South Carolina Department of Health and Environmental Control
Healthy People. Healthy Communities.

The Evidence for Mask Use in K-12 Schools

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Effectiveness of Masks

ABC Science Collaborative, Final Report, June 2021

- An initiative with 13 participating states coordinated by the Duke Clinical Research Institute at the Duke University School of Medicine
  - Connects scientists and physicians with school and community leaders to help understand the most current and relevant information about COVID-19.
  - Helps school leaders and state policymakers arrive at informed decisions about returning to school using data from their own communities.
- Shared goal
  - To keep students, teachers, and their local communities healthy and safe.
- Collected data from all NC K-12 schools operating under Plan A (full, in-person instruction, masking, and minimal physical distancing March- June 2021).
- The data represent 100 school districts, 14 charter schools with > 1,280,000 students and > 160,000 staff.

https://abcsciencecollaborative.org/wp-content/uploads/2021/06/ABCs-Final-Report-June-2021.06-esig-DB-KZ-6-29-21.pdf

ABC Science Collaborative, Final Report, June 2021

- Key Findings
  - Masks effectively prevented transmission even without physical distancing in schools and on buses.
  - NC schools adhering to the protocols succeeded in limiting the transmission rate of COVID-19 within schools.
  - ~ 1 in 3,000 students who were in school buildings became infected with COVID-19 during school, or 308 school-acquired cases recorded for students and 55 for staff
  - Estimated secondary attack rate < 1% (of all quarantined who acquired COVID)

https://abcsciencecollaborative.org/wp-content/uploads/2021/06/ABCs-Final-Report-June-2021.06-esig-DB-KZ-6-29-21.pdf

COVID-19 Cases and Transmission in 17 K–12 Schools — Wood County, Wisconsin, August 31–November 29, 2020

- Among 191 cases identified in students and staff members, only seven (3.7%) cases, all among students, were linked to in-school spread.
- COVID-19 incidence among students and staff members was lower than in the county overall (3,453 versus 5,466 per 100,000).

What are the implications for public health practice?

- With masking requirements and student cohorting, transmission risk within schools appeared low, suggesting that schools might be able to safely open with appropriate mitigation efforts in place.

Falk A, Benda A, Falk P, Steffen S, Wallace Z, Høeg TB. COVID-19 Cases and Transmission in 17 K–12 Schools — Wood County, Wisconsin, August 31–November 29, 2020. MMWR Morb Mortal Wkly Rep 2021;70:136–140. DOI: http://dx.doi.org/10.15585/mmwr.mm7004e3

K-12 schools can have in-person learning with limited in-school COVID-19 spread

17 K-12 schools in rural Wisconsin opened and implemented measures to limit spread:

- Used masks
- Established groups of 11-20 students
- Staff maintained 6 feet of distance, if possible
- Quarantined after exposures

* Weekly incidence of 34 to 1,189 per 100,000 persons in the community; 7-40% positive COVID-19 tests

Teachers reported more than 92% of students used masks

During 13 weeks of in-person learning

7 of 4,876 students
and
0 of 654 staff
are known to have gotten COVID-19 at school

No spread is known to have occurred to or from staff in school despite some times with high community spread*

CDC.GOV bit.ly/MMWR12621 MMWR

http://dx.doi.org/10.15585/mmwr.mm7004e3

Low SARS-CoV-2 Transmission in Elementary Schools — Salt Lake County, Utah, December 3, 2020–January 31, 2021

- SARS-CoV-2 testing offered to 1,041 school contacts of 51 index patients in 20 elementary schools.
- Included 1,214 staff members and 10,171 students, 81% of whom attended school in person.
- In a high community transmission setting, low school-associated transmission was observed with a 0.7% secondary attack rate.
- Mask adherence was high (86%); classroom seats were a median of 3 ft apart.

What are the implications for public health practice?

- These findings add to evidence that in-person elementary schools can be opened safely with minimal in-school transmission when critical prevention strategies including mask use are implemented, even though maintaining ≥6 ft between students' seats might not be possible.

