SARS CoV-2 seroprevalence in a US school district during COVID-19

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ABSTRACT

Reduced symptomatology and access to testing in children have led to underestimates of paediatric COVID-19 prevalence and raised concerns about school safety. To explore COVID-19 prevalence and risk factors in school settings, we conducted a SARS-CoV-2 serosurvey in a Vermont, USA school district in December 2020. Among 336 students (63%) and 196 teachers/staff (37%), adjusted seroprevalence was 4.7% (95% CI 2.9 to 7.2) and was lowest in preK-5 students (4–10 Years). Seroprevalence was 10-fold higher than corresponding state PCR data but was low overall with no evidence of onward transmissions. These results further support feasibility of in-person learning during COVID-19 with appropriate mitigation measures.

At the beginning of the COVID-19 pandemic, near-universal school closures were enacted to mitigate spread of SARS-CoV-2. Early studies suggested that children were less susceptible to SARS-CoV-2 and less likely to transmit.1 However, their high frequency of asymptomatic infections2 called into question the accuracy of incidence estimates using symptom-based testing and the true role of paediatric transmission, concerns that heavily influenced school reopening debates.

Therefore, we conducted a cross-sectional serosurvey to estimate COVID-19 prevalence and risk factors among students and staff attending ≥2 days/week of in-person learning in Colchester School District (Vermont, USA). Patients or the public were not involved in study design, conduct, reporting or dissemination. The University of Vermont Institutional Review Board approved the study. All participants/parent provided written informed consent and all children ≥grade 6 provided written assent. Exclusion criteria including bleeding or clotting disorder or other condition that would preclude safe blood collection. Capillary blood collection via fingerprick was performed 2–19 December 2020 for detection of serum antibodies to both receptor binding domain and full-length spike protein.3 4 Participants completed a self-administered REDCap questionnaire to assess risk factors (online supplemental materials). At the time of the study, state guidelines mandated universal masking for all students and staff and physical distancing of three feet for pre-Kindergarten (pre-K)–6th-grade students and six feet for 7th–12th-grade students. Seroprevalence with 95% CIs was calculated using Blaker’s method and adjusted for estimated assay sensitivity (95%) and specificity (99%) according to the formula prevalence adjusted = (prevalence observed +specificity-1)/(sensitivity +specificity -1).4

A total of 532 enrolled participants completed antibody measurement: 336 students (63%) and 196 teachers/staff (37%). The participation rate was 18% among students, equally distributed across age groups and 44% among teachers/staff. Overall adjusted seroprevalence was 4.7% (95% CI 2.9 to 7.2) and was similar among students and teachers/staff (table 1). Adjusted seroprevalence was lowest (1.8%, 95% CI 0.0 to 5.8) in pre-K-5 students. 527 participants (99%) completed the questionnaire, including all seropositive individuals. 95% identified as white race alone, similar to Vermont overall (94%). Two teachers/staff reported prior COVID-19, both were seronegative. Eighteen participants reported prior household COVID-19 contact between March and December 2020; none was seropositive. Thirty participants reported close non-household COVID-19 contact, only one student was seropositive. No associations were detected between seropositivity and out-of-state travel, sports participation, group activities or symptomatic illness without confirmatory testing. Nearly, all (99%) reported that family members wore masks ≥75% of the time in public.

In a low-incidence US region, we detected low SARS-CoV-2 seroprevalence among...
Table 1  SARS-CoV-2 IgG seroprevalence

<table>
<thead>
<tr>
<th>Total N</th>
<th>Age, years median (IQR)</th>
<th>Seropositive N</th>
<th>Unadjusted seroprevalence % (95% CI)</th>
<th>Adjusted seroprevalence % (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teachers/staff</td>
<td>196</td>
<td>45.1 (36.3–53.4)</td>
<td>11</td>
<td>5.6 (2.9 to 9.8)</td>
</tr>
<tr>
<td>Students</td>
<td>336</td>
<td>12.2 (8.5–14.9)</td>
<td>18</td>
<td>5.4 (3.3 to 8.2)</td>
</tr>
<tr>
<td>PreK-5</td>
<td>149</td>
<td>8.3 (6.7–9.8)</td>
<td>4</td>
<td>2.7 (0.9 to 6.5)</td>
</tr>
<tr>
<td>Grades 6–8</td>
<td>82</td>
<td>13.1 (12.3–13.8)</td>
<td>6</td>
<td>7.3 (3.2 to 14.9)</td>
</tr>
<tr>
<td>Grades 9–12</td>
<td>105</td>
<td>16.1 (15.1–17.1)</td>
<td>8</td>
<td>7.6 (3.4 to 14.4)</td>
</tr>
<tr>
<td>Grades 6–12</td>
<td>187</td>
<td>14.6 (13.3–16.3)</td>
<td>14</td>
<td>7.5 (4.4 to 12.1)</td>
</tr>
<tr>
<td>Total</td>
<td>532</td>
<td>–</td>
<td>29</td>
<td>5.5 (3.7 to 7.7)</td>
</tr>
</tbody>
</table>

N, number; preK, pre-Kindergarten.

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Contributors  BL conceptualised and designed the study, managed recruitment, enrolment, specimen collection, processing and ELISA; performed data management and analyses and reviewed and revised the manuscript. SSMB performed specimen collection and ELISA, data entry, drafted the initial manuscript and reviewed and revised the manuscript. BG and SC assisted with study instrument design, managed and performed specimen collection and reviewed and revised the manuscript. SAD, NRG and MC established and/or performed ELISA, and reviewed and revised the manuscript. DD assisted with study design, performed instrument design and data management, performed analyses and reviewed and revised the manuscript. BDK reviewed and revised the manuscript. All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

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