

# The Impact of SARS CoV-2 on Children and Adolescents

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## Abstract:

*The impact of SARS CoV-2 on children and adolescents is frequently dismissed as less of a burden than the disease in adults. And while the percentage of severe illness in this age range is less than the percentage of severe disease in patients over 65 years old, the impact goes well beyond the physical burden of disease. Educational losses, caregiver loss, and the emotional burden of the pandemic will be elements whose full impact will not be known for likely decades to come.*

***“As of November 18, 2021, almost 6.8 million children and adolescents have tested positive for SARS CoV2, representing 17% of all reported cases. (1) This number is certainly lower than the number of infected children as early on, the ability to test children was limited, and many households reported that they did not test symptomatic children in the household when adult members of the home tested positive.”***

## Physical Burden of Disease:

As of November 18, 2021, almost 6.8 million children and adolescents have tested positive for SARS CoV2, representing 17% of all reported cases. (1) This number is certainly lower than the number of infected children as early on, the ability to test children was limited, and many households reported that they did not test symptomatic children in the household when adult members of the home tested positive. Unfortunately, the Delta variant wave increased the case report to 8,641 cases per 100,000 children in the population, which is a number that has doubled since March 2021. (2)

The presenting symptoms of SARS CoV-2 in children and adolescents are broad and touch most organ systems. Respiratory and Cardiac symptoms lead to children requiring pediatric ICU care (3), while children requiring acute, non-ICU level care have had the full spectrum of symptoms from being admitted for other etiologies and incidentally covid positive to severe covid pneumonia. Children have been 1.7%-4.2% of total reported hospitalizations, and between 0.1%-2.0% of all children, COVID-19 cases resulted in hospitalization. Over time we have seen the percentage of children testing positive becoming a higher percentage of the total positive tests, and for the week ending November 18, children were 25.1% of reported weekly COVID-19 cases, yet children under age 18 make up only 22.2% of the US population. (2)

There has been much reported in the news of a small number

of myocarditis cases after the mRNA vaccine, especially in men 16-29 years of age. Getting live SARS CoV2 infection/COVID-19 was associated with 11 more events of myocarditis/100,000 people compared to 1.2 - 2.7 cases/100,000 in those receiving the vaccine, still favoring the choice to vaccinate. Men in the highest age range risk should consider if a non mRNA vaccine is preferred based on their health assessment with their physician. (4, 5)

While many children are fortunate to suffer asymptomatic or mild disease, they are at risk for developing Multisystem Inflammatory Syndrome in Children (MIS-C) post-SARS CoV-2 infection. This postinfectious inflammatory process presents with serum markers of inflammation, like elevated CRP or ferritin, and clinical symptoms of fever, gastrointestinal symptoms, lymphadenopathy, rash, mucocutaneous lesions, and in more severe cases, hypotension and shock. Not all children present the same, and other clinical symptoms are possible. The majority of patients have serum lab evidence of cardiac damage, and some have fulminant cardiac dysfunction, myocarditis, or acute kidney injury. To date, 5,973 children have met the criteria for MIS-C with a median age of 8 years old. Fifty-two children have died from MIS-C, with many others requiring prolonged ICU care, IVIG, IV glucocorticoids, or Anakinra, along with outpatient follow-up. Children of Hispanic/Latino or Black, Non-Hispanic race/ethnicity were disproportionately impacted, making up 60% of the reported cases. (6-8)

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Pediatric deaths from COVID-19 are rarer than deaths in older adults, yet their impact is arguably more significant in lost potential. Six hundred thirty deaths under 18 years old have been reported due to COVID-19. If the average age of death in America in 2020 was 77.8 years and the current estimate of years lost per child death is 68.8 years, then the death of these children accounts for 43,344 lost years of life. (9, 10) These are graduations and weddings never celebrated, new children not being brought into the world, and discoveries, inventions, and art not being found, developed, or created.