Hershow RB, Wu K, Lewis NM, et al. Low SARS-CoV-2 Transmission in Elementary Schools — Salt Lake County, Utah, December 3, 2020–January 31, 2021. MMWR Morb Mortal Wkly Rep 2021;70:442–448.
DOI: http://dx.doi.org/10.15585/mmwr.mm7012e3

CDC Science Brief: Transmission of SARS-CoV-2 in K-12 Schools and Early Care and Education Programs – Updated

- With approximately one quarter of teachers at higher risk of serious consequences of COVID-19 because of their underlying medical conditions,[53] reasonable concerns have been raised about the occupational risk of SARS-CoV-2 infection for teachers and school staff.
- Detection of cases in schools does not necessarily mean that transmission occurred in schools. The majority of cases that are acquired in the community and are brought into a school setting result in limited spread inside schools when multiple layered prevention strategies are in place.[38, 55-57]
- Studies of SARS-CoV-2 transmission in schools that consistently implemented layered prevention strategies have shown success in limiting transmission in schools.[38, 46, 49, 73-77]

https://www.cdc.gov/coronavirus/2019-ncov/science/science-briefs/transmission_k_12_schools.html#sars-cov-2
Updated July 9, 2021

CDC Science Brief: Transmission of SARS-CoV-2 in K-12 Schools and Early Care and Education Programs – Examples of the Evidence

- A study of 11 NC school districts with in-person learning for at least nine weeks during fall 2020 reported minimal school-related transmission even while community transmission was high.[38] These schools implemented and strictly adhered to multiple prevention strategies, including universal mask use and physical distancing.
- In a study of K-12 schools in St. Louis with multiple layered prevention strategies in place, only 2% of contacts of COVID-19 cases in the schools tested positive for the virus; this was despite high community transmission rates.[76]
- A study of Italian schools, which implemented a comprehensive prevention approach that included masking, distancing, cleaning, increased ventilation, and cancellation of extracurricular activities, found that school reopening was not associated with the second wave of COVID-19 in Italy.[47]

https://www.cdc.gov/coronavirus/2019-ncov/science/science-briefs/transmission_k_12_schools.html#sars-cov-2
Updated July 9, 2021

CDC Science Brief: Transmission of SARS-CoV-2 in K-12 Schools and Early Care and Education Programs – Examples of the Evidence

- A surveillance study of symptomatic and asymptomatic cases among children in Swiss schools found limited secondary transmission when multiple protective measures were used in schools,[56] including mask use, physical distancing, and other interventions.
- Data from surveillance of German school outbreaks detected outbreaks before any prevention strategies were implemented. After schools reopened with prevention strategies in place, the average number of outbreaks per week after the reopening (2.2) was smaller than before the school closed earlier in the pandemic (3.3), suggesting prevention strategies had some protective effect.[51]
- A study of private schools that reopened for in-person instruction in Chicago with the implementation of layered prevention strategies found minimal in-school transmission.[57]

https://www.cdc.gov/coronavirus/2019-ncov/science/science-briefs/transmission_k_12_schools.html#sars-cov-2
Updated July 9, 2021

School-level COVID-19 Modeling Results for North Carolina

- Modeling to illustrate COVID-19 spread within a hypothetical school over a semester, given different assumptions regarding mask usage, incoming protection, and testing policies.
- Modeling found that without masks or regular testing, up to 90% of susceptible students may become infected by the end of the semester. This high rate of infection would result in frequent quarantines of students and transmission to others.
- Masks and testing, when used in combination, can prevent 80% of new infections. While these strategies cannot prevent all, when used effectively, school districts can maximize the amount of time students are present for in-person instruction. This is particularly important in schools with children below age 12.
- The harm of new infections goes beyond the school. Exposed students can bring the virus home to infect younger siblings, pregnant mothers, and other vulnerable adults such as those with compromised immune systems.

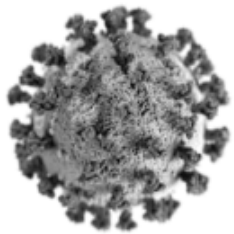
https://covsim.hosted-wordpress.oit.ncsu.edu/school-level-modeling-results/ Last updated: **08/05/2021**

COVID-19 Simulation Integrated Model (*COVSIM*) to Inform Local Decision-Making

COVID-19 Modeling Projections for Schools
Part 1: Model Background

Our Modeling Objective

To estimate the proportion of susceptible students infected throughout a school semester, depending on incoming protection as well as masking and testing policies.

