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Results of Testing Children for Severe Acute Respiratory Syndrome Coronavirus-2 Through a Community-based Testing Site

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Objective To describe the demographics, clinical features, and test results of children referred from their primary provider for severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) in the community setting.

Study design Retrospective cross-sectional study of children ≤22 years of age who were tested for SARS-CoV-2 at a community-based specimen collection site in Washington, DC, affiliated with a large children's hospital between March 21 and May 16, 2020.

Results Of the 1445 patients tested at the specimen collection site for SARS-CoV-2 virus, 408 (28.2%) had a positive polymerase chain reaction test. The daily positivity rate increased over the study period, from 5.4% during the first week to a peak of 47.4% ($P_{trend} < .001$). Patients with fever (aOR, 1.7; 95% CI, 1.3-2.3) or cough (aOR, 1.4; 95% CI, 1.1-1.9) and those with known contact with someone with confirmed SARS-CoV-2 infection (aOR, 1.6; 95% CI, 1.0-2.4.) were more likely have a positive test, but these features were not highly discriminating.

Conclusions In this cohort of mildly symptomatic or well children and adolescents referred to a community drive-through/walk-up SARS-CoV-2 testing site because of risk of exposure or clinical illness, 1 in 4 patients had a positive test. Children and young adults represent a considerable burden of SARS-CoV-2 infection. Assessment of their role in transmission is essential to implementing appropriate control measures. *(J Pediatr 2021;231:157-61)*.

As of May 30, 2020, 1.3 million cases of severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) infection had been reported in the US and more than 69 000 (5%) are among youth.[1] In the US, 22% of the population is composed of youth <18 years old. Experience from China and Europe suggests that children of all ages are susceptible to SARS-CoV-2, but the disease tends to be clinically milder compared with adults, with as many as 90% infected children being asymptomatic or having only mild or moderate symptoms.[2-4] Recent US data confirm this finding, but also include findings of a subset of patients with serious illness resulting in hospitalization, documenting that serious illness does occur in the pediatric population, possibly at higher rates than previously reported.[5,6]

A common challenge during the novel coronavirus disease-2019 (COVID-19) pandemic has been inadequate diagnostic testing capacity, limited personal protective equipment, and the need for social distancing in health care settings.[7] Drive-through/walk-up specimen collection sites for SARS-CoV-2 offer a community-based solution to these challenges. Regional variation in testing availability limits the ability to describe the referral patterns and clinical presentation of pediatric patients in the community setting. However, as the US reopens schools and childcare centers, information about the community spread of SARS-CoV-2 among children has attracted great attention to guide recovery planning.

Drive-through/walk-up testing sites outside of a traditional acute care setting have emerged around the world to meet the need for testing mildly ill or asymptomatic individuals.[8,9] Community-based testing sites have the advantages of minimizing exposure risk to other patients and healthcare workers, preserving personal protective equipment, centralizing specimen collection services, mitigating acute care site overcrowding, and informing public health authorities of the community's disease burden. Responding to the needs of patients served by an affiliated clinically integrated network of pediatric practices in the Washington, DC, metropolitan region, the COVID response team at a free-standing pediatric hospital established an exclusively pediatric SARS-CoV-2 testing site on March 21, 2020. The primary objective of this study was to describe the features of children tested at this site who did not require acute medical care. The secondary objective was to compare demographic and clinical differences between patients who tested positive and negative for SARS-CoV-2.

