Association between School Mask Mandates and SARS-CoV-2 Student Infections: Evidence from a Natural Experiment of Neighboring K-12 Districts in North Dakota

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Abstract

There is still considerable debate about whether mask mandates in the K-12 schools limit transmission of SARS-CoV-2 in children attending school. Randomized data about the effectiveness of mask mandates in children is still entirely lacking. Our study took advantage of a unique natural experiment of two adjacent K-12 school districts in Fargo, North Dakota, one which had a mask mandate and one which did not in the fall of the 2021-2022 academic year. In the winter, both districts adopted a masks-optional policy allowing for a partial crossover study design. We observed no significant difference between student case rates while the districts had differing masking policies (IRR 0.99; 95% CI: 0.92 to 1.07) nor while they had the same mask policies (IRR 1.04; 95% CI: 0.92 to 1.16). The IRRs across the two periods were also not significantly different (p = 0.40). Our findings contribute to a growing body of literature which suggests school-based mask mandates have limited to no impact on the case rates of COVID-19 among K-12 students.

Introduction

School districts across the nation have implemented mask mandates for children in the hope of reducing COVID-19 transmission, but the impact of school-based mask mandates on COVID-19 transmission in children is not fully established. While observational studies of school mask mandates have had conflicting results, randomized studies have failed to detect an impact of masking on participants under 50 years of age [1-6]. Here we report the results of a natural experiment in two large K-12 school districts in Fargo, North Dakota, Fargo Public Schools (FPS) and West Fargo Public Schools (WF), to estimate the association between school mask mandates and COVID-19 infections. Our study population is unique because the districts are adjacent to each other in the same county and have similar student demographics, COVID-19 mitigation policies and staff vaccination rates. At the start of the Fall 2021 semester, FPS mandated masks and WF did not. On January 17, 2022, FPS also moved to a mask optional policy, creating a unique natural experiment to study school-based mask mandates.

Results

Table 1 shows school characteristics, total number of positive student tests and the COVID-19 risk mitigation measures implemented by each district. Both school districts had similar COVID-19 mitigation policies, although FPS had more stringent rules for quarantining close contacts. WF also had higher percentages of low-income and minority students. Figure 1 shows that overall trends in COVID-19 incidence among students were similar in the two districts. From August 26, 2021, to January 17, 2022, cumulative incidence in the mask compulsory school district was almost identical to cumulative incidence in the mask-optional district (WF: 1596/12,254 [13.0%; 95% CI: 12.4, 13.6]); FPS: 1475/11,419 [12.9% 95% CI: 12.3, 13.6%]). IRR 0.99; 95% CI: 0.92, 1.07). Post January 17, 2022, when both districts had mask-optional policies, case rates were also not significantly different (WF: 622/12,254 [5.1%; 95% CI: 4.7, 5.5]; FPS: 600/11,419 [5.3%; 95% CI: 4.9, 5.7]). IRR 1.04; 95% CI: 0.92, 1.16). The IRRs across the two periods were also not statistically significantly different (p value = 0.40). Based on an incidence rate of 13%, we had 80% power to detect a 1.2% difference in incidence between the districts.

Discussion

This study found that K-12 school mask mandates were not associated with significantly lower COVID-19 student case rates. This is consistent with adult randomized data on community cloth masking [6], multiple observational studies of school mask mandates [1,2,3] and a systematic review of medical or surgical cloth masking for influenza [8]. Studies of school-based mask mandates are particularly prone to bias [9] as student cases detected within the school may be at least 20x more likely to have been contracted outside of school than in [10]. Other observational studies have reported a negative association between school mask mandates and SARS-CoV-2 cases [11,12,13] but may have had important methodological limitations [9,14].

The strengths of the study include the similarities of the two K-12 districts including size, adjacent location within a county, similar demographics, and COVID-19 policies beyond masking. Second, the study includes a partial crossover design with the mask mandate district dropping its mandate during the study period. The partial crossover should have revealed the presence of any major confounding effect. The lack of significant difference between the districts however persisted post partial crossover, when both districts had masks-optional policies. Based on the size of our study and the incidence rate during the study period, we had 80% power to detect a 1.2% difference in incidence between the districts, so if we failed to detect a benefit of mask mandates, that benefit would have been very small. An additional strength of this study is it includes a relatively long study period with data from both the delta and omicron waves.

The study also has limitations. We did not have information on the number of tests performed by each school district, although both school districts had similar testing access and policies. Second, this study did not specifically evaluate in-school transmission. We also did not have data on the types of masks being worn or on masking adherence rates in the two school districts; however, parents and administrators indicated via personal communication with SH, masking was near universal in the district with a mask mandate and 5% or less in the masks-optional district [15]. In conclusion, school mask mandates were not found to be associated with significantly lower student SARS-CoV-2 case rates. This is consistent with a growing body of scientific literature and should be taken into consideration and weighed with the harms and discomfort of masking in the educational setting.

