

Masking Adherence in K–12 Schools and SARS-CoV-2 Secondary Transmission

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abstract

OBJECTIVES: Masking is an essential coronavirus 2019 mitigation tool assisting in the safe return of kindergarten through 12th grade children and staff to in-person instruction; however, masking adherence, compliance evaluation methods, and potential consequences of surveillance are currently unknown. We describe 2 school districts' approaches to promote in-school masking and the consequent impact on severe acute respiratory syndrome coronavirus 2 secondary transmission.

METHODS: Two North Carolina school districts developed surveillance programs with daily versus weekly interventions to monitor in-school masking adherence. Safety teams recorded the proportion of students and staff appropriately wearing masks and provided real-time education after observation of improper masking. Primary infections, within-school transmission, and county-level severe acute respiratory syndrome coronavirus 2 infection rates were assessed.

RESULTS: Proper mask use was high in both intervention groups and districts. There were variations by grade level, with lower rates in elementary schools, and proper adherence being higher in the weekly surveillance group. Rates of secondary transmission were low in both districts with surveillance programs, regardless of intervention frequency.

CONCLUSIONS: Masking surveillance interventions are effective at ensuring appropriate masking at all school levels. Creating a culture of safety within schools led by local leadership is important and a feasible opportunity for school districts with return to in-person school. In our study of schools with high masking adherence, secondary transmission was low.



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Dr Kalu conceptualized and designed the study, drafted the initial manuscript, and reviewed and revised the manuscript; Mr Warren, Mr Garcés, and Ms Pendleton conceptualized and designed the study, drafted the initial manuscript, designed the data collection instruments, collected data, conducted the initial analyses, and reviewed and revised the manuscript; Dr Brookhart conducted the initial analyses and reviewed and revised the manuscript; Ms Edwards designed the data collection instruments, collected data, conducted the initial analyses, and reviewed and revised the manuscript; Drs Benjamin, Boutzoukas, Corneli, Jackman, Weber, Maradiaga Panayotti, and Ms Blakemore reviewed and revised the manuscript; Drs Moorthy, Mann, and Zimmerman, conceptualized and designed the study, drafted the initial manuscript, coordinated and supervised data collection, designed the data collection instruments, collected data, conducted the initial analyses, and critically reviewed the manuscript for important intellectual content; and all authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

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WHAT'S KNOWN ON THIS SUBJECT: Masking is an effective method to limit severe acute respiratory syndrome coronavirus 2 transmission in schools. Public health and child health organizations recommend universal masking in schools, given increasing rates of highly transmissible variants and the fact that most children are not yet eligible for vaccination.

WHAT THIS STUDY ADDS: Masking surveillance interventions are effective at ensuring highly consistent masking at all grade levels. Creating a culture of safety within schools may be feasible through adherence evaluations. Secondary transmission rates are low when school communities have high masking adherence.

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During the coronavirus 2019 (COVID-19) pandemic, masking has been an effective strategy for controlling transmission of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2).¹ Similarly, masking has been an essential component for the safe return of kindergarten through 12th grade (K–12) schoolchildren and staff to in-person classrooms, particularly because children younger than 12 years of age are currently ineligible for vaccination.^{2–5} Masking is effective, even in settings of poor ventilation, emerging viral variants, and under circumstances of reduced physical distancing (<6 ft) between students and/or staff.^{2,6–8} Nevertheless, masking remains one of the most controversial topics both within and outside of the K–12 school community.

In May 2021, the Centers for Disease Control and Prevention (CDC) revised its guidance to only recommend mask use in some settings according to vaccination status. In early July 2021, the CDC suggested that only those who were unvaccinated should mask in the school setting.⁹ This guidance prompted a “return to normal” with subsequent lifting of many statewide masking mandates, physical distancing requirements, and capacity limits for indoor activities. Recently, spread of the highly transmissible SARS-CoV-2 variant, B.1.617.2 (ie, Delta variant), has led to increased COVID-19 cases worldwide, particularly among those who are unvaccinated. The CDC issued revised guidance in late July 2021 that aligned with the American Academy of Pediatrics, recommending masking for all individuals in K–12 schools, regardless of vaccination status, given the rapid spread of the Delta variant and lack of vaccine eligibility for those <12 years of age. The

discrepancies in masking recommendations from public health organizations has created even more confusion for those who are working to maintain a safe environment for return to in-person school during the upcoming school semester, which happens to coincide with respiratory illness season. Additionally, school staff and many parents of children <12 years remain adamant that masking in schools must occur for them to feel that school buildings are safe, yet schools are struggling to contend with increasing opposition to masking in their surrounding communities.