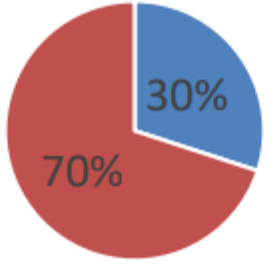




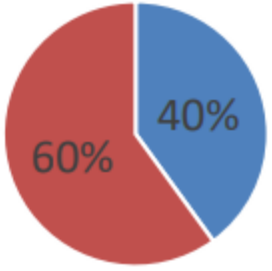
Imagine a school…

- Student population: 500
- 2-3 students begin infected with COVID-19 at the start of the semester
- Some students have either already had COVID-19 or have received the vaccine ("**incoming protection**"), or are susceptible to becoming infected

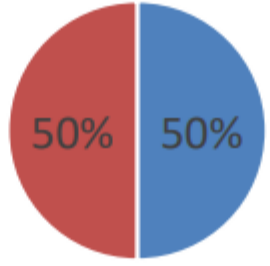
Elementary School Setting



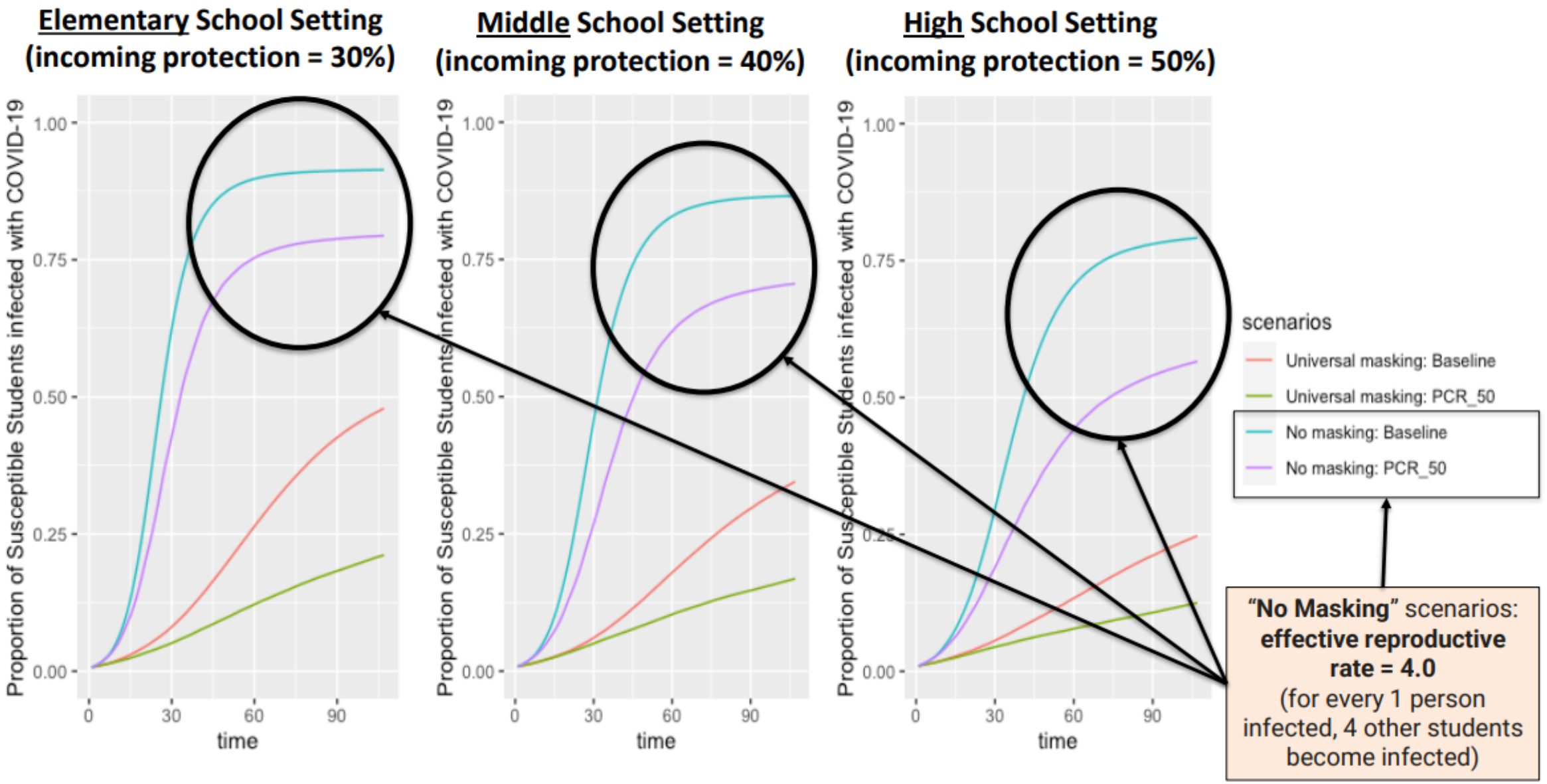
Middle School Setting

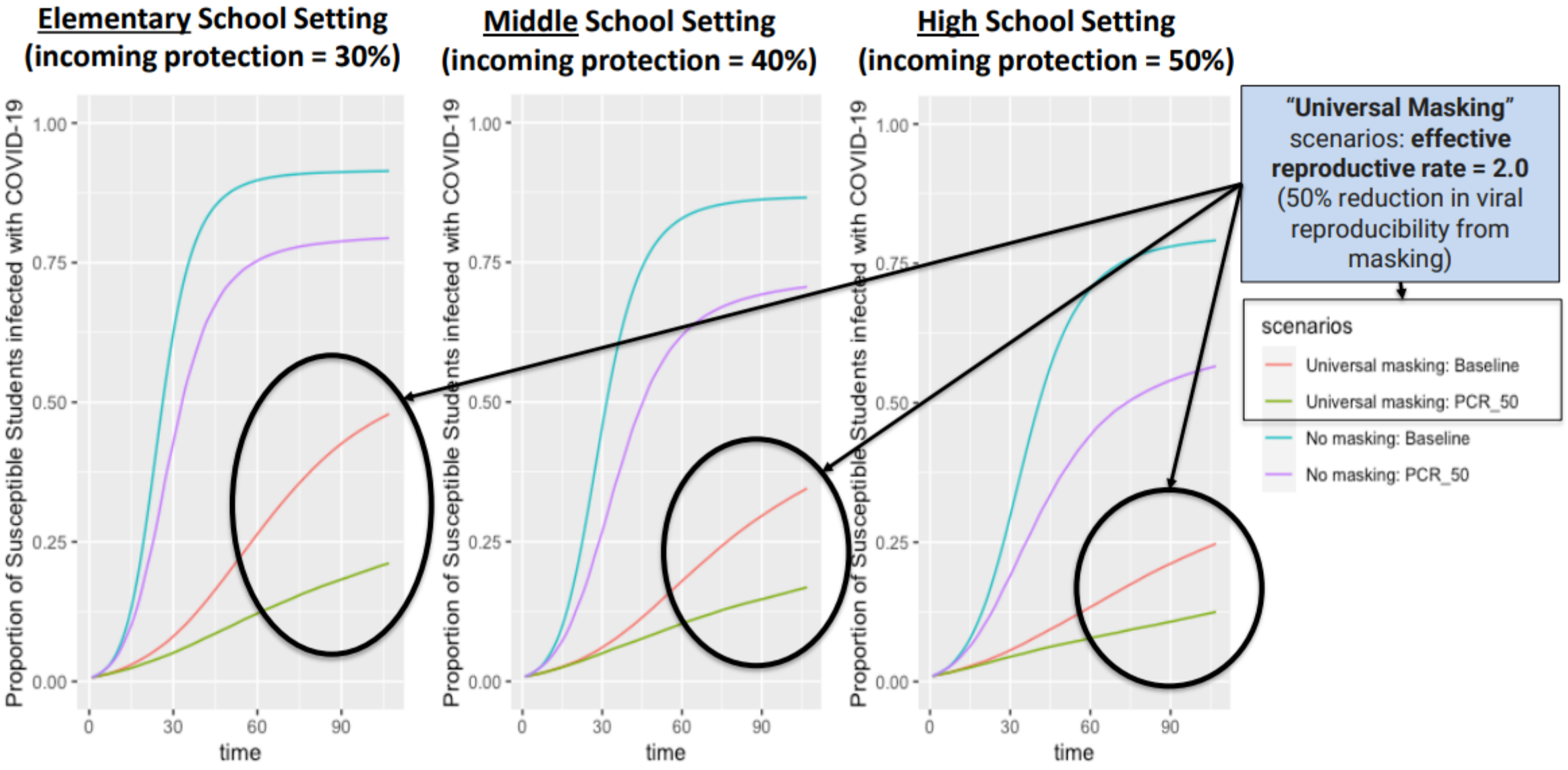


High School School Setting



Incoming Protection Susceptible





Safety of Masks on Children

Masks are Safe for Children

- Do **not** cause low O_2 levels, high CO_2 levels, or respiratory distress
- Allow O_2 and CO_2 molecules to move through and around them but block droplets containing virus particles
- No data that wearing a mask weakens immune system, increases risk of infection with another germ, nor has any other negative impact on children's physiology

The effects of wearing facemasks on oxygenation and ventilation at rest and during physical activity

- 2021 study by researchers from University Hospitals of Cleveland
- Ten-minute periods of sitting quietly and walking briskly without a mask and while wearing a cloth mask and a surgical mask by 50 adults
- Measured carbon dioxide and oxygen levels in the blood at end of each period