Methods

We obtained data on student enrollment, masking policies, masking compliance, demographic information and COVID-19 mitigation measures from district administrators and official school district websites. We obtained publicly available data on new student COVID-19 case rates in each school district from August 26, 2021, to March 2, 2022, from the North Dakota Department of Health website [https://www.health.nd.gov/k-12-school-dashboard]. We determined the COVID-19 student case rates and incidence rate ratio (IRR) as well as 95% confidence intervals (CI) for case rates between the districts, both while FPS had a mask mandate and WF did not and then when FPS dropped their mandate on January 17, 2022, (after which both districts had mask-optional policies). The study is not considered human subjects research as the data were not collected specifically for this study and do not have subject identifiers. We used Stata Version 17 and UCSF Sample Size Calculator [7] for the analysis. A post-hoc power calculation was performed using ClinCalc. Our report follows the STROBE reporting guidelines for observational studies.

Declarations

Acknowledgements

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Author Contributions

SH, TH and NS conceived the study design, SH, JS and NS collected the data, NS, JS and TH analysed the data and NS and TH interpreted the results. All authors reviewed the manuscript.

Competing Interests

TH has provided expert testimony for multiple lawsuits involving SARS-CoV-2 in-school transmission and student mask mandates. Otherwise, the authors declare no relevant competing interests.

Data availability

The raw data used for our calculations are available online at https://github.com/tracybethhoeg/North-Dakota-Mask-Study

The data used in this analysis are also publicly available North Dakota Department of Health website available at https://www.health.nd.gov/k-12-school-dashboard , accessed March 31, 2022. Information on enrollment from school district websites. WFPS: https://www.west-fargo.k12.nd.us/site/default.aspx?PageType=3&DomainID=22&ModuleInstanceID=11253&ViewID=6446EE88-D30C-497E-9316-3F8874B3E108&RenderLoc=0&FlexDataID=24239&PageID=37 accessed March 31, 2022. FPS: https://www.fargo.k12.nd.us/page/365 accessed March 31, 2022.

Ethics declarations

According to the NIH's Human Subjects Research Decision Tool (https://grants.nih.gov/policy/humansubjects/hs-decision.htm), this study was IRB exempt.

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Table 1

Table 1: School district characteristics and COVID-19 risk mitigation measures in Fall 2021 in study school districts

School Policies and Characteristics	West Fargo Public School District (School District with mask optional policy)	Fargo Public School District (School district with mandatory masking till Jan 17, 2022 and mask optional thereafter)
Student Enrollment in August 2021[a]	12,254	11,419
Total Number (% [95% CI]) of students testing positive up to 1/17/22	1596 (13.0% [12.4, 13.6])	1475 (12.9% [12.3, 13.6])
Total Number (% [95% CI]) of Students Testing Positive After 1/17/22	622 (5.1% [4.7, 5.5])	600 (5.3% [4.9, 5.7])
Average Class Size[b]	21-Elementary School, 23-Middle School, 23-High School	18.7-Elementary School, 21.2 Middle School, 20.1 High School
Race/Ethnicity of Students in 2021-2022 School Year[c]	71% White, 17% African American, Asian 4%, Hispanic 4%	69% White, 16% African American, Asian 4%, Hispanic 6%
Fraction of Low-Income students in 2021-2022 School Year[c]	23%	18%
Staff vaccination rate at school year start[b]	74.5%	77.6%
Face covering required when using district provided transportation[d]	Yes	Yes
Mandatory physical distancing[d]	No	No
Regular cleaning of high touch surfaces[d]	Yes	Yes
Does the school conduct routine COVID testing of all children? [d]	No. Children are given the option to use a rapid test on certain times and days at school sites. Children need parent permission and need to preregister. Children who develop symptoms at school have the option to test with parent permission when parent picks up child from school.	No. The district has 2 testing sites where students and their families can get tested, but it is voluntary. A parent needs to escort their student to the site or have a permission slip filed in.

School activities, events, assemblies, and gatherings allowed[d]	Yes	Yes
Has the school upgraded ventilation systems? [d]	Yes, iMod air filtration units have been installed in every school	Yes, Needlepoint Bi-polar Ionization units have been installed in each school buildings HVAC system.
Symptomatic students sent home[d]	Yes	Yes
How long are COVID+ children required to stay at home? [d]	10 days	10 days
When can symptomatic children return to school? [d]	Students with symptoms other than loss of taste or smell can return when they have been symptom free for 24 hours without use of medications. Students with loss of taste or smell can return after 10 days or the following day after a negative test	Students can return after 10 days from onset or date of negative COVID test whichever is earlier, and free of fever for 24 hours with improving symptoms.
Are children in the same classroom as COVID+ case required to quarantine? [d]	No, a notification is sent to all children in the classroom and parents are asked to monitor their children for symptoms	Not all of them. Only individuals who are close contacts (close contact being anyone within 6ft for 15 cumulative minutes or more in one day) and unmasked (unmasked contacts generally originate from lunch or snack times) are required to quarantine or go through testing protocol to remain in school.
Are “close contacts” required to quarantine? [d]	Only symptomatic individuals or persons who are unvaccinated and unwilling to do a rapid test every other day for seven days need to quarantine	Only unmasked close contacts are required to quarantine or submit to every other day testing to remain in school