There is substantial evidence to support the use of masking as an effective method to limit SARS-CoV-2 transmission in schools.^{2,4,5} However, student and staff adherence to masking, optimal methods to evaluate and encourage masking on the basis of surveillance, and potential consequences of masking surveillance within school buildings are currently unknown, particularly given the rapidly changing public health guidance and increasing opposition within local communities. In this article, we describe 2 school districts’ approaches to evaluate and encourage masking in schools during the fourth quarter of the 2020–2021 school year. We also characterize the relationship between masking evaluation method and adherence.

METHODS

Target Population

The ABC Science Collaborative (ABCs) worked with 2 large (>15 000 students) traditional public school districts in North Carolina to design and evaluate masking interventions. District 1 initially returned prekindergarten students to in-person classrooms in

September 2020, followed by other elementary school students and a small number of high school students. All phase-in activities for these students were completed by mid-November 2020, and ~20 000 students returned to in-person class 5 days a week. Grades 6–12 were subsequently phased in by using a hybrid model that combined virtual learning and in-person school starting in late February 2021 and transitioned to in-person class 5 days per week by mid-April 2021.

District 2 opened school buildings in mid-August 2020 for in-person learning, 5 days per week for prekindergarten to fifth grade and 2 days per week for sixth to 12th grade. All students returned to in-person classes 5 days a week in early April 2021. Both schools followed guidance outlined in the StrongSchoolsNC Public Health Toolkit (K–12).¹⁰ Schools were encouraged to maintain a minimum of 3 ft of distance between K–12 students, whenever possible. Neither district 1 nor district 2 had major changes to their ventilation systems, and students and staff did not undergo routine surveillance testing for SARS-CoV-2.

Interventions

From April 5, 2021, to May 21, 2021, each district implemented their own surveillance program to monitor masking adherence within school buildings (Table 1). The CDC’s guidance change to masking based on vaccination status occurred on May 13, 2021, which was at the end of week 6 of the 7-week study period.

In district 1, the mask adherence surveillance plan was developed by the local teachers’ organization that included staff (ie, teachers, school administrators) from each school in the district. On return to in-person education, local school leadership (ie, teachers, administrators, and

TABLE 1 Masking Surveillance Program Descriptions

	District 1	District 2
Leadership	Local teachers' organization and local school leadership	School district administration
School levels	Elementary schools (9)	Elementary (17), middle (9), and high schools (9)
Education	Teachers' organization educating school leaders, safety teams, video on proper masking	ABCs provided education on proper masking to district administrators
Intervention	Safety team member reminding individuals of correct masking in real time	Administrator reminding individuals of correct masking in real time
Monitoring frequency	Daily (4 schools), weekly (2 schools), none/control (3 schools)	Daily in 20% of students and staff at all schools in district
Weeks of intervention	Weeks 1–6 (April 5, 2021–May 14, 2021)	Weeks 3–7 (April 19, 2021–May 21, 2021)

staff) served as a safety team to encourage and monitor appropriate safety measures, including masking. This grassroots effort was led and designed by school leadership to best fit the needs of their school, staff, and students. The teachers' organization collaborated with ABCs to develop a video on the specific criteria for proper mask use (cloth or medical mask worn over the nose, mouth, and chin) and designed the 6-week pilot intervention to monitor masking adherence.

Nine of eleven elementary schools in district 1 participated in the pilot intervention. District 1 schools conducted surveillance during weeks 1–6 of the study period. Safety team leaders at 4 school buildings performed daily walkthroughs to document the proportion of students and staff properly wearing masks. When students and staff were identified without masks or with improper mask use (eg, not fully covering the nose, mouth, and chin), the safety team member gently reminded these individuals of the importance of correct masking and asked for the mask to be worn appropriately.¹¹ At 2 schools, walkthroughs and mask evaluations occurred once per week. At the end of each week, the safety teams reported their findings to school administrators; if <90% masking adherence within a school

building was documented over the course of a week, then a remediation plan was developed.