COVID-19	Novel coronavirus disease-2019
SARS-CoV-2	Severe acute respiratory syndrome coronavirus-2

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Methods

This was a cross-sectional study of children tested for SARS-CoV-2 at an exclusively pediatric drive-through/walk-up urban specimen collection site affiliated with a large, tertiary care children's hospital in Washington, DC, from March 21 to May 16, 2020. Patients were referred by community pediatricians through an online registration and referral process. Self-referral was not permitted. Referring clinicians included members of an affiliated clinically integrated network of >500 regional pediatricians. Pediatricians were advised to refer patients between the ages of 0 and 22 years if they reported mild symptoms or met the following criteria: patients who were at high risk for serious infection, patients who lived with high-risk household members, or patients who lived with household members whose work status would be impacted by the presence of infection. The site was located within 1 mile of the hospital at an outdoor parking lot of a local university and was operational 2-3 days per week. Patients were seen in single file and remained in their vehicle, or, if ambulatory, ≥6 feet apart from other patients. All specimens were collected via nasopharyngeal or oropharyngeal swab by trained healthcare workers and sent to an offsite commercial laboratory (Quest Diagnostics, Inc) for Emergency Use Authorization-approved real-time reverse transcription polymerase chain reaction testing. Results were returned to the referring provider. The hospital's institutional review board approved this study.

Data Collection

Demographic and clinical data were extracted from the electronic referral forms and merged with laboratory results from the electronic medical record system. Collected data included age, sex, race/ethnicity, and home address. Consistent with other studies, race/ethnicity was categorized as non-Hispanic Black, non-Hispanic White, Hispanic, and other.[10] Age was organized into the following categories: <1, 1-4, 5-11, 12-17, and 18-22 years of age. Home address was used to measure the distance from the testing site. The reason for referral was categorized as high-risk patient for exposure or infection, household member with a high risk for exposure or infection, need to know status for work or contact tracing, and known exposure. Reasons for referral were not mutually exclusive. Symptoms were classified into the following non-mutually exclusive categories: none, upper respiratory tract symptoms (eg, sore throat or nasal congestion), cough, lower respiratory tract symptoms (eg, difficulty breathing), gastrointestinal symptoms (eg, vomiting or diarrhea), neurologic symptoms (eg, headache), and systemic symptoms (eg, fever). The presence of symptoms was analyzed as a binary variable (yes/no).

Statistical Analyses

We used standard descriptive statistics to summarize the study population. We performed bivariable logistic regression analyses to calculate unadjusted and aOR with 95% CI to identify demographic and clinical characteristics associated with SARS-CoV-2 infection. We also performed multivariable logistic regression that was a priori adjusted for age, race/ethnicity, sex, and distance from testing site. We calculated SARS-CoV-2 positivity rates and assessed temporal trends in positivity rates over the study period using p-trend analyses. All analyses were conducted using SAS, version 9.4 (SAS Institute Inc).

Geospatial analysis was conducted using ArcGIS Pro (Esri, Redlands, California). Home addresses were geocoded to create a point layer with all patients tested and patients tested positive. Patients were excluded from the geospatial analysis if they had invalid addresses (n = 12). The point layers were spatially joined with a zip code polygon layer to develop a map with pie charts to view the spatial distribution of testing and positivity by zip code.

Results

Testing Numbers and Burden of Infection

During the study period, 1445 patients were referred to the testing site for specimen collection. An average of 79 patients (IQR, 53.0-104.5 patients) were tested each day. There were 408 patients who tested positive (28.2%, 95% CI, 18.2-23.3.) The average daily rate of positivity ranged from 5.4% in the first week of testing site opening (March 21-29) to a peak of 47.4% on May 5. The rate of positivity for the last week of the study period (May 9-16) was 37.8% ($P_{trend} < .001$) (Figure 1).

Characteristics of Tested Patients

The median age of all the patients tested was 8 years (IQR, 3-14 years) and 34.7% of patients were Hispanic ethnicity, followed by non-Hispanic Black (28.3%) and non-Hispanic White (16.8%) (Table I).

Patients were referred to the testing site using telemedicine (44.3%), office visits (15.4%), and telephone calls (7.6%).

