



The COVID-19 pandemic and its potential enduring impact on children

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Purpose of review

The COVID-19 pandemic has ushered in great and rapid change in our society. Although children are somewhat less likely to get infected or have severe symptoms from COVID-19, they are being adversely affected by this global public health emergency in many direct and indirect ways. This review focuses on the major areas in which children and adolescents are suffering, and how pediatricians can anticipate and optimize child healthcare and support as the COVID-19 pandemic and its aftermath continues.

Recent findings

This review provides preliminary insights into the physical, psychological, educational, developmental, behavioral, and social health implications of the pandemic on the pediatric population, highlighting both the pandemic's current and potential future impact on children.

Summary

The COVID-19 pandemic has and will likely continue to adversely affect many different aspects of children's health and well-being. It is important for pediatricians to be aware of these consequences of COVID-19 and take steps to help their patients now and in the future. Because the virus continues to ravage many parts of the world, continued research is needed to identify and evaluate any additional COVID-related challenges and concerns that adversely impact the growth and development of children.

Keywords

COVID-19, isolation, morbidity, public health

INTRODUCTION

Although children are somewhat less likely to get infected or experience severe symptoms from COVID-19, the pandemic has caused widespread and profound disruptions in daily life for children and adolescents across the globe. Through social distancing, sheltering-in-place, and closings of schools, they have been forced to face a sudden and 'new normal'. Such significant disruptions in the lives of children are not without consequences. Although these dramatic changes may be new for today's children, there are some parallels between the terror attacks on September 11, 2001 and the current pandemic. Just as today, schools temporarily closed with little to no warning; every news outlet focused on gruesome replays of the attacks; and the economy suffered – imposing harsh financial consequences for many families. In both cases, there were a number of direct and indirect victims [1,2].

Nonetheless, there are also many critical differences between these two epochal events. First, given new strains and global inequitable access to vaccines, it is still unclear when the COVID-19

pandemic will end and what it will look like. This uncertainty leads to greater and ongoing concern for children about their future. Second, while both events have had significant indirect global repercussions (e.g., financial markets, international relationships), COVID-19 has already had a direct impact on a large number of people. Finally, in the wake of September 11, the government, nonprofit organizations, hospitals, and research institutions organized psychological task forces dedicated to children's mental health. However, during the current public health crisis, government action and policy have

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KEY POINTS

- COVID-19 is causing major physical, psychological, educational, developmental, behavioral, and social health short-term and long-term consequences for children.
- Although multiple factors, including age and background, will impact individual child experiences, all pediatricians and caregivers should be aware of the similar foreseeable effects and provide additional guidance and support for the children and their families when appropriate or requested.
- Long-term management of the pediatric morbidity of COVID-19 must take a more individualized, forward-facing approach.
- It is important to use existing screening tools that identify high-risk groups, such as children with severe psychological burdens, toxic home environments, and unaddressed developmental concerns, or children who are struggling with the reentry back to society.

been more focused on the physical health of the most vulnerable populations [3[■]] – and less focused on the emotional well-being and mental health. Thus, some of the immediate consequences of COVID-19 relating to children and those bound to present or intensify over time have not received appropriate attention.

It is important to emphasize that the impact of COVID-19 on children will not be uniform given their developmental differences. On one hand, younger children may be more vulnerable to indirect suffering from the pandemic given their dependence on caregivers, though they may also be more shielded from information and comprehension relating to the viral pandemic [4]. In contrast, adolescents will have greater exposure to information about the pandemic. Yet, their increased independence, ability to communicate with friends, and skills to cope with hardship and disruption help them manage these events.

Even among children of the same age group, the impact of the pandemic will likely vary. Research suggests that children from different cultural backgrounds have different experiences [2,4,5]. A family's socioeconomic status, political leanings, education levels, and areas of residence may all impact how a child perceives events. Moreover, children who live in the same household with multiple relatives, including grandparents or other family members with medical risk factors, will likely have vastly different experiences from those in smaller families without concerns about the elderly or family members with chronic health issues [6].

Children whose parents are frontline healthcare providers or other essential workers may especially be at risk due to the psychological stress and emotional toll that their parents face each day [7,8,9[■]]. Furthermore, after the pandemic subsides, the 'new normal' conditions to which a child returns – in the classroom, their communities, and at home – will likely influence the healing process. For instance, losing a loved one or increased financial insecurity will likely have a sustained impact on children and families even after the economy fully reopens.