In collaboration with ABCs, district 2 administrators developed the masking adherence pilot intervention in elementary, middle, and high schools in response to rising rates of within-school transmission. Similar to district 1, this was a grassroots effort tailored to the school district with the input of school administrators. District 2 schools conducted masking surveillance during weeks 3–7 of the study period. During the 5-week study period, district administrators evaluated daily mask use in a randomly selected 20% of students and staff at each school.

Administrators recorded the portion of evaluated students and staff that were appropriately wearing masks during walkthroughs. If improper masking was observed, then administrators provided a real-time, verbal reminder to these students and staff of the importance of proper masking and asked for the mask to be adjusted accordingly. Notably, although researchers in previous studies have used more standardized and structured observational methods, the school districts in our study designed feasible, observational methods tailored to the needs and capacities of their specific district and school

population that aligned with CDC guidance.^{12–14}

Additional Data Sources

To characterize county-level COVID-19 rates during the study period in districts 1 and 2, in-school attendance, and school demographics, we used state-level data from 3 publicly available online databases: the John Hopkins University Coronavirus Resource Center,¹⁵ the North Carolina Department of Public Instruction's Principal's Monthly Report,¹⁶ and the Public Schools of North Carolina Statistical Profile.¹⁷ Primary SARS-CoV-2 infections and within-school transmission were obtained from a concurrent study performing weekly surveillance of these metrics by school in 100 public school districts in North Carolina over a 12-week period (ABCs of North Carolina's Plan A, Duke University Institutional Review Board, Pro00108073).

Outcome Measures

The primary study outcome was the proportion of observed students and staff with appropriate mask use. The secondary outcome was secondary transmission rates within schools participating in the masking project.

Statistical Analysis

We used SAS v9.4 (SAS Institute, Inc, Cary, NC) for all statistical analyses.

We used descriptive statistics to analyze appropriate mask use overall, by week, by district, and by study cohort (daily evaluation by staff, daily evaluation by administrators, weekly evaluation by staff). We used generalized estimating equations with an independent correlation structure to estimate predictors of masking adherence.

Institutional Review Board Approval

This work was declared as exempt research under the ABCs research program by the Duke University Institutional Review Board (Pro00108127).

RESULTS

Study Population

In District 1, the 6 elementary schools with masking surveillance interventions enrolled a total of ~2400 students. District 2 included 17 elementary schools, 9 middle schools, and 9 high schools, with a total enrollment of ~20 000 students (Table 2). The district 1 schools enrolled fewer White students than district 2 schools (22% vs 63% respectively; Table 2). The 2 school districts had similar overall percentage of students on-site for in-person instruction (78.2% district 1 vs 81% district 2; Table 2); however, district 2 had variable percentages of learners on-site, depending on school and grade level (eg, (80% to 94% in middle and 46% to 100% in high school; Table 2).

Primary Cases and Secondary Transmission

Within the 2 school districts, 127 primary SARS-CoV-2 infections (ie, community-acquired) were documented by diagnostic testing during the study period; however, there were only 14 cases of secondary (ie, within school) transmission in the 2 districts

during the study period (Table 3). There were 10 primary infections (0.42%) and only 1 secondary infection in district 1—participating schools. District 2 had 117 documented primary infections (0.58%) across all participating schools. There were 13 secondary infections in district 2 in four different schools, all of which occurred during weeks 3 to 7; 11 occurred in middle schools and 2 occurred in 1 high school. During the study period, county-level rates of infection remained low in both districts (county 1, 0.06% to 0.18%; county 2, 0.07% to 0.14%; Table 2).

Masking Adherence Over Time by District, School Level, and Surveillance Program

There was high masking adherence (>80%) in both school districts at all school levels (elementary, middle, and high school). Proper mask adherence remained consistently high over the study period, despite changes in CDC guidance and county rates of infection (Fig 1). The percentage of students and staff properly masked at all elementary schools ranged from 89% in week 1 to 82% in week 7 and were similar in district 1 (88% to 90%) and district 2 (81% to 85%); Table 4. In district 2, the percentage of proper masking adherence was 81% to 95%, and it was similar in middle and high schools for students, staff, and overall (Table 4).

