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

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Abbreviations: Coronavirus Disease 2019 (COVID-19); NC (North Carolina); Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2); YMCA of the Triangle (YMCA)

Contributor's Statement Page

Emily D'Agostino conceived of the study, prepared all sections of the text and performed all analyses.

Sallie Permar and Ibukunoluwa Akinboyo conceived of the study, revised it critically for important intellectual content, and supervised all aspects of the manuscript preparation.

Sarah Armstrong conceived of the study and revised the manuscript critically for important intellectual content.

Lisa Humphreys, Stacey Coffman, and Gordon Sinclair collected and managed the study data and revised the manuscript critically for important intellectual content.

All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

TABLE OF CONTENTS SUMMARY

During peak regional COVID-19 incidence, extremely low symptomatic SARS-CoV-2 attack and transmission rates were observed across 54 day camps in North Carolina.

WHAT'S KNOWN ON THIS SUBJECT

SARS-CoV-2 infections among youth remain a pressing concern. Many schools are holding virtual or hybrid classes, increasing reliance on community recreational settings to support youth with in-person programs. However, recent reports demonstrate limited SARS-CoV-2 transmission among children in congregate settings.

WHAT THIS STUDY ADDS

During peak regional COVID-19 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 recreational settings with appropriate adherence to mitigation protocols.

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 >6500 youth and staff at YMCA of the Triangle day camps in North Carolina (March-August 2020).

Methods: We performed a retrospective analysis of de-identified SARS-CoV-2 cases reported by YMCA day camps in six counties (Chapel Hill, Chatham, Durham, Johnston, Lee, Wake) over 133 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/ethnicity) were self-reported and linked to SARS-CoV-2 case-data 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, 60% female (mean age 22 years). Nineteen primary SARS-CoV-2 infections occurred during the study period among 10 youth (mean age=9.7 years) and 9 staff (mean age=27 years) who were linked to 3030 contacts present in-person during the week prior to positive cases and only 2 secondary infections were linked to primary cases. SARS-CoV-2 primary case attack rate was 0.6% (19/3030) 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 133-day period across 54 YMCA camps from March-August 2020, when local COVID-19 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.

INTRODUCTION

As of October 2020, the novel severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) caused over 41 million infections and over one 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 significant local impact in North Carolina (NC) with over 253,000 lab-confirmed cases of COVID-19 by October 2020.^{4,5} Due to 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 (i.e., among children < 18 years) in Durham NC measured as a proportion of all positive cases increased from 9% in May to 17% in August. Given limited regional testing for children in March – 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/hybrid school classrooms have necessitated increased reliance on community congregate care (youth afterschool/camp/recreation) settings that are often relied upon to provide adult supervision, supplemental technology access, academic support, and wellness resources.⁶ Children who identify as racial/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 since 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 recreational settings for group interactions among children are disproportionately affecting Black and Hispanic youth.

Community recreational 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 over 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 pre-camp quarantining, pre- and post-arrival testing and/or symptom screening, face coverings, hand hygiene, environmental cleaning/disinfecting, maximal outdoor programming, and maintaining small cohorts, was successful in mitigating SARS-CoV-2 transmission in four overnight summer camps. Despite recent contrasting reports describing SARS-CoV-2 transmission among children in congregate care settings,^{11,12} the YMCA remained safely open in 31 NC sites, offering 54 indoor/outdoor day camps from March-August 2020. Here, we describe SARS-CoV-2 infection rates and transmission among >6,000 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 childcare 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 feet), small cohorts (≤10 youth and 1 adult), scheduled site cleaning and staff COVID-19 education/workplace training.¹⁰ Specifically,

participants' parent/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/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) were used to care for the child.