Given that COVID-19 has already profoundly altered so many aspects of daily life with no immediate return to previous baselines, the objective of this paper is to highlight many of the foreseeable consequences of the COVID-19 pandemic for children and adolescents. Most specifically, we will review the direct and indirect impacts that the current pandemic will likely have on the physical, psychological, educational, developmental, and social health of children in both the near and long term.

PHYSICAL HEALTH

Although children have been relatively spared from serious acute illness due to COVID-19 compared with older adults, some children have required hospitalization for respiratory disease or related conditions [10,11[■]]. Although a small percentage of children are directly experiencing serious immediate health consequences from COVID-19, the current pandemic has impacted children's health in terms of diminished access to care, less developmental surveillance, decreased immunization rates, compromised nutrition (food insecurity for some and obesity for others), and most seriously, failure to timely identify child abuse or maltreatment.

Access to healthcare and health surveillance

Throughout most of 2020, children may have been unable to access healthcare due to loss of health insurance, cancelation of medical consultations, elective procedures and appointments, and parental fears about interacting with any part of the healthcare system during the pandemic. These changes resulted in many parents delaying their children's routine vaccinations and preventive health visits. In May 2020, the Centers for Disease Control and Prevention (CDC) reported data showing significant reductions in vaccine orders and vaccinations administered as of mid-March 2020 [12]. In the state of Michigan, the proportion of children under 2 years of age with up-to-date vaccinations declined to less than 50% in May 2020 from two-thirds in

2016 to 2019 [13]. Data from New York City suggest that routine pediatric vaccine administration in the city has rebounded since the initial decrease during the early months of the pandemic surge, but still has not reached levels comparable with 2019 [14]. This reduction in routine vaccine administration suggests that US children and their communities face increased risks for outbreaks of vaccine-preventable infections, such as measles or mumps. Moreover, a delay in well-child visits could result in a delay in identification of developmental delays and disorders in young children and thus delays in early intervention therapies and services. Similarly, failure to do routine vision screening may result in delayed identification of visual impairment. It has been suggested that the increased near-work associated with virtual learning and screen time in general, coupled with reduced time outside, may lead to a greater incidence of myopia [15]. A large, population-based school photoscreening study comparing 2020 findings with annual findings for the preceding 5 years found a 1.4–3-fold increase in the prevalence of myopia in children 6–8 years of age [16].

Acute and persistent economic insecurity may also have compromised access to healthcare and maintenance of the medical home. In 2020, unemployment in the United States increased from 3.5% in February to 6.7% in December, with a peak unemployment rate of 14.8% in April [17[¶]]. Between February and July of 2020, there was a net reduction of 6.2 million workers with employee-sponsored health insurance [18[¶]]. This loss of health insurance had a notable impact on the pediatric population: results of a June 2020 national survey of parents found that employer-sponsored health insurance coverage of children decreased by 4.8% since March 2020 [19]. Even if children subsequently received healthcare through federal safety-net programs like Medicaid or Children's Health Insurance Program, families may have been required to change their primary care provider if the child's original pediatrician did not participate in certain programs.

Food insecurity

Another foreseeable and concerning consequence related to physical health is nutrition, in particular an increase in food insecurity. The UN has predicted that, because of COVID-19, the number of people worldwide facing food insecurity may double to 265 million [20]. In the United States, a May 2020 survey of parents with children ages 5–18 years revealed that, of households that were food secure before the pandemic, 15.6% were experiencing low food security and 15.3% were experiencing very low food security when surveyed [21]. This increase in food

insecurity among US households can be partially attributed to school closures during the early months of the pandemic, given that 30 million or 41% of school-age children in the United States receive meals through school lunch programs [22].

Because of the Families First Coronavirus Response Act, states were able to mitigate the impact of lost school meals through a new United States Department of Agriculture (USDA) program called Pandemic Electronic Benefits Transfer [23]. These benefits were recently extended through September 2021 to allow schools to provide benefits to children when schools are operating with a mix of hybrid virtual and in-person classes [24]. As of May 19, 2021, 43 states have been approved to issue benefits to students learning virtually or in a hybrid model for the 2020–2021 school year, and one state, Indiana, has been approved to issue benefits through summer 2021 [24]. COVID-19 has not only disrupted school-age children from receiving free or subsidized meals, but similar issues have likewise affected preschool children in early childcare and education programs as well [25].