In district 1, the weekly surveillance cohort had a higher proportion of students and staff with appropriate masking than the daily surveillance cohort (1.82 [95% confidence interval: 1.22–2.72]; Table 5). Higher grade level was a predictor of masking adherence (Table 5).

DISCUSSION

With this study, we assessed the effect of masking surveillance

interventions on appropriate mask adherence in school settings and evaluated the relationship between masking adherence and secondary transmission of SARS-CoV-2 amid changing public health guidance and increasing community opposition to masking. We found that masking adherence was high in both daily and weekly surveillance groups (88% to 95%) and across varying grade levels in both districts (82% to 95%). There were variations by grade level, with lower rates of proper masking in elementary schools, and higher proper masking adherence in the weekly surveillance group, which may reflect that our study captured variability in multiple, different cohorts. Rates of secondary transmission were low in daily and weekly masking intervention cohorts and in both districts. Our findings also suggest that elementary school students should have close surveillance of masking adherence, particularly with the spread of variants and lack of vaccine availability in this age group. Lessons learned from this evaluation may be useful going forward as school districts plan for in-person school attendance in the middle of an ever-changing pandemic.

The effects of surveillance and real-time education on proper mask adherence have not previously been studied. Additionally, the efficacy of a grassroots intervention such as ours in mitigating in-school spread has not previously been measured. Researchers in an observational study in Georgia elementary schools who assessed the period of time that an entire class was appropriately masked found that younger, elementary-aged students had lower adherence but could reliably wear masks during the school day.¹⁸ We found that middle and high school students had a

TABLE 2 School Demographics

	Total Enrolled, <i>n</i> (%)	Male, <i>n</i> (%)	White, <i>n</i> (%)	On-Site, <i>n</i> (%)
All schools	22 325	11 464 (51)	13 015 (58)	17 706/21 983 (81)
District 1	2405	1 238 (52)	535 (22)	1880/2405 (78)
School 1-1	419	208 (50)	8 (2)	323/419 (77)
School 1-2	159	79 (50)	4 (3)	111/159 (70)
School 1-3	448	226 (50)	22 (5)	345/448 (77)
School 1-4	465	244 (53)	20 (4)	353/465 (76)
School 1-5	651	340 (52)	477 (73)	514/651 (79)
School 1-6	263	141 (54)	4 (2)	234/263 (89)
District 2	19 920	10 226 (51)	12 480 (63)	15 826/19 578 (81)
Elementary schools	8107	4229 (52)	4906 (61)	7470/8375 (89)
School 2.1-1	365	197 (54)	48 (13)	331/374 (89)
School 2.1-2	713	381 (53)	221 (31)	579/707 (82)
School 2.1-3	322	167 (52)	162 (50)	310/325 (95)
School 2.1-4	332	168 (51)	231 (70)	335/352 (95)
School 2.1-5	514	278 (54)	163 (32)	488/547 (89)
School 2.1-6	651	334 (51)	440 (68)	608/687 (89)
School 2.1-7	243	123 (51)	188 (77)	222/237 (94)
School 2.1-8	228	113 (50)	175 (77)	188/234 (80)
School 2.1-9	608	310 (51)	417 (69)	536/639 (84)
School 2.1-10	487	229 (47)	186 (38)	436/480 (91)
School 2.1-11	524	285 (54)	387 (74)	513/569 (90)
School 2.1-12	469	261 (56)	316 (67)	463/492 (94)
School 2.1-13	641	338 (53)	526 (82)	628/681 (92)
School 2.1-14	622	329 (53)	383 (62)	570/625 (91)
Middle schools	4756	2429 (51)	2925 (62)	4201/4781 (88)
School 2.1-15	352	159 (45)	317 (90)	338/361 (94)
School 2.1-16	395	209 (53)	255 (65)	339/388 (87)
School 2.1-17	641	348 (54)	491 (77)	586/677 (87)
School 2.2-1	489	209 (43)	317 (65)	403/465 (87)
School 2.2-2	590	303 (51)	440 (75)	527/571 (92)
School 2.2-3	379	201 (53)	241 (64)	341/385 (89)
School 2.2-4	632	325 (51)	465 (74)	573/663 (86)
School 2.2-5	467	236 (51)	92 (20)	454/490 (93)
School 2.2-6	545	253 (46)	412 (76)	429/534 (80)
High schools	7057	3568 (51)	4649 (66)	4155/6422 (65)
School 2.2-7	621	337 (54)	483 (78)	548/626 (88)
School 2.2-8	620	340 (55)	341 (55)	565/620 (91)
School 2.2-9	413	225 (55)	134 (32)	361/427 (85)
School 2.3-1	1980	1052 (53)	1563 (79)	900/1970 (46)
School 2.3-2	1600	812 (51)	1143 (71)	1061/1519 (70)
School 2.3-3	246	102 (42)	175 (71)	138/138 (100)
School 2.3-4	854	416 (49)	193 (23)	601/828 (73)
School 2.3-5	923	493 (53)	635 (69)	597/845 (71)
School 2.3-6	230	119 (52)	140 (61)	65/65 (100)
School 2.3-7	133	61 (46)	119 (90)	128/128 (100)
School 2.3-8	817	427 (52)	525 (64)	534/798 (67)
School 2.3-9	274	86 (31)	156 (57)	131/131 (100)