During camp, universal mask wearing by staff was enforced for all indoor activities (including contact sports), and also for outdoor activity if participants were unable to remain physically distanced (6 feet 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 based on 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, 2020,¹³ there was >95% mask compliance among campers and staff. Youth/staff cohorts were maintained such that there were no more than two 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, 2020.¹⁴

All participant/staff data including participant/staff demographics, enrollment/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

De-identified data for symptom screening and self-reported cases were retrospectively obtained from YMCA prospectively collected database. Data were included for youth/staff who attended or were staffed YMCA youth indoor, outdoor, and split indoor/outdoor camps (n=54) in six NC counties (Chatham, Durham, Johnston, Lee, Orange and Wake) during the study period (March 30-August 24, 2020). Any youth who attended YMCA camps during the study period from March-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 one camp session per week. Contacts were defined as any youth or staff present in-person on camp site during the week prior to 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/staff, sites and camps were also computed. Means and standard deviations were generated for age of youth and staff, attendance (percent of days attended/total days eligible to attend based on camp duration) and camp duration

(total days) overall, and by camp location (primarily indoor, primarily outdoor, and split indoor/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 at the same camp during the study period. Primary cases were defined as index youth/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/staff) positive viral SARS-CoV-2 PCR 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 (less than 6 feet for 15 minutes or more) on-site with primary cases during camp week of infection with or without masks in accordance with local/state health department policies.¹⁵ Primary case attack rate was calculated as the number of new primary cases during the camp week of infection/total 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/(total contacts-primary cases). Statistical analyses were performed using SAS v.9.4.

RESULTS

Youth were 66% white, 54% male, mean age of 8.5 years with mean attendance rate of 88% (n=5,344). Staff were 64% white, 60% female, 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, while 23% of youth attended split indoor/outdoor

camps. Percent of all youth identifying as racial or ethnic minorities by camp setting was 23% and 25% for indoor and split indoor/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 7:30am-6pm). Staff completion rate for three COVID-19 virtual training sessions prior to the beginning of camp was 67%. Nineteen primary symptomatic SARS-CoV-2 infections occurred during the study period among 10 youth (mean age=9.7 years) and 9 staff (mean age=27 years, Table 2) who were linked to 3030 contacts present in-person during the week prior to positive cases and only 2 symptomatic secondary infections linked to primary cases. Symptomatic SARS-CoV-2 primary case attack rate was 0.6% (19/3030) and secondary case transmission rate was 0.07% (2/3011). 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 1. Moreover, no COVID-19 case clusters (locally defined as more than 5 related cases) occurred in these camps.¹⁶

DISCUSSION

Extremely low youth and staff symptomatic SARS-CoV-2 attack and transmission rates were observed during a 133-day period across 54 YMCA camps from March-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/10,000 population per day.⁴ Low symptomatic SARS-CoV-2 attack and transmission rates also contrast with prior reports for youth ages 6-19 who attended an overnight camp in Georgia where a 44% attack rate also based on symptomatic testing was reported.¹² 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 masking practices, physical distancing, indoor singing/shouting while unmasked, and reliance on tests within 12 days of camp (vs. days prior to infection to avoid re-exposure).¹² Instead, our findings correspond to data from other reports of childcare 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 childcare settings with adherence to mitigation protocols.¹¹ Similarly, some reports have shown that transmission among youth returning to schools after reopening has been low,^{17,18} and outbreaks in these settings have been attributed to lack of adherence to both masking and physical distancing,^{19,20} 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 congregate care settings to allow children, particularly those from vulnerable groups, to safely return to school and congregate recreation settings.

Importantly, during a period of rapid regional increase in SARS-CoV-2 incidence rates, there were only 19 COVID-19 cases among 6,830 youth and staff. The majority of participant and staff cases were primary cases, likely reflecting community/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 congregate care settings where the majority of time has to be spent indoors due to weather or learning conditions.

It may be hypothesized that basic infection control protocols including masking, handwashing, physical distance, thorough staff training, and organizational resources dedicated to COVID-19 mitigation successfully reduced transmission within recreational 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.

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 due to technology limitations.