- No episodes of a low oxygen or high carbon dioxide level in the blood
- No statistically significant differences in oxygen or carbon dioxide levels between measurements without a mask and those taken while wearing either kind of mask at rest or after walking briskly

PLoS One. 2021;16(2):e0247414. doi: 10.1371/journal.pone.0247414

Assessment of respiratory function in infants and young children wearing face masks during the COVID-19 pandemic

- 2020 cohort study in Italy of 47 healthy children divided into 2 groups by age (≤24 months and >24 months to 144 months)
- Examined if use of surgical masks among children is associated with low O_2 levels in the blood or respiratory distress
- Children remained at rest for 30 minutes while not wearing a mask then for 30 minutes while wearing one. After that hour, the older group did a walking test for 12 minutes
- Level of CO_2 the child was exhaling, level of O_2 in their blood, HR, & RR were measured every 15 minutes
- No significant change in any of these over the first 60 minutes (without or with a mask while at rest) in either age group
- HR & RR increased after the walking test compared to before it for older group but no change in CO_2 level the child was exhaling or O_2 level in their blood

JAMA Netw Open. Mar 1 2021;4(3):e210414. doi: 10.1001/jamanetworkopen.2021.0414

A randomized clinical trial to evaluate the safety, fit, comfort of a novel N95 mask in children

- 2016 randomized study of 106 healthy children 7-14yo in Singapore evaluated safety of a pediatric N95 mask
- Measured the level of CO_2 exhaled by while wearing the mask compared to without the mask
- Demonstrated that even a pediatric N95 mask is safe for use by healthy children by showing the children were not building up CO_2 in their lungs

Sci Rep. 2019;9(1):18952. doi: 10.1038/s41598-019-55451-w

Notice of retraction. Walach H, et al. Experimental assessment of carbon dioxide content in inhaled air with or without face masks in healthy children: a randomized clinical trial

- Now-retracted study in *JAMA Pediatrics* in June 2021 widely cited masks were dangerous for children because they caused them to breathe in higher amounts of CO_2
- Reported high levels of CO_2 measured on inside surfaces of masks worn by children
- Methods and assumptions criticized; article retracted by journal just 16 days later
  - Used device to measure CO_2 levels that was known to have large margin of error when used in open setting rather than incubators
  - Made assumption that the air just on the inside of the mask was the only source of air being inhaled; would have been mixture of the air there and the air around the child with lower CO_2 level