Total percentages may not add to 100% because of rounding.

higher percentage of proper masking when compared with elementary school students; however, adherence reached 90% in some elementary schools, and surveillance interventions may increase adherence. The groups studied had high adherence to masking; therefore, we did not see changes in adherence reflected over

time. The sampling structure of our study, particularly in district 2, may not wholly reflect subtle improvements in masking adherence because it is possible that the same group of students were not re-evaluated given random sampling. Nevertheless, in some settings, just-in-time education may ensure appropriate mask use and, as a

result, prevent in-school COVID-19 spread. Our study continues to support existing data on low secondary transmission rates in schools that implemented various mitigation strategies.⁴

CDC guidance regarding masking in communities and within schools is ever-changing on the basis of the

TABLE 3 Within-School and District-Level Infections During Study Period

	Week 1, n (%)	Week 2, n (%)	Week 3, n (%)	Week 4, n (%)	Week 5, n (%)	Week 6, n (%)	Week 7, n (%)
All schools							
Primary infections	3/17 706 (0.02)	26/17 706 (0.15)	26/17 706 (0.15)	17/17 706 (0.10)	13/17 706 (0.07)	28/17 706 (0.16)	14/17 706 (0.08)
Secondary infections	0	0	2/17 706 (0.01)	5/17 706 (0.03)	0	5/17 706 (0.03)	2/17 706 (0.01)
District 1							
County infection rate	927/537 174 (0.17)	980/537 174 (0.18)	855/537 174 (0.16)	679/537 174 (0.13)	536/537 174 (0.10)	592/537 174 (0.11)	327/537 174 (0.06)
Elementary schools							
Primary infections	0	0	4/1880 (0.21)	1/1880 (0.05)	1/1880 (0.05)	3/1880 (0.16)	1/1880 (0.05)
Secondary infections	0	0	0	0	0	1/1880 (0.05)	0
District 2							
County infection rate	198/181 806 (0.11)	251/181 806 (0.14)	247/181 806 (0.14)	222/181 806 (0.12)	205/181 806 (0.11)	208/181 806 (0.11)	131/181 806 (0.07)
Primary infections	3/15 826 (0.02)	26/15 826 (0.16)	22/15 826 (0.14)	16/15 826 (0.10)	12/15 826 (0.08)	25/15 826 (0.16)	13/15 826 (0.08)
Secondary infections	0	0	2/15 826 (0.01)	5/15 826 (0.03)	0	4/15 826 (0.03)	2/15 826 (0.01)
Elementary schools							
Primary infections	1/7470 (0.01)	6/7470 (0.08)	9/7470 (0.12)	7/7470 (0.09)	5/7470 (0.07)	7/7470 (0.09)	3/7470 (0.04)
Secondary infections	0	0	0	0	0	0	0
Middle schools							
Primary infections	1/4201 (0.02)	10/4201 (0.24)	5/4201 (0.12)	1/4201 (0.02)	5/4201 (0.12)	8/4201 (0.19)	5/4201 (0.12)
Secondary infections	0	0	2/4201 (0.05)	5/4201 (0.12)	0	4/4201 (0.10)	0
High schools							
Primary infections	1/4155 (0.02)	10/4155 (0.24)	8/4155 (0.19)	8/4155 (0.19)	2/4155 (0.05)	10/4155 (0.24)	5/4155 (0.12)
Secondary infections	0	0	0	0	0	0	2/4155 (0.05)