Obesity

Reduced household incomes, uncertainty surrounding the duration of complete lockdowns, and anxiety related to going to grocery stores during the pandemic may have caused families to forgo purchasing fresh fruits and vegetables for less expensive foods with a longer shelf-life [26]. Prolonged consumption of calorie-dense, ultra-processed food leads to increased weight gain and childhood obesity, especially when coupled with an increase in sedentary behaviors and a decrease in physical activity due to school closures, suspension of extracurricular activities, and lockdown orders [27]. Even before the COVID-19 pandemic, the CDC reported concerning numbers in relation to childhood obesity and its progression as children age: prevalence of 13.9% among 2–5 years old, 18.4% among 6–11 years old and 20.6% among 12–20 years old [28]. It is also important to note that the prevalence of childhood obesity is greatest in households with lower socioeconomic status, and it is these families that have been most adversely affected by the pandemic in terms of household income and food security [28]. Thus, the childhood obesity prevalence estimates from the CDC will likely increase as a consequence of the COVID-19 pandemic and related safety measures.

Child maltreatment or abuse

Financial insecurity, global anxiety, loss of support structures, and parental frustration may lead to an

increase in both domestic abuse and child abuse during the COVID-19 pandemic [29[■],30[■]]. One national help service, Childhelp, reported an increased need for services amid the global pandemic [31]. There may also be underreporting of such abuse or neglect, as children no longer individually see other community members as frequently, such as daycare providers and teachers, who are mandated to make disclosures [29[■],32]. Poignantly, a longitudinal analysis of data from New York City's Administration for Child Services from January 2015 to May 2020 found that there were 29% fewer total reports of child maltreatment in March 2020 than forecasted, and just in April and May 2020, the number of reports was approximately half of what was expected [33]. When extrapolated, the researchers estimated that approximately 276,293 allegations of child maltreatment which would have otherwise been reported nationally were not reported during this same 3-month period [33].

PSYCHOLOGICAL HEALTH

Empirical studies focused on the adverse consequences of the pandemic on children's mental health are limited. However, because of the unprecedented interruptions to daily life caused by the spread of COVID-19, it is speculated that the pandemic will have a lasting psychological impact on children and adolescents [34]. Due to the sudden closure of schools, stay-at-home orders, fears of illness and dying, periods of boredom and frustration, extreme disruptions to daily routine, and a lack of in-person contact with friends and family, children will have been exposed to increased stress in the home environment [35[■],36[■],37[■]]. Challenges with work-life balance and financial uncertainties created by the pandemic may have also increased emotional strain within many families [38]. For example, caregivers who were required to work remotely may have had difficulty balancing their obligations as parents (and surrogate teachers) with responsibilities to their employers, whereas others may have felt distressed due to job loss and financial instability. With limited access to external support systems, such as those found at school or preschool, and increased family hardships, children will likely experience significant psychological strain due to the pandemic.

The behavioral and emotional symptoms experienced by children during the pandemic depend on their developmental stage. In the short term, younger children may exhibit nervousness, clinginess, anxiety when separated from their caregiver(s), irritability, and disobedience [39]. Among adolescents, common reactions to hardship may include antisocial or disruptive behavior, aggression, resistance of authority,

inattention, poorer school performance, and acute depression symptoms [39]. Both domestic and international reports suggest that children and adolescents have experienced an increase in internalizing (depressive) and externalizing (conduct) symptoms during the COVID-19 pandemic. One study of primary school children in Wuhan, China in the spring of 2020 found that 22.6% of children exhibited depressive symptoms and 18.9% exhibited anxiety symptoms when evaluated following the relaxation of home confinement orders [40[■]]. Another study of youth participants in Canada from April 2020 noted a significant deterioration of mental health during the COVID-19 pandemic as compared with pre-COVID times, with 39.9% and 16.9% meeting the criteria for diagnosis for an internalizing and externalizing disorder, respectively [41]. In the United States, data from the early months of the pandemic suggest that changes in normalcy and economic hardships negatively impacted children's conduct. Parents reported worsening behavioral health for their children during the pandemic as compared with the pre-COVID era [19,42,43[■]]. Notably, externalizing symptoms among children in the United States were found to be significantly increased in lower-income households, single-parent households, and African American households [44].

As a long-term result of the pandemic, children may be at risk for developing persistent mental health disorders or at least persistent internalizing symptomology [45[■]]. Evidence from previous traumatic experiences and disasters also suggests that exposed children may exhibit symptoms of post-traumatic stress disorder (PTSD) [45[■],46,47]. An earlier study found that 30% of American children who were isolated or quarantined in areas severely impacted by the 2009 H1N1 influenza pandemic met the criteria for PTSD based on parental reports [48]. Preadolescents (9–12) may be at greatest risk for developing PTSD because, from a developmental standpoint, they have started to develop their own thoughts and autonomy, but still do not have robust rationalization or coping mechanisms [4,49]. For instance, after a natural disaster like Hurricane Katrina, children ages 9–11 reported more depression and PTSD symptoms 2–3 years than did younger or older children [50]. With respect to the current COVID-19 pandemic, a child who loses a loved one to COVID-19 or experiences substantial hardships during the stay-at-home orders is likely to have higher levels of PTSD or other mental health disorders than a child who simply misses school.

