

## *Coronavirus and the Pediatric Population: An Analysis*

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Wuhan Province in China first reported an outbreak of a novel respiratory illness in early December 2019. The infection soon exploded onto the global stage, rapidly spreading to six continents and more than 100 countries, causing economies and lives to grind to a halt as governments urged people to self-quarantine to prevent the spread of the virus. Some governments have completely locked their countries down, preventing citizens from leaving their homes except for emergencies and to get essential items like food or medicine, while other governments have been more resistant to ordering a mandatory quarantine of their entire population. Evaluating the epidemiology and transmission patterns of a novel virus during a global pandemic in real time as the numbers change by the second, with increasing testing and exponential spread to all corners of the globe, is a daunting task. The differences in testing capability between countries, as well as variability in the criteria a patient must meet to qualify for testing further complicates this analysis. While the global picture of the vast spread of disease is becoming slightly clearer as more and more patients become symptomatic and are tested, the role that children play in this global pandemic is still largely unknown. Early reports from China indicated that children were less susceptible to coronavirus infection for unknown reasons. Later results indicated that children may be asymptomatic carriers, unknowingly contributing to the rapid virus spread across the globe. The purpose of this paper is to evaluate and synthesize the current data surrounding the pediatric population and the COVID-19 outbreak as well as to evaluate the impact of the global pandemic on this vulnerable population. I will propose policy recommendations for how to best address the ongoing situation while simultaneously preparing for future pandemics.

### **Epidemiology:**

It is difficult to estimate precisely how the pediatric population is impacted by COVID-19, but there are a few larger studies that have been published in recent weeks that provide high quality, large datasets. This data is mainly from early impacted countries, including China and Italy. A *JAMA* study of 45,000 laboratory tests in China confirmed 2% of COVID-19 patients were individuals under 18 and there were no pediatric deaths reported in this population (Wu 2020). Another study published in *Pediatrics* looked at the epidemiology and transmission patterns among pediatric patients with COVID-19 in China (Dong 2020). The data in this study consists of a nationwide case series of 2,143 patients from January and February 2020. The study found that the median age of infected pediatric patients was seven years of age, however children of all ages were susceptible to COVID-19. Over 90% of identified pediatric cases were classified as asymptomatic, mild or moderate with most patients showing mild respiratory symptoms and low grade fevers. Dong et. al found a significantly lower proportion of cases classified as severe or critical in the pediatric population (5.9%) than the adult population (18.5%).

Another way to estimate the impact that the coronavirus may have on the pediatric population is to retrospectively identify how other coronaviruses have impacted children in the past. For example, COVID-19 has some similarities to Severe Acute Respiratory Syndrome (SARS), another novel respiratory virus that emerged in November 2002. While SARS had a

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much smaller global impact, killing 774 and infecting more than 8,000 individuals before burning out, we can still look at the proportion of children infected during that time frame. There were only 80 laboratory confirmed cases and 55 suspected SARS cases in individuals under the age of 18 while no children died from SARS, and those aged 12 and under displayed milder symptoms than those 12+ (Hon 2007). The CDC found only one instance where they could track a child transmitting SARS to another individual. Similar patterns of infection and transmission among the pediatric population were also found during the Middle Eastern Respiratory Syndrome (MERS) epidemic in 2008 (Memish 2014).

One explanation that has been gaining increasing acceptance for why the pediatric population is less susceptible to these novel coronaviruses has to do with how these viruses enter human host cells. Data has shown that the virus attaches to the angiotensin converting enzyme 2 (ACE-2) receptor on host cells (Rabi 2020). Children have lower levels of this protein expressed on their cells which could, in part, explain their lowered susceptibility. Another proposed theory is that children have immune systems that are not as developed as those of their adult counterparts, leading to a less robust immune response. Anecdotal evidence illustrates that significant morbidity and mortality stemming from coronavirus is attributable to a robust immune response, with lungs filling with fluid and debris from an overabundance of immune cells and inflammation leading to Acute Respiratory Distress Syndrome (ARDS). Another theory is that children may also have some cross-protection from antibodies for other coronaviruses, such as the common cold, that are already circulating in their bloodstream due to the high prevalence of these viruses among children. Finally, it is possible that children are less likely to be impacted because families with young children are more likely to adhere to strict cleanliness procedures and isolation guidelines.