JAMA Pediatr. Published online June 30, 2021. doi: 10.1001/jamapediatrics.2021.2659
JAMA Pediatr. Published online July 16, 2021. doi: 10.1001/jamapediatrics.2021.3252

Impact of Masks on Academics

Experts Deny Negative Impact

- No data on impact of mask wearing on academics identified during thorough scientific literature review
- Experts reject concerns about this, including the American Academy of Pediatrics: “Masks will not affect your child's ability to focus or learn in school.”
- No evidence that masks cause delays in language development or speech
  - Visually impaired children develop these skills at the same rate as children without visual impairment
  - Other senses may be heightened when one sense is not present
  - See gestures and eyes showing emotions and hear words and tone of voice

Updated August 5, 2021. https://www.healthychildren.org/English/health-issues/conditions/COVID-19/Pages/Mask-Mythbusters.aspx

Updated August 8, 2021. https://www.healthychildren.org/English/health-issues/conditions/COVID-19/Pages/Do-face-masks-interfere-with-language-development.aspx

Impact of Masks on Emotional/ Behavioral Development

No Negative Impact

- No data showing mask use has negative impact on a child's emotional or behavioral development
- Data from study during pandemic by University of Wisconsin shows children can identify emotions in another person's face even when the face is wearing a mask
  - Examined ability of 80 children 7-13yo to identify emotions (happy, angry, sad, disgusted, afraid, or surprised) on faces covered by a mask or sunglasses compared to on unobscured faces
  - Could be expected to randomly guess correctly 17% of the time since there were six choices
  - Without any masks or sunglasses blocking the face, they were correct as often as 66% of the time, making unobscured faces the easiest for them to read
  - Also correctly identified sadness 28% of the time, anger 27% of the time, and fear 18% of the time when the face was wearing a mask.
  - Results suggest that although unobscured faces are easiest for children to read, they can read faces blocked with masks, maintaining a key part of socialization

PLoS One. 2020;15(12):e0243708. doi: 10.1371/journal.pone.0243708

References

- COVID-19 Guidance for Safe Schools. American Academy of Pediatrics. July 18, 2021. Accessed August 19, 2021. https://www.aap.org/en/pages/2019-novel-coronavirus-covid-19-infections/clinical-guidance/covid-19-planning-considerations-return-to-in-person-education-in-schools/
- Guidance for COVID-19 Prevention in K-12 Schools. Centers for Disease Control and Prevention. Updated August 5, 2021. Accessed August 19, 2021. https://www.cdc.gov/coronavirus/2019-ncov/community/schools-childcare/k-12-guidance.html
- COVID-19 Interim Guidance for K-12 School Operations. Updated July 29, 2021. Accessed August 20, 2021. https://scdhec.gov/sites/default/files/media/document/Interim-COVID-19-Guidance-for-K-12-School-Operations-2021-07-29_0.pdf
- The ABC Science Collaborative, Final Report, June 2021. June 30, 2021. Accessed August 19, 2021. https://abcsciencecollaborative.org/wp-content/uploads/2021/06/ABCs-Final-Report-June-2021.06-esig-DB-KZ-6-29-21.pdf
- Falk A, Benda A, Falk P, Steffen S, Wallace Z, Høeg TB. COVID-19 Cases and Transmission in 17 K–12 Schools — Wood County, Wisconsin, August 31–November 29, 2020. *MMWR Morb Mortal Wkly Rep*. 2021;70:136–140. doi: 10.15585/mmwr.mm7004e3
- Hershow RB, Wu K, Lewis NM, et al. Low SARS-CoV-2 transmission in elementary schools — Salt Lake County, Utah, December 3, 2020–January 31, 2021. *MMWR Morb Mortal Wkly Rep*. 2021;70:442–448. doi: 10.15585/mmwr.mm7012e3
- School-level COVID-19 Modeling Results for North Carolina. Updated August 5, 2021. Accessed August 19, 2021. https://covsim.hosted-wordpress.oit.ncsu.edu/school-level-modeling-results/
- Science Brief: Transmission of SARS-CoV-2 in K-12 Schools and Early Care and Education Programs – Updated. Centers for Disease Control and Prevention. Updated July 9, 2021. Accessed August 19, 2021. https://www.cdc.gov/coronavirus/2019-ncov/science/science-briefs/transmission_k_12_schools.html#sars-cov-2