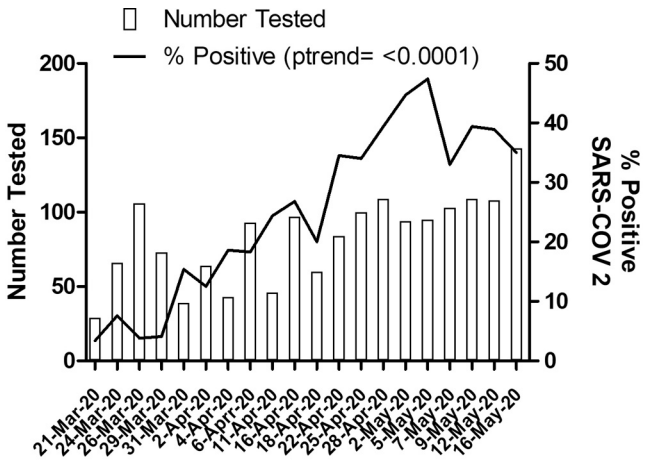

Figure 1. Trends in testing and positivity rates. Average number of daily SARS-CoV-2 specimen collections and positive test rates.

Table I. Selected patient demographics of patients referred for SARS-COV-2 testing

Characteristics	Total	Result status		Odds of positive test	
		Negative (n = 1037; 71.8%)	Positive (n = 408; 28.2%)	OR (95% CI)	aOR (95% CI)*
Age, years					
<1	119 (8.2%)	83 (8.0)	36 (8.8)	Referent	Referent
1-4	383 (26.5)	311 (30.0)	72 (17.6)	0.5 (0.3-0.9)	0.5 (0.3-0.8)
5-11	428 (29.6)	292 (28.2)	136 (33.3)	1.1 (0.7-1.7)	0.8 (0.5-1.3)
12-17	344 (23.8)	224 (21.6)	120 (29.4)	1.2 (0.8-1.9)	1.0 (0.6-1.6)
18-22	171 (11.8)	127 (12.3)	44 (10.8)	0.8 (0.5-1.3)	0.7 (0.4-1.2)
Sex					
Female	697 (48.2)	496 (47.8)	201 (49.3)	Referent	Referent
Male	733 (50.7)	539 (52.0)	194 (47.6)	0.9 (0.7-1.1)	0.9 (0.7-1.2)
Not documented	15 (1.0)	2 (0.2)	13 (3.2)	–	–
Race/ethnicity					
Non-Hispanic White	243 (16.8)	225 (21.7)	18 (4.4)	Referent	Referent
Non-Hispanic Black	409 (28.3)	305 (29.4)	104 (25.5)	4.3 (2.5-7.2)	4.1 (2.4-7.0)
Hispanic	501 (34.7)	268 (25.8)	233 (57.1)	10.9 (6.5-18.1)	10.3 (6.2-17.3)
Other	173 (12.0)	147 (14.2)	26 (6.4)	2.2 (1.2-4.2)	2.3 (1.2-4.4)
Unknown/missing	119 (8.2)	92 (8.9)	27 (6.6)	–	–
Distance from testing site-miles	7.3 (4.3-12.9)	7.0 (2.0-14.0)	10 (4.0-14.0)	0.9 (0.9-1.0)	0.9 (0.9-1.0)
Referral visit type					
Office	110 (7.6)	75 (7.2)	35 (8.6)	Referent	Referent
Telemedicine	640 (44.3)	455 (43.9)	185 (45.3)	0.9 (0.6-1.3)	–
Phone	223 (15.4)	129 (12.4)	94 (23.0)	1.6 (0.9-2.5)	–
Missing	472 (32.7)	378 (36.5)	94 (23.0)	–	–

Values are number (%) or median (IQR) unless otherwise noted.
*Adjusted for age, race/ethnicity, sex, and distance from specimen collection site.

The most common reasons were a high-risk family member (35%) or need to know for work (30%) (Figure 2). Of those tested, 83.7% (n = 1210) had symptoms documented by the referring provider. The most common symptoms reported were lower respiratory complaints (41.6%) and fever (35%) (Table II). The median distance from the patients' homes to the specimen collection site was 7.3 miles (IQR, 4.3-12.9 miles); the farthest distance traveled was 73.6 miles (Figure 3; available at www.jpeds.com).

