

## The Science on Mask Use in K-12 Schools

### COVID-19 IN SOUTH CAROLINA K-12 SCHOOLS

COVID-19 is a serious risk to South Carolinians of all ages, and has caused over 10,000 deaths statewide. The Delta variant, which is the currently predominant one in South Carolina (and the United States), is more transmissible than previous variants and also poses a greater risk to children. Although severe cases of COVID-19 in children are relatively unusual, hospitalization and death can occur. As of August 17, 2021, 15 South Carolinian children have died from COVID-19, and pediatric hospitalization rates have also increased recently.

In addition, COVID-19 has had a significant impact on children's education, leading to many school districts to close and move to virtual education during the initial phases of the pandemic. South Carolina schools have since reopened to in-person education; however, COVID-19 continues to have a negative impact on many children's education.

The American Academy of Pediatrics (AAP) recommends children attend in-person school to the greatest extent possible.<sup>1</sup> However, U.S. Centers for Disease Control and Prevention (CDC), AAP, and South Carolina Department of Health and Environmental Control (DHEC) guidance<sup>1,2,3</sup> recommend students who are not fully vaccinated and are exposed to COVID-19 quarantine for a period of 10 – 14 days, thus removing them from school.

During the 2020-2021 academic year in South Carolina, DHEC identified 14,378 COVID-19 cases among students and 4,520 cases among staff who reported having attended school or a school-related event (e.g., sports practice) during their infectious period.

According to data collected by DHEC, there have been 374 COVID-19 cases among students and 99 cases among staff thus far in the 2021-2022 academic year statewide. However, this data is incomplete and based on review of individual school district reports, the actual number is significantly higher. DHEC is working to obtain more timely data for cases in students or staff who have been on a school campus while contagious.

DHEC is also working to compile accurate statistics on the number of children in quarantine (and therefore not in school) due to exposure to COVID-19. Based on review of incomplete school district reports, it appears that well over 1000 students are currently quarantined in South Carolina due to COVID-19, and already one school district had to temporarily move to all virtual learning due to an outbreak. In addition, several high school sports and other extracurricular teams have had to quarantine due to COVID-19. The number in quarantine is likely to rise given that case transmission rates are high in all South Carolina counties and many school districts are returning to school for the fall semester this week.

Vaccination is the most effective way to prevent COVID-19, however many students are not eligible for the vaccine. Currently, all people age 12 years and older are eligible in the United States for vaccination against COVID-19 with the Pfizer-BioNTech mRNA vaccine. Therefore,

only roughly half of all students in kindergarten through 12<sup>th</sup> grade are eligible for vaccination, and even fewer have elected to receive it. As of August 17, 2021, 158,071, or an estimated 20.1%, of South Carolinians between 12 to 19 years old had received at least one dose of COVID-19 vaccine.

The U.S. Centers for Disease Control and Prevention (CDC), the American Academy of Pediatrics (AAP), and DHEC currently recommend universal masking by all people age two years and older when indoors at schools, even if fully vaccinated.<sup>1,2,3</sup>

With the relatively low rate of vaccination of students, the use of masks in schools has been the subject of much discussion. In keeping with DHEC's role as the state's public health authority to provide information about the causes and prevention of disease, this paper will examine the scientific evidence regarding this issue.

## **EFFECTIVENESS OF MASKS**

The ABC Science Collaborative is an initiative that extends across 13 states, connecting scientists and physicians with school and community leaders to help understand the most current and relevant information about COVID-19. The program helps school leaders and state policymakers arrive at informed decisions about returning to school using data from their own communities. The shared goal is to keep students, teachers, and their local communities healthy and safe. The report found in part that masks effectively prevented COVID-19 transmission even without physical distancing in schools and on buses. The study collected data from all North Carolina elementary, middle, and high schools operating under a model called Plan A, which provided full, in-person instruction, masking, and minimal physical distancing from March to June 2021. The data represent 100 local school districts and 14 charter schools comprising more than 1,280,000 students and 160,000 staff.