However, prior reports of SARS-CoV-2 transmission in congregate care settings similarly drew from self-report data and convenience samples.^{11,12} The state of testing that was available in the first 6-8 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 demonstrates that SARS-CoV-2 transmission can be mitigated in childcare 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 vulnerable populations, outweighs the risk of viral spread. There is very little formal data on transmission of SARS-CoV-2 in recreation/school settings in a school or childcare setting. Thus, these data reflect an important contribution for school systems and childcare 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 schools and childcare settings, particularly among disproportionately affected racial/ethnic groups, to inform best practices for reducing immediate and long-term impacts of COVID-19 on youth and their families.

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Table 1. Participant (N=6,830) characteristics for YMCA of the Triangle camps, North Carolina, March 30-August 24, 2020

Characteristic	All Camps	Primarily Indoor Camps	Primarily Outdoor Camps	Split Indoor/Outdoor
Youth				
Age (years; mean [SD])	8.5 (2.5)	8.5 (2.7)	8.4 (2.2)	8.5 (2.5)
Race / 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 (years; mean [SD])	22.4 (9.4)	23.4 (10.2)	19.2 (4.4)	22.1 (9.0)
Race / 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				
Number of Youth ^a	5344	2083	2018	1243
Number of Staff ^a	1486	714	288	357
Number of Sites	31	16	8	7
Number of Camps	54	10	29	15
Percent (%[SD]) Days Attended ^{b,c}	88% (25%)	88% (26%)	92% (21%)	86% (27%)
Mean Camp Duration ^c (days)	5 (2)	5 (1)	7 (4)	5 (0)

^an_{youth missing race}=3528, n_{youth missing sex}=22, n_{staff missing indoor/outdoor}=127; ^bPercentages may not sum to 100 due to rounding;

^cBased on all weeks during study period.

Table 2. Confirmed symptomatic SARS-CoV-2 cases (n=19), YMCA of the Triangle, North Carolina, March 30-August 24, 2020

Participants	Sites with Cases			
	All	Primarily Indoor	Primarily Outdoor	Split Indoor/Outdoor
Youth				
Total Cases ^a	10	6	1	3
Cases per Site	0.8	1.0	0.3	1.0
Staff				
Total Cases	9	2	3	4
Cases per Site	0.7	0.3	0.8	1.3
All				
Total Sites	13	6	4	3
Total Cases	19	8	4	7
Cases per Site	1.5	1.3	1.0	2.3
Number of Contacts ^b	3030	1309	391	1330
Number of 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%

^aA SARS-CoV-2 case was defined as a positive viral SARS-CoV-2 test from a specimen collected or reported to health department; ^bContact=on-site with symptomatic primary cases during camp week of infection; ^cPrimary Case Attack Rate=new symptomatic primary cases during camp week of infection/total participants on-site at the same camp during the week of infection; ^dSecondary Case Transmission Rate=number of symptomatic secondary cases among contacts of primary cases/(total contacts-primary cases).

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

Table S1: Symptomatic SARS-CoV-2 primary case^a attack rate by camp site (n=13), YMCA of the Triangle, North Carolina, March 30-August 24, 2020

Camp Setting	Number of Contacts ^b	Number of Cases	Primary Case Attack Rate ^c
All Sites	3030	19	0.6%
Primarily Indoor Camp Sites			
Camp A	142	2	1.4%
Camp B	96	1	1.0%
Camp C	261	1	0.4%
Camp D	292	1	0.3%
Camp E	90	1	1.1%
Camp F	320	2	0.6%
Outdoor Camp Sites			
Camp G	160	1	0.6%
Camp H	160	1	0.6%
Camp I	54	1	1.9%
Camp J	136	1	0.7%
Split Indoor/Outdoor Camp Sites			
Camp K	478	3	0.6%
Camp L	188	1	0.5%
Camp M	653	3	0.5%

^aA SARS-CoV-2 case was defined as a positive viral SARS-CoV-2 test from a specimen collected or reported to health department; ^bContact=on-site with primary cases during camp week of infection; ^cPrimary Case Attack Rate=new primary cases during camp week of infection/total participants on-site at the same camp during the week of infection;

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