A confounding factor to note is the potential that the medical community is underestimating the impact on children because of less testing performed in this population, particularly if they are asymptomatic. Also, China has a different population age structure than the US and Western Europe, with fewer young children due to the years long One Child Policy, so we may see an increase in pediatric cases as the virus spreads to countries with different age distribution. The testing has largely focused on adults because of the significant burden of disease in this population but the production of more tests will allow for broader testing. Only time will tell how the epidemic truly plays out for the pediatric population.

### **COVID-19, Pregnancy, and Newborns**

Another topic of interest is how to address the concerns of women who are pregnant or have recently given birth during the COVID-19 epidemic. There are an estimated one million women expected to give birth in the next three months in the United States during the peak of the pandemic. There is skyrocketing worry among pregnant women as hospitals restrict visitors, some even going as far as saying pregnant women are not allowed to have visitors while they are in labor. However, the worry does not simply end at delivery, as it is unclear if and how COVID-19 can spread from mother to child and the potential health implications of this mode of transmission.

As this is a novel virus, there is minimal data on the implications of a coronavirus infection during pregnancy including short and long term health impacts on mother and baby. The American College of Obstetricians and Gynecologists (ACOG) states that currently available data does not demonstrate that pregnant women are at increased risk for contracting COVID-19, although we know that they are at increased risk of morbidity and mortality from

other common respiratory infections, such as influenza, and thus should be classified as a high risk group. According to ACOG guidelines, preterm birth has been reported among COVID-19 positive patients although it is difficult to establish if COVID-19 infection directly lead to early delivery. It has not yet been established if COVID-19 can cross the placenta, although a small sampling of cases have found no positive infants born to COVID-19 positive mothers (Chen 2020).

Limited studies have demonstrated that COVID-19 has not yet been found in breastmilk which holds true with other coronaviruses and respiratory viruses, namely SARS and influenza (Anderson 2020). Given this data, the WHO and CDC state that mothers with COVID-19 can breastfeed as long as they take precautions to prevent the spread of COVID-19 to their babies such as washing hands before touching the infant and wearing a facemask if possible while the baby is breastfeeding. The safest method would be for a mother to pump her breastmilk and then have a healthy family member feed the infant. It is the recommendation of the Academy of Breastfeeding Women that a COVID-19 positive mother should remain separate from other family members including the infant during the course of infection and should continue to use a facemask for at least a week after respiratory symptoms have improved. It is important to discuss with the mother the risks and benefits from isolation from her newborn during the important first two weeks of life and make decisions in accordance with the mother's wishes.

### **Asymptomatic Transmission:**

One evolving concern is that children are asymptomatic vectors of disease transmission. The idea is that while children may be less likely to demonstrate symptoms or end up hospitalized, they can still become infected with COVID-19 and can potentially spread the disease to the adult populations they are exposed to, either through viral respiratory secretions or through stool. This is particularly relevant for the pediatric population because children are more likely to harbor the virus in their upper respiratory tract compared to deeper in the lung tissue, which partially explains their decreased likelihood to develop pneumonia or other severe respiratory complications (Cai 2020). However, a higher viral load in the upper respiratory tract means increased chance of transmission to close contacts, especially as children are less likely to cover their sneezes and wash their hands appropriately. It is estimated that children shed viral particles in respiratory secretions for an average of 12 days after infection, with a range from 2 to 22 days (Cai 2020). The same study found that children carried coronavirus particles in their stool for up to 30 days after they became asymptomatic (Cai 2020). Numerous ongoing studies are trying to determine exactly how the virus is spread and for how long, which can help to inform policies about future school openings and prevent community spread. Even if children are asymptomatic, the evidence seems to be pointing toward the fact that they can bring the virus home to the most susceptible population, such as older adults sharing the family home, and that widespread school closings were imperative to halting the rapid spread of Covid-19.