Characteristics of Patients who were SARS-CoV-2-Positive

We found no notable sex or age differences among those with confirmed infection. Compared with non-Hispanic White children and after adjustments for age, sex, and distance of residence from specimen collection site, minority children had a higher likelihood of infection (Hispanic, aOR, 10.3; 95% CI, 6.2-17.3; non-Hispanic Black, aOR, 4.1; 95% CI, 2.4-7.0) (Table I).

Patients who self-reported a known exposure to COVID-19 were more likely to test positive compared with those who did not report a known exposure (aOR, 1.6; 95% CI, 1.0-2.4). Other reasons for referral (need to know for work, high-risk patient for exposure or infection, household member with high risk for exposure or infection) were not associated with positivity. Patients with a cough (aOR, 1.4; 95% CI, 1.1-1.9) or fever (aOR, 1.7; 95% CI, 1.3-2.3) were more likely to have a positive test than patients without those symptoms. Neurologic, upper respiratory tract symptoms, lower respiratory tract symptoms and gastrointestinal symptoms were not associated with testing positive in our population (Table II).

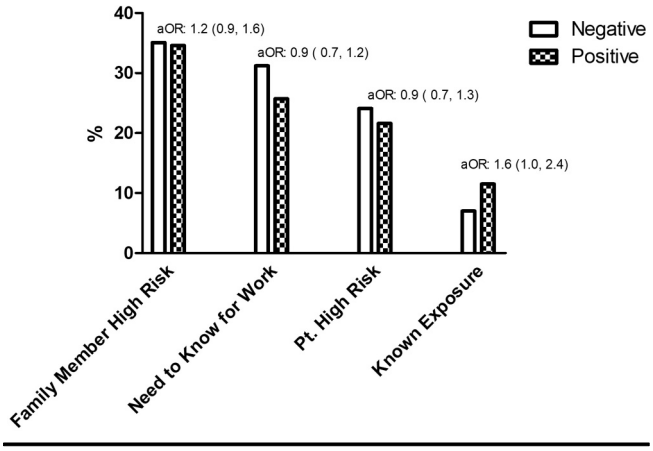

Figure 2. Referral reasons for SARS-CoV-2 testing. Frequency of referral reasons for SARS-CoV-2 testing.

Discussion

This study describes the clinical and demographic characteristics of a large sample of children referred to a community-based SARS-CoV-2 drive-through/walk-up testing site in Washington, DC, because of the risk of exposure or infection or both. The overall positivity rate was nearly 30%; rates increased throughout the study period from approximately 5% to almost 50% at the peak on May 5, 2020. The daily positivity rates throughout the study period followed a trend similar to the overall population's SARS-CoV-2 rates for the Washington, DC, and the surrounding regions, suggesting that children have a similar prevalence of viral infection

Table II. Reported symptoms among patients referred for SARS-COV-2 testing (n = 1210)

Symptoms*	No. (%)	Result status		Odds of positive test	
		Negative (n = 832; 68.8%)	Positive (n = 378; 31.2%)	OR (95% CI)	aOR (95% CI)†
None	411 (34.0)	288 (34.6)	123 (32.5)	0.9 (0.7-1.2)	0.8 (0.6-1.0)
Fever	423 (35.0)	276 (33.2)	147 (38.9)	1.3 (1.0-1.7)	**1.7 (1.3-2.3)**
Neurologic	195 (16.1)	124 (14.5)	71 (18.8)	1.3 (1.0-1.8)	1.2 (0.9-1.8)
Upper respiratory tract symptoms	385 (32.0)	266 (32.0)	119 (31.5)	1.0 (0.9-1.3)	1.1 (0.8-1.4)
Cough	487 (40.3)	213 (37.5)	175 (46.3)	**1.4 (1.1-1.8)**	**1.4 (1.1-1.9)**
Lower respiratory symptoms	67 (5.5)	54 (6.5)	13 (3.4)	**0.5 (0.3-0.9)**	0.5 (0.3-1.0)
Gastrointestinal symptoms	150 (12.4)	115 (13.8)	35 (9.3)	**0.6 (0.4-0.9)**	0.8 (0.5-1.2)

