships relevant to this article to disclose.

FUNDING: No external funding.

POTENTIAL CONFLICT OF INTEREST: The authors have indicated they have no potential conflicts of interest to disclose.

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