### **Impact on daily life:**

Aside from the health impact of coronavirus on the pediatric population, there are a myriad of impacts in every area of life, including disruption of daily activities such as school and extracurriculars, the psychological toll of anxiety and worry about health and safety, and food security concerns. It is estimated that nearly 54 million students are out of school in the US as of late March 2020, with governors ordering the mandatory closure of public schools until summer or at least for the foreseeable future (Donner 2020). The number of children out of school is even

more staggering when looking at the numbers globally, with UNESCO estimating over 1.5 billion children, or 87% of the school age population, affected by school closures (Jolie 2020). The magnitude of this interruption on children cannot be underestimated, however it also impacts families and caregivers. There is now an added burden to provide or find childcare during the work week, which especially impacts parents in the medical or other essential fields who are still required to go to work to help combat this virus and keep the basic structure of society functioning. The psychological stress on caregivers now required to both work from home and care for children simultaneously cannot be underestimated. Caregivers are also faced with the task of providing reassurance to their children in this time of uncertainty and fear and finding the balance of what to talk to their children about which varies with different age groups. Numerous articles published in recent weeks provide advice on how to talk to children about coronavirus and the rapidly changing world around us, both in the lay media and more professional organizations such as the American Academy of Pediatrics. These resources should be shared as widely as possible so that parents have support and guidance in addressing this unprecedented situation.

One of the most immediate concerns is how children who rely on school for daily meals will have steady access to food during this virus outbreak. This problem is compounded by the fact that students who rely on school programs for breakfast and lunch are from low-income families who are also most likely to be negatively impacted by the sudden stop to the economy in terms of lost wages and unemployment. This is not just a problem in the US but also globally. For instance, in India, over 100 million children receive free school lunch on a daily basis and studies have shown that these school lunches reduce protein deficiency by 100%, calorie deficiency by 30% and iron deficiency by 10% (Afridi 2010). School lunches supported by the United States National School Lunch Program provide over a third of daily calories to the 22 million US students who utilize subsidized food programs (Story 2009). Aside from providing food, many schools are the only source for physical, mental, and dental health care for hundreds of thousands of children in the United States and across the globe. A 2019 study of school-based health centers estimates that primary care services are provided by more than 11,000 schools in the US, covering over six million children (Love 2019). In addition, schools are a source of built in physical activity through gym class or recess which has a huge impact on both mental and physical health. The lack of physical activity and being isolated in a house with no option to leave can lead to rising tensions among families.

Several experts have explored the potential psychological impact of the sudden shift in daily life on children. Available evidence shows that children who are out of school for an extended period of time are less physically active, have significantly increased amount of screen time, less regular sleep schedules, and less healthy and balanced diets. The factors that impact the psyche include boredom, fear, frustration, decreased social contact, and lack of personal space (Wang 2020). One study explored PTSD scores after mandatory quarantine among pediatric patients and found scores were four times higher than individuals who did not undergo quarantine (Sprang 2013). We can also look at the impact of other large scale disasters and how children were most impacted, as well as effective strategies for promoting healthy recovery after the acute crisis has passed. For example, the book *Children of Katrina*, looks at the impact of Hurricane Katrina on children at the time of the disaster and in the years since. The authors found that “children exposed to Katrina were significantly more likely to suffer emotional disturbances than other kids, even years later...the likelihood of uneven recovery among kids was directly linked to existing social disadvantages- namely poverty and race” (Fothergill 2015).