Bold represents a *P* value of < .05. Values are number (%) unless otherwise indicated.
*Not mutually exclusive.
†Adjusted for age, race/ethnicity, sex, and distance from specimen collection site.

compared with adults with risk factors for exposure, despite different rates of illness severity in children.[11]

Patients with COVID-19 exposure and symptoms were more likely to have a positive test than patients without symptoms. This finding supports the need for contact tracing for symptomatic cases and for testing as important tools in detecting and containing community spread. Although most patients were referred because they lived with a family member with a high risk for exposure or infection, this factor was not associated with positive test results.

To alleviate the risk of unintentional viral transmission between patients and healthcare providers, physicians have rapidly adopted telemedicine during the pandemic.[12] In line with this recent transition, most referrals to the testing site were after telemedicine visits. The drive-through site allows pediatricians to avoid having to bring potentially infectious patients into their offices that may not be equipped with the personal protective equipment required to handle test collection safely.

This study had several limitations. This was a retrospective study reliant on the accuracy of the data collected at the time of physician referral and the electronic health record. Approximately one-third of patients tested were young children (≤5 years of age); therefore, the number and type of reported symptoms may have been underestimated. The small number of patients <1 year of age limits our ability to confidently comment on the symptomatology and severity of illness in infants with positive SARS-CoV-2 tests. Although this testing site was a unique resource for children early in the pandemic, over time, additional venues opened; therefore, these data may not represent the entire spectrum of children undergoing testing who have mild illness or a high risk of exposure.

The impact of SARS-CoV-2 is broad and impacts planning for children, especially as schools and childcare centers reopen. Understanding the community prevalence of infection in the pediatric population may also have implications for individuals who reside or work with children. A determination of the transmission potential of these mildly symptomatic or well children and young adults is important for guiding the development of measures to control the ongoing pandemic. ■

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Data Statement

Data sharing statement available at www.jpeds.com.

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50 Years Ago in *The Journal of Pediatrics*

The Wind of Change in Lactose Malabsorption Diagnostics: From Invasive Tolerance Tests to Hydrogen Breath Tests

Varavithya W, Valyasevi A, Charuchinda S. Lactose Malabsorption in Thai Infants. J Pediatr 1971;78:710-5.

The 1970s marked an era of development of noninvasive modalities for diagnosing lactose malabsorption, a common pediatric problem with a worldwide prevalence of 68%.[1] Healthy infants have abundant lactase activity to digest the main sugar in milk, lactose, to glucose and galactose. The enzyme activity gradually decreases in early childhood, especially in preschool aged children, as shown in numerous epidemiological studies.[2] In 1971, Varavithya et al focused on the prevalence of lactose malabsorption in a cohort of malnourished Thai infants using both the lactose tolerance test and the glucose-galactose tolerance test. In both modalities, children are given a predetermined amount of the respective sugars orally after a period of fasting with frequent blood draws at 20 minute intervals over a 2-hour period. Lactose, glucose, or galactose malabsorption is shown by an increase in the serum blood sugar of less than 20 mg/dL.