EDUCATIONAL

In response to the initial outbreak of COVID-19, all schools and daycares across the United States closed

during the spring of 2020, halting all in-person instruction. In a very short period, the pandemic forced the cancelation of traditional learning in a classroom setting and required teachers to adapt their in-person curricula for virtual learning. During the final months of the 2019–2020 academic year, the majority of school districts provided some type of virtual instruction for their students [51]. This instruction varied in quality, as some schools required regular virtual class sessions, whereas others provided assignments and resources for parents to teach their own children. With the pandemic continuing through the 2020–2021 school year, more than half of US school districts started with some form of hybrid or remote learning [52]. These unprecedented, large-scale changes to how education is delivered have worried parents and instructors across the nation, as virtual instruction is unlikely to achieve the same quality of traditional classroom learning.

Despite the best efforts of school administrations and instructors, it is widely accepted that pandemic-related school closures will likely negatively affect student achievement and result in substantial learning loss for many children [53]. Projections of COVID-related learning loss during school closures in the spring of 2020 suggest that children ended the 2019–2020 school year with only 63–68% of learning gains in reading and 37–50% of learning gains in math relative to a typical school year [54]. A separate investigation of learning loss in children in kindergarten through fifth grade found that students had, on average, learned only 87% of the reading and 67% of the math that grade-level peers would typically have learned by the start of the following school year [55]. Of note, the observed learning deficits were greater for schools where the majority of grade school students were of color compared with elementary schools where the majority of the students were white. Overall, the researchers considered four different scenarios of learning during the 2020–2021 school year that varied in type of instruction and investment in remote learning, which projected that students on average could lose five to nine months of learning by June 2021 [55]. Although these levels of learning loss are concerning, the data suggest that investment in the quality of remote opportunities, as well as reaching a point where children can safely return to classrooms, may lessen the severity of learning loss and allow students to catch up on missed educational opportunities.

Experiences with virtual learning and learning loss will not be uniform among children, as there are substantial socioeconomic inequities that will also influence students' capacities for and experiences in remote learning environments. For instance,

children from lower socioeconomic status families might not have reliable Wi-Fi and/or adult caregivers in the home who can help with homeschooling or facilitate a productive learning environment [56]. An analysis of student use of Zearn, an online math platform used by almost one million elementary school children in the United States, found a similar disparity. Children in high-income areas experienced a temporary reduction in learning on Zearn at the onset of the COVID-19 pandemic, but soon recovered to baseline levels after use; by contrast, children in lower-income areas consistently remained 50% below baseline levels. [57] Another study found areas of the United States with higher income, greater internet access, and fewer rural schools experienced significantly larger increases in internet searches for both school- and parent-focused learning resources during the spring of 2020 than in other parts of the country [58]. These findings add to the growing body of evidence that socioeconomic inequities will likely further widen achievement gaps among students that already existed even before the pandemic.

Children with special education needs are also at unique risk during the COVID-19 pandemic. During the initial months of the pandemic, infection concerns precluded many school districts from performing psychoeducational evaluations of children in the early grades who were having academic struggles. This likely led to a delay in the identification and intervention of learning and other developmental problems. For children who were already receiving special education services and therapies at school (i.e., occupational therapy, physical therapy, speech-language therapy), school closures threatened to stall their progress and may have caused missed opportunities for the development of essential skills [59,60]. In recent months, school districts have developed mechanisms for the virtual evaluation of children with difficulties in school, as well as the provision of special education and related services on a remote basis. However, these services were developed with varying amounts of guidance from local and state governments and thus may not be accessible or effective for all students. They also were sometimes not comparable to the services that students would receive in-person [61]. Educators and parents are calling for additional federal input and support in order to properly navigate individualized education plans and to lessen the impact of the pandemic on these children's right to a free and appropriate public education.