References

- Zimmerman KO, Akinboyo IC, Brookhart MA, et al. Incidence and secondary transmission of SARS-CoV-2 infections in schools. *Pediatrics*. 2021;147(4). doi: 10.1542/peds.2020-048090
- Dawson P, Worrell MC, Malone S, et al. Pilot investigation of SARS-CoV-2 secondary transmission in kindergarten through grade 12 schools implementing mitigation strategies – St. Louis County and City of Springfield, Missouri, December 2020. *MMWR Morb Mortal Wkly Rep*. 2021;70:442–448. doi: 10.15585/mmwr.mm7012e3
- Gandini S, Rainisio M, Iannuzzo ML, et al. A cross-sectional and prospective cohort study of the role of schools in the SARS-CoV-2 second wave in Italy. *Lancet Reg Health Eur.* 2021;5:100092. doi: 10.1016/j.lanepe.2021.100092
- Kriemler S, Ulyte A, Ammann P, et al. Surveillance of acute SARS-CoV-2 infections in school children and point-prevalence during a time of high community transmission in Switzerland. *Front Pediatr.* 2021;9:645577. doi: 10.3389/fped.2021.645577
- Otte Im Kampe E, Lehfeld AS, Buda S, et al. Surveillance of COVID-19 school outbreaks, Germany, March to August 2020. *Euro Surveill.* 2020;25(38). doi: 10.2807/1560-7917.Es.2020.25.38.2001645
- Fricchione MJ, Seo JY, Arwady MA. Data-driven reopening of urban public education through Chicago's tracking of COVID-19 school transmission. *J Public Health Manag Pract.* 2021;27(3):229-232. doi:10.1097/phh.0000000000001334
- Shein SL, Whitticar S, Mascho KK, Pace E, Speicher R, Deakins K. The effects of wearing facemasks on oxygenation and ventilation at rest and during physical activity. *PLoS One*. 2021;16(2):e0247414. doi: 10.1371/journal.pone.0247414
- Lubrano R, Bloise S, Testa A, et al. Assessment of respiratory function in infants and young children wearing face masks during the COVID-19 pandemic. *JAMA Netw Open*. Mar 1 2021;4(3):e210414. doi: 10.1001/jamanetworkopen.2021.0414

References

- Goh DYT, Mun MW, Lee WLJ, Teoh OH, Rajgor DD. A randomized clinical trial to evaluate the safety, fit, comfort of a novel N95 mask in children. *Sci Rep*. 2019;9(1):18952. doi: 10.1038/s41598-019-55451-w
- Walach H, Weikl R, Prentice J, et al. Experimental assessment of carbon dioxide content in inhaled air with or without face masks in healthy children: a randomized clinical trial. *JAMA Pediatr.* Published online June 30, 2021. doi: 10.1001/jamapediatrics.2021.2659
- Christakis D, & Fontanarosa PB. Notice of retraction. Walach H, et al. Experimental assessment of carbon dioxide content in inhaled air with or without face masks in healthy children: a randomized clinical trial. *JAMA Pediatr.* Published online July 16, 2021. doi: 10.1001/jamapediatrics.2021.3252
- Mask Mythbusters: Common Questions about Kids & Face Masks. American Academy of Pediatrics. Updated August 5, 2021. Accessed August 19, 2021. https://www.healthychildren.org/English/health-issues/conditions/COVID-19/Pages/Mask-Mythbusters.aspx *Mortal Wkly Rep.* 2021;70(12):449-455. doi: 10.15585/mmwr.mm7012e4
- Do Masks Delay Speech and Language Development? American Academy of Pediatrics and American Speech-Language-Hearing Association. Updated August 8, 2021. Accessed August 19, 2021. https://www.healthychildren.org/English/health-issues/conditions/COVID-19/Pages/Do-face-masks-interfere-with-language-development.aspx
- Ruba AL, & Pollak SD. Children's emotion inferences from masked faces: implications for social interactions during COVID-19. *PLoS One.* 2020;15(12):e0243708. doi: 10.1371/journal.pone.0243708