Levitt introduced the concept of breath hydrogen generation during lactose fermentation in adults, which eventually changed the clinical diagnostics of lactose malabsorption.[3] The concept led to the development of the noninvasive lactose hydrogen breath test, often used in cooperative young children able to drink a formulation of lactose and exhale when asked to do so. Bacteria ferment the malabsorbed sugar when given orally to produce hydrogen and methane, which is then exhaled. Patients with an increase of more than 20 ppm of hydrogen in exhaled air within 3 hours are determined to have lactose malabsorption, with 77.5% sensitivity and 97.6% specificity.[1,4] The test can include simultaneous symptom assessment of abdominal pain, bloating, flatulence, and diarrhea. In the late 1970s, lactase activity was also assessed on duodenal biopsy samples obtained during esophagogastroduodenoscopy. The procedure is not indicated for the sole reason to test for lactose malabsorption owing to its invasive nature and the need for anesthesia. Moreover, low tissue enzyme levels correlate poorly with patient-specific symptoms. Genetic testing can detect polymorphism if present, but also fails to allow symptom assessment, is more costly, and is often used for epidemiologic studies.

Although the diagnostic modalities for lactose malabsorption have progressed since the 1970s, the lack of a gold standard has caused variability in clinical practice. Empiric treatment options are available for perceived symptoms consistent with lactose intolerance and consist of avoidance of excessive amounts of dairy, use of lactase-containing tablets and beverages, prebiotics, or probiotics. In children with symptoms suggestive of malabsorption or symptoms impacting growth or the quality of life, we recommend further testing to confirm the diagnosis and consider other etiologies. We suggest the use of hydrogen breath tests as first line owing to its high sensitivity; all it takes is a breath of fresh air.

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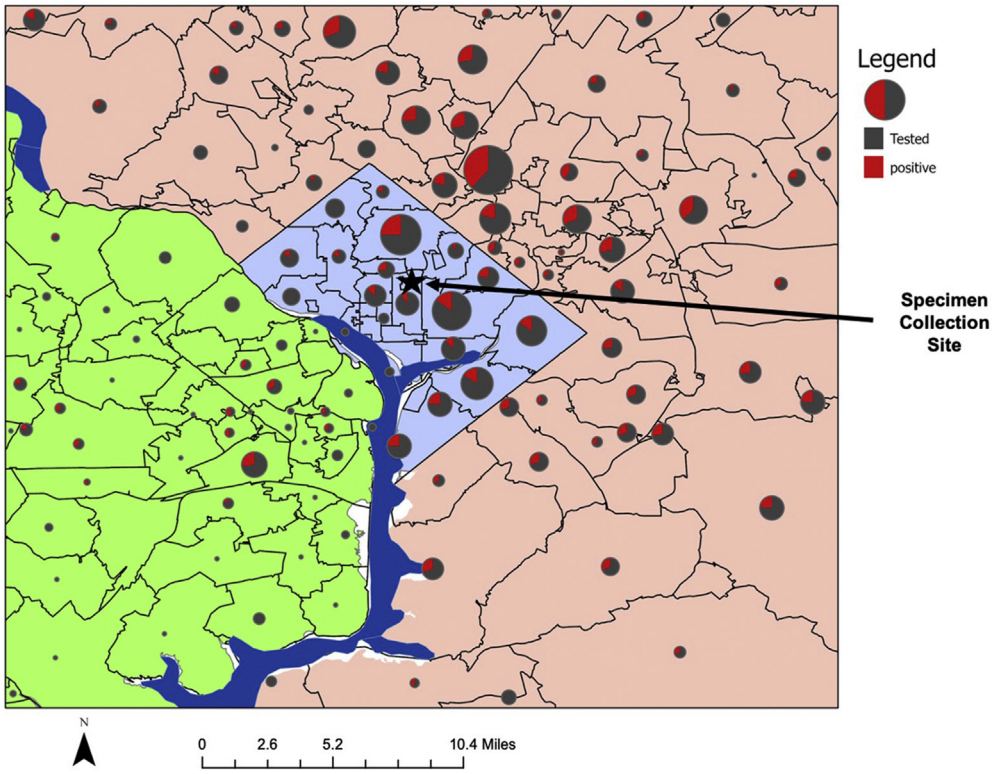

Figure 3. Geographic distribution of patients referred to specimen collection site. Geographic distribution of patients referred to testing site across 3 distinct regions: Washington DC, Maryland, and Virginia. The star and the arrow show the location of the specimen collection site.