## Educational Burden from Disease:

There is no doubt that the best interest of public health was considered when from March 2020 thru August 2021, nineteen thousand schools closed to in-person learning affecting 12 million students in all 50 states. Yet, we cannot overlook the impact of learning

loss, and we must plan a robust intervention to overcome this loss. Learning loss is defined as knowledge or skills that students forget while they are not in school for extended periods and also encompasses the gap in knowledge or skills that students would have learned in a “normal” year but did not learn. Stanford University’s Center for Research on Education Outcomes estimated learning loss in math and reading during the 2019-2020 school year for 17 states, the District of Columbia, and New York City. While estimated learning losses varied based on historical school performance and student profiles, students in Illinois lost the greatest in math, an estimated 232 days of school learning, and students in South Carolina lost 183 days in reading. (11) These losses do not consider the further losses in the 2020-2021 school year. Add to that the 9,313 schools over 916 districts that have unexpectedly closed since reopening in August 2021 due to outbreaks, staff or teacher shortages, and mental health concerns, and it is evident that this problem is not over. (12)

School shutdowns have made existing inequity of learning worse, as students of color are estimated to have lost twice as much as their white peers during the pandemic. (13) Libby Pier’s group evaluated the CORE data collaborative where 18 school districts report California state MAP and STAR assessment results and found significant learning loss in both English Language Arts (ELA) and Math over the period from fall 2019 to fall 2020 compared to the three prior years. Socioeconomically disadvantaged students (SED) or English language learner (ELL) status were disproportionately impacted. For example, 5<sup>th</sup> graders classified as SED had a loss of STAR scale points in math of almost twice those not classified as SED, and 7<sup>th</sup>-grade students classified as ELL learners had approximately a four-fold loss in ELA compared to their English-speaking peers. Access to reliable wifi, home computer, or family members to assist all contributed to the widened gap for these learners. (14) In addition to these populations, children with special needs, homeless, and foster youth were farther behind than their age-matched peers with chronic absence playing a role. The impact on learning from food and housing insecurity cannot be undervalued. Children who are calorie deficient or afraid for their safety cannot learn. Black and Latino families in the US are twice as likely to face food insecurity, and women from these groups were more than twice as likely to have lost their job during Covid-19 pandemic lay-offs. (15)

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Critical milestones occur in education related to proficiency in reading and math. The reading skills of retelling stories, asking and answering questions are foundational and learned in kindergarten and first grade. Learning these skills prepares students for more in-depth reading skills to learn to read in K-3 and read to learn starting in the 4<sup>th</sup> grade. The percentage of kindergartners and first graders not on target to learn to read almost doubled from 28% to 47% and from 26% to 43% from 2019-20 to 2020-21, respectively. Again, children of color are disproportionately affected, with 54% of Black and 59% of Latino kindergartners not on track for reading in 2020-21. Without additional support, all children who are behind in reading in grade one will have a 90% chance of remaining a poor reader, and children with poor reading skills at the end of the third grade are four times less likely to graduate from high school and six times less likely if they are SED. (13, 16, 17) With respect to math skills, algebra is considered the foundational math milestone and should be mastered no later than the end of ninth grade. According to the CA State Accountability Report Card, in the 2018-19 California school year, Black and Latino eighth grade students were 12% and 24% respectively on track for math compared to 52% of their white peers. State testing for this age range did not occur in the 2020-21 school year, so the impact of learning loss is yet to be fully understood, but if the data related to elementary school learning loss is applied, we could be looking at or more than a full year’s loss of math skills in this grade level.

In California, nearly 1 in 5 elementary school children missed >10% of school in the 2020-2021 school year, which is the percentage that defines chronic absence and that up to 1.5 million students are disconnected because of a lack of reliable internet or computer. Students with special needs were impacted due to poor access to assistive devices for learning and online platforms being non-conducive to students with visual or auditory loss. It is estimated that almost 3 million of the most marginalized students across the US have disengaged from school. In the Spring of 2020, nationwide, only 60% of low-income students regularly participated in their online school activities compared to 90% of high-income students. When students miss school and fall behind, they become disengaged, frustrated, and more likely to fail courses and drop out of school. Only approximately 30% of students who drop out will re-enroll in school, and of those, only 18% graduate from high school. (13) In addition, California saw its most significant drop in Spring 2021 college enrollment, which was down 5.3% and more heavily weighted towards community colleges. National fall enrollment is running 2.6% below last year with an astounding 7.8% drop overall and a 15% drop for community colleges since 2019. (18) This is alarming as community colleges serve a higher proportion of disadvantaged students and students of color, further widening income potential and job security.