prevalence of COVID-19 transmission. During this study, although CDC masking guidance in community settings changed, masking adherence within these schools did not. County-level transmission rates also had no impact on in-school mask adherence. These data suggest that staff members were adept at maintaining consistent and high levels of mask adherence, even as guidance and community infection rates fluctuated.

Because masking remains a divisive issue in the United States, regular internal surveillance may set a tone of unity and empowerment that improves the overall culture of safety for staff and students. In district 1, weekly evaluations had higher levels of masking adherence when compared with daily evaluations; because observations only occurred at 1 weekly time point, students and staff may have been more cognizant of their masking and anticipated evaluation. Conversely, those in daily surveillance cohorts had many more opportunities for observation and may have been identified during moments of masking fatigue. Additionally, perhaps daily evaluations captured more variability in adherence in different cohorts, as opposed to weekly adherence, which may reflect a snapshot of a singular cohort given the random sampling in the weekly intervention group.

As schools return to in-person learning, staff are understandably concerned about school safety.¹⁹ Researchers have suggested that improper masking can increase teachers' risk of anxiety.²⁰ These grassroots interventions were developed to allow teachers and school administration to be empowered and play a role in creating a safe learning environment. Work done to create a culture of safety and trust in the school setting may have contributed

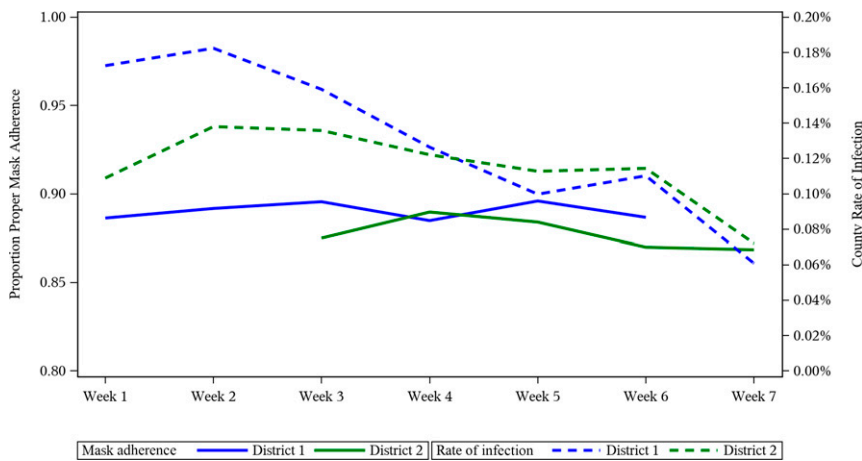


FIGURE 1 Proper masking proportion. Proper masking proportion and county rates of infections over time by district.

to excellent masking. Employees who perceived their jobs as safe have been shown to comply with safety behaviors at work more frequently.²¹ There was no clear difference in adherence between evaluations conducted by internal school staff (ie, district 1) and administrators (ie, district 2). Therefore, tasking either school leadership and/or administration to

lead internal surveillance of appropriate adherence to safety measures may be effective in ensuring appropriate mask use. Researchers in other studies have demonstrated that work safety climate is influenced by leadership and co-worker commitment to safety; such a climate is associated with improved employee satisfaction and stronger employee-employer

relationships.^{22,23} Schools need to create an environment where staff feel comfortable. Further study is needed to evaluate the impact of school-led masking adherence and safety initiatives on teacher anxiety and co-worker perceptions of safety.