Tragically, studies have found that rates of child abuse and neglect tend to track with traumatic events in society, as parents and caregivers are faced with job loss and financial stress, leading to volatile emotions. Reports are already emerging documenting increasing cases of physical abuse in the past few weeks. For instance, a hospital in Fort Worth, Texas, reported six cases of severe physical abuse in children under the age of four in one week in early March, which is the same volume they usually see in a month (Clarridge 2020). These cases were linked to significant stress among parents with families cooped up together and growing concerns about financial security stemming from the coronavirus epidemic. In addition, with schools closed for the foreseeable future, children lose the protection of teachers, social workers and school counselors who are common reporters of signs of suspected neglect, physical or sexual abuse. Illinois provides a case study illustrating the realities of this concern- for the week of March 9, 2020 Illinois DCFS received 6,672 reports of abuse and neglect via a statewide hotline. Schools were ordered to shut-down starting March 18, 2020 and that week the hotline reported calls decreasing by 45%, down to 3,675 calls (Eldeib 2020). The hotline is expecting further decreases in reports as the mandatory lockdown continues indefinitely and mandated reporters are separated from children.

The majority of schools are moving toward an online learning community for their students to minimize the interruption in education. While teachers should be universally commended for their adaptability and dedication to their students, it is difficult to replicate an in-person learning experience via the internet. The challenges of transitioning to online teaching is particularly concerning for children with special needs who require a range of educational interventions. The logistics of this are also difficult as some children lack access to the internet or computers. This disproportionately affects lower income children and puts them at a significant learning disadvantage if they miss out on online learning activities and have a months-long education hiatus. It is not known how this sudden interruption of our normal school year patterns will impact students in the long term. One recent commentator in the WSJ questioned whether school systems should delay instruction until online opportunities are equally available to all students, suggesting that holding back all students would be a worse harm than excluding a few (Solomon 2020). Instead of requiring such choices, however, a holistic approach to realizing the interdependence of rights would recognize the importance of leveling the playing field by investing in resources that reduce the structural nature of inequalities before a crisis amplifies them further.

### **Policy recommendations**

- 1. Access to the internet should be guaranteed for every household as a universal right. All school age children should be given an internet accessible device to enable communication with teachers and participation in educational activities.**
- 2. Ensure food security for the nation's children, especially those who rely on food assistance programs run by school systems.** This is especially important during times of school hiatus, including pandemics but also scheduled times like summer vacation. Novel ideas include distribution of food at bus stops and distribution of prepaid debit cards to families to purchase food.
- 3. Implement policies to promote awareness of increased risks of child abuse during times of restricted social movement and financial insecurity.** Encourage teachers to check in with children they are worried about. Distribute educational information to parents about how to deal with stress and anxiety and protect their children.

#### **4. Guaranteed coverage for testing costs, and income replacement assistance for parents required to stay at home for children required to quarantine.**

#### **Conclusions**

In summary, it is largely unknown how the Covid-19 global pandemic will impact the pediatric population both in the immediate future and long-term. It is clear that the repercussions will be felt beyond just the physical threat of illness, which has been demonstrated to be more mild in the pediatric population compared with adults. However, we should not be lulled into a false sense of security in terms of assuming our children are safe from the physical tolls of Covid-19 just by the nature of their age. As the virus spreads, we will gather more and more data which can help to demonstrate the true impact of this virus on the world's children. The larger and more long term impacts will be in terms of economic and academic disruption and the psychological toll stemming from the abrupt halt in daily life, social isolation and familial tensions, and the fear and grief stemming from illness and death related to Covid-19. This will be a generation defining moment and the most important thing to remember is that we are all in this together and must work diligently to help both our youngest and oldest generations come through this trial stronger and more united.

Additionally, it is important to implement a strong system of surveillance after the acute threat of this pandemic has passed. This is especially pertinent for the pediatric population since they may be asymptomatic vectors for transmission, so testing them should be routinely performed in communities continuing to see spikes in coronavirus cases. In addition, work needs to be done to address vaccine hesitancy, especially among parents of children. Even if researchers do develop a successful vaccine, we need the vast majority of people to receive the vaccine to provide protection and gaps in immunity due to anti-vaxxers will harm this effort. Thus, continued funding and advocacy for the scientific community to educate the general public is imperative.

While the spread of this particular virus will be halted at some point, either by the development of herd immunity in the community or creation of a successful vaccine, there are likely to be future viral pandemics. Therefore, we can use the lessons gleaned from this experience to better prepare for the future in terms of adapting policies to ensure the safety, security and stability of the pediatric population.

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