#### **Emotional Burden of Disease:**

Rightfully so, attention has been given to the increased levels of emotional distress that our country and the world have endured since the pandemic’s start. Unfortunately, children and teenagers have been far from protected from this impact. The psychological impact on children includes their worry about sick parents or caregivers, worry about becoming sick themselves, worry about where their next meal will come from, witnessing the anxiety of adult caregivers, and dealing with the loss of a primary caregiver. In addition, they have been separated from the protecting factors of socialization in school and extramural activities and have experienced higher levels of online bullying and the loss of monumental milestones, like prom and graduation celebrations.

With over 779,000 Covid-19 deaths in the United States, it is estimated that more than 140,000 children here have experienced the loss of a parent or primary care grandparent, with more than 1.5 million children worldwide experiencing this loss. (19, 20) This

figure represents a 20% increase in parent loss over pre-Covid-19 years. California, Texas, and New York have suffered the highest total numbers of caregiver loss, but racial and ethnic populations are suffering high numbers clustered in certain states. New Mexico, Texas, and California reported that 49-67% of caregiver loss were Hispanic, while Alabama, Louisiana, and Mississippi reported 45-57% were black. Montana, New Mexico, and South Dakota report a high percentage of Native American and Alaskan Native caregiver loss. (21) Predictability is a stabilizing force for children and adolescents, and youth are in a critical period of neurodevelopment. So significant disruption in this predictability brings a significant challenge for children. Pre-Covid work has informed us of the deep impact of caregiver loss on children. These children are at increased risk of traumatic grief, depression, poor educational outcomes, unstable housing, poverty, and suicide or unintentional death. (20, 22) Unfortunately, this increase in caregiver loss for our children during the pandemic is occurring at a time of social isolation and economic hardship that may leave many children who experience the death of a primary caregiver without the necessary bereavement support.

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The world has struggled with the unknown that the pandemic has brought rising levels of anxiety and depression. That effect has been felt deeply in the pediatric world as well. Multiple studies have been published validating the impact, but sometimes the voice of the children speaks the loudest. One online questionnaire queried 359 children and 3,254 adolescents aged 7 to 18 years and found that 22.3% of youth had scores indicative of clinical depressive symptoms with the baseline estimated prevalence pre-covid of 13.2%. (23) Another administered PHQ-9 and GAD-7 in >8,000 Jr and Sr High School students and found 43% with depressive symptoms and 37% with anxiety. Knowledge of protective measures against covid correlated with fewer symptoms and youth who had a family member or friend with COVID-19 had higher anxiety levels than those who did not. When looking at specific symptoms, the most frequently observed changes were difficulty concentrating (76.6%), boredom (52%), irritability (39%), restlessness (38.8%), nervousness (38%), loneliness (31.3%), uneasiness (30.4%), and worries (30.1%). (24) In addition, about 75% of parents reported feeling stressed about the quarantine situation, and we know that children are affected by the stress levels they observe in their home environment. Even more concerning, a study by Loades showed that social isolation and loneliness increased the risk of depression up to 9 years later and that the duration of loneliness was more strongly correlated than the intensity of the loneliness, further making us concerned about the future for our children. (22)

An additional burden felt in the pediatric world is the increased level of children and adolescents presenting with eating disorders requiring hospitalization. Pre-pandemic, the pediatric world saw an increasing number of children presenting with eating disorders, and the age was skewing younger. Eating disorders often stem from an attempt to control an area and encompass a complex

relationship with food. Food insecurity and panic buying, social isolation, loss of routines, and the social media bullying about weight gain that have occurred with the pandemic are elements that have promoted the societal setup for eating disorders. The UK National Health Service has seen an almost doubling of urgent and routine referrals for eating disorders. (25) In our experience at Loma Linda University Children's Health, the six months from 3/1/21 to 8/31/21 has seen a threefold increase from the same 6-month blocks in the previous two years with frequent co-morbidities of anxiety or depression. (26) To work to stem this flood, we must normalize our children's emotions without an unhealthy focus on the loss of control and seek early support when symptoms arise. With our national shortage of pediatric therapists, the burden will fall on primary care providers to have close follow up with these children. Fortunately SAMHSA is working within their strategic plan to increase mental health support but the barriers of not enough total workforce or diversity in the mental health workforce are not factors that can be rapidly corrected.