Our study had several limitations. First, data on masking adherence were collected by school leadership. There are limitations to self-reporting (including bias), potential reliability issues related to perception of appropriate mask adherence, and missing data. Second, school-level demographics were obtained from state databases that may have errors or missing data. Third, school participation in the ABCs was voluntary, and data submission may have resulted in selection bias of schools that enforce mitigation strategies and/or greater data transparency. We acknowledge that we have no comparison data regarding masking adherence in nonintervention schools. Our sampling strategy may not have

TABLE 4 Proportion of Students and Staff Properly Masked During Study Period

	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7
By school level							
All districts							
Elementary schools	0.89	0.89	0.84	0.85	0.86	0.84	0.82
Middle schools	N/A	N/A	0.92	0.93	0.92	0.90	0.90
High schools	N/A	N/A	0.92	0.95	0.91	0.91	0.93
District 1							
Elementary schools	0.89	0.89	0.90	0.88	0.90	0.89	N/A
District 2							
Overall							
Elementary schools	N/A	N/A	0.81	0.84	0.85	0.83	0.82
Middle schools	N/A	N/A	0.92	0.93	0.92	0.90	0.90
High schools	N/A	N/A	0.92	0.95	0.91	0.91	0.93
Students							
Elementary schools	N/A	N/A	0.81	0.83	0.85	0.82	0.82
Middle schools	N/A	N/A	0.92	0.93	0.92	0.90	0.89
High schools	N/A	N/A	0.91	0.95	0.91	0.90	0.93
Staff							
Elementary schools	N/A	N/A	0.88	0.90	0.92	0.91	0.88
Middle schools	N/A	N/A	0.93	0.96	0.94	0.96	0.96
High schools	N/A	N/A	0.98	0.98	0.95	0.96	0.95
By evaluation type							
District 1							
Daily	0.88	0.88	0.88	0.88	0.89	0.88	N/A
Weekly	0.92	0.94	0.95	0.92	0.92	0.94	N/A

N/A, not applicable.

TABLE 5 Predictors of Masking Adherence

Predictor	Estimate (95% CI)
All districts	
CDC guidance change	0.93 (0.82–1.05)
County infection rate	1.09 (0.92–1.29)
District 1	
County infection rate	1.06 (0.89–1.25)
Weekly evaluation type (versus daily)	1.82 (1.22–2.72)
District 2	
CDC guidance change	0.93 (0.82–1.05)
County infection rate	1.08 (0.86–1.36)
Middle school (versus elementary school)	1.87 (1.15–3.07)
High school (versus elementary school)	2.21 (1.18–4.13)
School secondary transmission rate	0.72 (0.40–1.29)

CI, confidence interval.

allowed for a complete assessment of the impact of real-time education; however, these interventions were not initially designed with that in mind and rather focused on staff empowerment. Finally, secondary transmission rates were adjudicated by local health department staff in each district with varying resource capabilities, and exposure testing was not required for return to school in North Carolina, potentially leading to underreporting of secondary transmission. Nonetheless, rates observed in this study were similar to those reported outside of North Carolina when testing has been conducted.^{2–4} Notably, community transmission was relatively low during this short study period and

may increase in fall and winter 2021 because of surges of variant strains and loosening of masking requirements in communities. Secondary transmission could increase in the school setting if school masking guidelines are changed.

CONCLUSIONS

Masking surveillance interventions are effective at ensuring highly consistent masking at all grade levels. Creating a culture of safety within schools through surveillance led by local leadership can assist in decreasing spread of in-school infections. With this study, we also add to the previously noted evidence that secondary

transmission rates are low when school communities have high masking adherence. Masking adherence is more important than ever as more transmissible variants circulate and rates of COVID-19 infections in unvaccinated children increase. Our findings contribute to keeping school settings safe as districts transition to in-person learning during an ever-changing pandemic with fluctuating masking guidelines for community and school settings.

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ABBREVIATIONS

ABCs: ABC Science Collaborative
 CDC: Centers for Disease Control and Prevention
 COVID-19: coronavirus 2019
 K–12: kindergarten through 12th grade
 SARS-CoV-2: severe acute respiratory syndrome coronavirus 2

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