The report finds that NC schools adhering to the protocols succeeded in limiting the transmission rate of COVID-19 within schools. Approximately 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.<sup>4</sup>

A study conducted in seventeen rural Wisconsin schools and published by CDC, reported student mask-wearing was high, and the COVID-19 incidence among students and staff members was lower than in the county overall (3,453 versus 5,466 per 100,000). Among 191 cases identified in students and staff members, only seven (3.7%) cases, all among students, were linked to in-school spread. The conclusion of the implications for public health practice included that 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.<sup>5</sup>

A study published by CDC reported SARS-CoV-2 testing was offered to 1,041 school contacts of 51 index patients across 20 elementary schools in Salt Lake County, Utah. The 20 elementary schools included 1,214 staff members and 10,171 students. In a high community transmission

setting, low school-associated transmission was observed with a 0.7% secondary attack rate. Mask adherence was high, but students' classroom seats were less than six feet apart and a median of three feet apart. The conclusion of the implications for public health practice included that 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 six feet or more between students' seats might not be possible.<sup>6</sup>

A modeling study was conducted to illustrate COVID-19 spread within a hypothetical school over the course of 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 cases, 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.<sup>7</sup>

A science brief on COVID-19 transmission in K-12 schools by the CDC reviewed over 90 peer-reviewed scientific articles related to COVID-19 transmission in school and day care centers. The brief noted the key points that "with approximately one quarter of teachers at higher risk of serious consequences of COVID-19 because of their underlying medical conditions, 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.... Studies of SARS-CoV-2 transmission in schools that consistently implemented layered prevention strategies have shown success in limiting transmission in schools, even when testing of close contacts has been incomplete." Further, "When a combination of effective prevention strategies is implemented and strictly adhered to in the K-12 in-person learning environment, the risk of transmission in the school setting appears to be lower than or equivalent to the transmission risk in other community settings."<sup>8</sup>

Specifically related to masks, the article finds, "Most studies that have shown success in limiting transmission in schools have required that staff only or staff and students wear masks as one of the school's prevention strategies." It also notes, "Inconsistent mask use may have contributed to school-based outbreaks."<sup>8</sup>

The science brief example studies included:<sup>8</sup>

- 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. These schools implemented and strictly adhered to multiple prevention strategies, including universal mask use and physical distancing.<sup>9</sup>

- A study of Utah elementary schools who implemented layered prevention strategies, such as mask wearing and cohorting, found very low transmission (secondary attack rate 0.7%) in December 2020- January 2021.<sup>6</sup>
- 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.<sup>10</sup>
- 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.<sup>11</sup>
- 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, including mask use, physical distancing, and other interventions.<sup>12</sup>
- 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.<sup>13</sup>
- 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.<sup>14</sup>

Based on the above, the scientific evidence clearly shows that wearing masks in schools reduces the rate of COVID-19 transmission, especially when used as part of a comprehensive, layered strategy, and that the effectiveness of mask use is tied to the level of compliance.

## **SAFETY OF MASKS ON CHILDREN**

Scientific studies have shown that the use of surgical (disposable) or cloth face masks are safe for children to wear. Multiple studies have demonstrated that they do not cause low oxygen levels, high carbon dioxide levels, or respiratory distress in people wearing them. These masks are made to allow oxygen and carbon dioxide molecules to move through and around them while blocking droplets or small amounts of moisture containing virus particles.

A study published in 2021 by researchers from University Hospitals of Cleveland looked at 50 adults who had a median age of 33 years old and of whom 32% had a comorbidity. Carbon dioxide and oxygen levels in the blood were measured at the end of ten-minute periods of sitting quietly and walking briskly without a mask and while wearing a cloth mask and a surgical mask. There were no episodes of a low oxygen or high carbon dioxide level in the blood. There were no statistically significant differences in oxygen or carbon dioxide levels between baseline measurements without a mask and measurements taken while wearing either kind of mask at rest or after walking briskly for ten minutes.<sup>15</sup>

A hospital in Italy did a cohort study in early summer of 2020 to examine if use of surgical masks among children is associated with low oxygen levels in the blood or respiratory distress. They included 47 healthy children divided into two groups by age ( $\leq 24$  months and  $>24$  months to 144 months). The 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. The level of carbon dioxide the child was exhaling, the level of oxygen in their blood, their heart rate, and their respiratory rate were measured every 15 minutes. There was no significant change in any of these measurements over the first 60 minutes (without or with a mask while at rest) in either age group. The heart rate and respiratory rate increased after the walking test compared to before it for the older group but there was no change in the level of carbon dioxide the child was exhaling or the level of oxygen in their blood.<sup>16</sup>