#### **Vaccine Hope:**

Since the pandemic's start, the scientific response worldwide for collaborative vaccine solutions has been rapid and impressive. Vaccines are a safe and reliable preventative measure against deadly diseases. In comparison to covid, other vaccines recommended for routine vaccination had much lower death rates than we have seen in covid. The meningococcal vaccine was recommended after seeing eight deaths in 11-18-year-olds between 2000 and 2004, while rotavirus caused 20 deaths in children under five between 1985 and 1991. (27, 28) Currently, in the United States, Pfizer - BioNTech have approved vaccines for ages five and up, and by December 6, 4.8 million children from 5-11 years old have received one dose, and 1.2 million children have been fully vaccinated without any severe side effects reported. In the 12-17 year population, 61.5% have received at least one dose, and 51.7% are fully vaccinated. According to the CDC, using a benefit accrual assumption over six months and the recent incidence in this age range, it is estimated that for every million doses in children 5-11 years old, more than 114,000 cases, 417 hospitalizations, 260 cases of MIS-C, and 132 PICU admissions could be avoided. (29) It is important to note that vaccinating our children goes beyond protecting the child themselves to include vulnerable members of their family and the community, making a return to normal activities safer for all. Moderna has submitted data from their 12-17-year-old trial, and the FDA is likely to rule in January 2022. In addition, trials for Johnson and Johnson, Moderna, and Pfizer-BioNTech are ongoing down to 6 months of age and in pregnant women, with data expected in 2022.

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Many have discussed the pros and cons of natural immunity versus vaccine immunity. Surviving an infection with SARS CoV-2 has been shown to create variable neutralizing antibody levels with people under 30 who recovered from moderate COVID-19 having lower levels than older people, suggesting that they are at greater risk for a second infection. (30) Infections with SARS CoV-2 cause the immune system to produce virus-specific antibodies as well as memory B cells to assist with protection from a second infection. While research is still ongoing to understand how antibodies wane over time in both vaccinated and in people with prior infection, data shows that vaccination in people with prior infection is a safe and vital step in decreasing the chance for future disease. In October 2021, the CDC showed that those who were unvaccinated and had a recent COVID-19 infection were five times more likely to have COVID-19 again than those who were recently fully vaccinated and had not had a prior infection. More importantly, prevention against hospitalization and death continues to be strong in vaccinated compared to unvaccinated people worldwide. In country-specific data released by the University of Oxford, Americans are 13 times more likely to die if unvaccinated, with significantly different rates between vaccinated and unvaccinated people in the UK, Chile, and Switzerland. (31) Vaccines are making a difference in severe infection rates and death. However, the data alone seems unlikely to sway the remaining vaccine-resistant population making future infection waves inevitable if we cannot find ways to make vaccine-hesitant and resistant people more accepting of vaccine science.

***“The initial impact from the first 21 months of the pandemic has been devastating, but the effects and total impact are still unknown. It is upon all of us to rally around our children to lessen the future impact by encouraging vaccination, improving mental health resources, and investing in learning catch-up strategies.”***

#### **Conclusion:**

SARS CoV-2, as the novel coronavirus causing COVID-19, has made a significant impact on the health and well-being of our pediatric population. It has caused acute illness, postinfectious MIS-C, death, and emotional and psychological burden on our children, along with academic learning loss. The initial impact from the first 21 months of the pandemic has been devastating, but the effects and total impact are still unknown. It is upon all of us to rally around our children to lessen the future impact by encouraging vaccination, improving mental health resources, and investing in learning catch-up strategies.

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