Notes:

[a] Information from school district websites. WFPS: https://www.west-fargo.k12.nd.us/site/default.aspx?PageType=3&DomainID=22&ModuleInstanceID=11253&ViewID=6446EE88-D30C-497E-9316-3F8874B3E108&RenderLoc=0&FlexDataID=24239&PageID=37 accessed March 31, 2022.
FPS: https://www.fargo.k12.nd.us/page/365 accessed March 31, 2022.

[b] Information from communication with school administrators.

[c] Information from official portal for North Dakota state government.
WFPS: https://insights.nd.gov/Education/District/EnrollmentDemographics/09006 accessed March 31, 2022.
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[d] Information from school COVID-19 protocols. WFPS: https://www.west-fargo.k12.nd.us/cms/lib/ND02203445/Centricity/Domain/2935/COVID%20Health%20and%20Safety%20Protocols%202021-22.pdf accessed March 31, 2022. FPS: https://drive.google.com/file/d/1qyn7DNvCnSuKszHqM8C8BTAixmnCbToS/view accessed March 31, 2022.

Figures

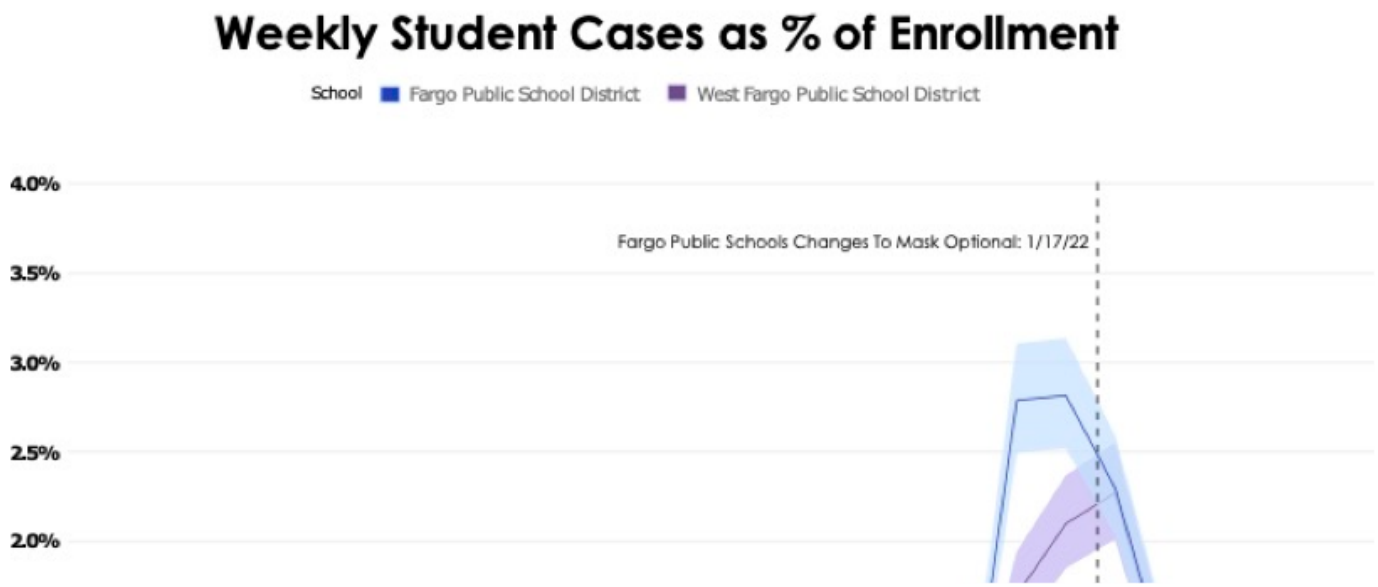

Figure 1

Weekly COVID-19 Incidence in School Districts Since Start of 2021 School Year

Notes: Shaded region represents 95% confidence intervals. Information on new student COVID-19 cases from North Dakota Department of Health website available at https://www.health.nd.gov/k-12-school-dashboard , accessed March 31, 2022. Information on enrollment from school district websites. WFPS: https://www.west-fargo.k12.nd.us/site/default.aspx?PageType=3&DomainID=22&ModuleInstanceID=11253&ViewID=6446EE88-D30C-497E-9316-3F8874B3E108&RenderLoc=0&FlexDataID=24239&PageID=37 accessed March 31, 2022. FPS: https://www.fargo.k12.nd.us/page/365 accessed March 31, 2022.