Prior to the pandemic, in 2016, a randomized study in Singapore evaluated the safety of a pediatric N95 mask. They measured the level of carbon dioxide exhaled by 106 healthy children aged seven to 14 years old while wearing the mask compared to without the mask. They demonstrated that even a pediatric N95 mask is safe for use by healthy children as the children were not building up carbon dioxide in their lungs.<sup>17</sup>

A now-retracted study published in *JAMA Pediatrics* in June 2021 is widely cited as having shown that masks were dangerous for children to wear because they caused the children to breathe in higher amounts of carbon dioxide. The researchers reported high levels of carbon dioxide measured on the inside surfaces of masks worn by children. However, the study's methods and assumptions were quickly criticized by the medical community when it was published, and it was officially retracted by the journal just 16 days after publication. Problems with the methods included using a device to measure the carbon dioxide levels that was known to have a large margin of error when used in an open setting rather than the incubators in which it was designed to be used. The authors also made the assumption that the air just on the inside of the mask was the only source of air being inhaled, when in reality the air inhaled would have been a mixture of the air there and the air around the child, which would have had a lower carbon dioxide level.<sup>18,19</sup>

There is no peer-reviewed scientific literature to support the false claims that wearing a mask weakens a person's immune system, increases the risk of infection with another pathogen (germ), nor has any other detrimental impact on the physiology of healthy children. There is also no evidence in the above studies of any detrimental physical impact on children when they wear a mask.

## **IMPACT OF MASKS ON ACADEMIC DEVELOPMENT**

No data regarding the impact of mask wearing on children's academic development or performance was identified during a thorough scientific literature review. However, experts reject concerns about this, including the AAP, who notes, "Masks will not affect your child's ability to focus or learn in school."<sup>20</sup>

Experts such as pediatricians and speech-language pathologists report there is no evidence that masks prevent or cause delays in language development or speech, noting that children who are visually impaired develop these skills at the same rate as children without visual impairment. This is potentially because other senses may be heightened when one sense is not present, and/or because children can see gestures and eyes show emotions and hear words and tone of voice.<sup>21</sup>

## **IMPACT OF MASKS ON EMOTIONAL/ BEHAVIORAL DEVELOPMENT**

There is also no data showing mask use has a negative impact on a child's emotional or behavioral development. In fact, there is data to suggest identification of emotions in another person's face can be performed by children even when the face is wearing a mask. A study by the University of Wisconsin during the pandemic examined the ability of 80 children between the ages of seven and 13 years old to identify emotions on faces covered by a mask or sunglasses compared to on unobscured faces. The children noted whether each face was happy, angry, sad, disgusted, afraid, or surprised. They could be expected to randomly guess correctly 17 percent of the time since there were six choices. Without any masks or sunglasses blocking the face, the children correctly identified the emotions as often as 66 percent of the time, making unobscured faces the easiest for them to read. However, the children 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. These results suggests that although unobscured faces are easiest for children to read, they can read faces blocked with masks, maintaining a key part of socialization.<sup>22</sup>

## **SUMMARY**

Vaccination remains the most effective intervention to prevent COVID-19 in schools. However, until all students are eligible for vaccination, and vaccination rates rise, the wearing of masks is an effective method to reduce the spread of COVID-19 in schools.

The effectiveness of masks depends on the level of compliance, with high levels of compliance associated with greater effectiveness.

The use of masks in children is safe and expert consensus is that mask wearing does not negatively impact academic development or performance.

Rather, since mask wearing reduces the risk of COVID-19, and the risk of being quarantined, it can be expected to help keep children in school, which should lead to increased academic performance and socialization compared to being quarantined.

Based on the above, the universal wearing of masks in a school environment, especially in areas with a high transmission of COVID-19, will reduce the risk of COVID-19 infection and quarantine, and may improve academic performance and socialization.

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