DEVELOPMENTAL AND BEHAVIORAL

Increased screen time, school closures, and stay-at-home orders during the COVID-19 pandemic have

likely had and will continue to have a negative impact on children's development. Survey responses from parents of young children suggest that children's physical activity levels decreased and sedentary behaviors (e.g., watching television, using screen devices, and playing video games) increased during the early months of the pandemic, with parental anxiety potentially mediating these effects [62,63]. If these sedentary patterns continue after stay-at-home orders are relaxed, children without preexisting developmental disorders may be at risk for delayed development of gross motor skills that are formed from activities like running, jumping, and balancing [64]. A study also showed that higher screen time exposure during early childhood was associated with more autism spectrum disorder (ASD)-like behaviors due to the adverse impact of excessive screen time on social learning, brain processing, and the potential to promote visual brain hyperconnectivity [65]. It is possible that these downstream effects will be exacerbated by increased screen use for education, relaxation, socialization, and other aspects of daily life during the pandemic.

Furthermore, children with neurodevelopmental disorders, such as those with attention-deficit/hyperactivity disorder (ADHD), may be at a higher risk for negative outcomes related to the COVID-19 pandemic. The negative (and positive) impact of COVID-19 on children, adolescents, and/or adults with ADHD are summarized in a very recent review article by Breaux *et al.* [66]. In terms of the adverse impact of COVID-19, the authors cite several studies that have documented greater challenges with sustained attention required for remote learning, as well as increased oppositionalism, defiant behavior, and emotional outbursts. Adolescents with ADHD have reported increased substance use (i.e., alcohol, cigarettes, and vaping) during the pandemic, and parents of youth with mental health disorders (including ADHD) have also reported increased use of substances. On the other hand, the COVID-19 pandemic has had some demonstrable positive impact on youth with ADHD. For example, home learning has provided a more flexible schedule and learning environment for students, which may be especially beneficial for some youth with ADHD. In addition, virtual learning at home has shielded youth with ADHD from bullying in the school setting. Compared with youth who have not been diagnosed with ADHD, a few studies have shown that youth with ADHD report less school-related strain in adapting to the pandemic and also reported improved self-esteem having received less negative feedback [66]. As noted by Breaux *et al.*, follow-up studies are needed to assess the long-term impact of COVID-19 on youth with ADHD and other developmental disorders.

SOCIAL

Social distancing measures are still in place all over the United States one year into the COVID-19 pandemic. This trend is likely to continue for many more months, even with widespread adoption of COVID-19 vaccines. The concept of social distancing is not only difficult for many children to understand, but may be particularly harmful to children that rely on social interactions to properly develop their social and emotional intelligence [67–69]. For many children, isolation from their friends, teachers, caregivers, and other family members can lead to feelings of intense loneliness, adversely impacting self-esteem and motivation [70]. Moreover, when children are unable to play freely with their classmates and friends, they forfeit crucial peer social interactions which are a cornerstone of normal development [69]. Children with existing social limitations, such as those diagnosed with ASD, may be further impaired by the socially isolating aspects of the pandemic. When social interactions do occur during the course of the pandemic, they will likely involve individuals wearing masks. Although mask wearing helps decrease the spread of COVID-19, it poses issues for young children trying to communicate and socialize; because masks conceal important identifying facial features and facial expressions, children may have more difficulty recognizing people and reading affect and emotion when interacting with others [71].

NEXT STEPS

As the COVID-19 pandemic continues, several steps can be taken by pediatricians and caregivers to address the short-term and long-term health needs of children. Pediatricians should provide developmentally appropriate resources, such as those created by the Centers for Disease Control and Prevention (<https://www.cdc.gov/coronavirus/2019-ncov/daily-life-coping/talking-with-children.html>) and the American Academy of Pediatrics (<https://www.healthychildren.org/English/health-issues/conditions/COVID-19/Pages/default.aspx>), that caregivers can utilize to provide their children with a fact-based and balanced education regarding the pandemic and viruses in general [72,73]. As advocates for children with special healthcare needs and/or learning challenges, pediatricians should be prepared to provide guidance and support to caregivers who are concerned that their child is falling behind – developmentally, academically, and/or socially. Further, parents should be reminded that children mirror parental distress, so it is important to make sure that caregivers themselves are receiving the support they need alongside their children.

In order to provide individualized care and targeted intervention strategies for children and families during the pandemic, screening tools and instruments used by pediatricians and other health-care professionals must be updated or developed to identify high-risk groups, including children with severe psychological burdens, toxic home environments, unaddressed developmental concerns, or perhaps simply, children who struggle with return to previous routines and expectations once things begin to return to a new baseline. Many of these screening tools, such as using preexisting depression, food insecurity, or child abuse screening tools, can be delivered in the virtual setting given that they are question-based tools. There is also a pressing need for more crisis mental health resources now and in the future to address the impact of the pandemic on children and their families.

CONCLUSION

In summary, this review has strived to provide preliminary insights into the physical, psychological, educational, developmental, behavioral, and social impact of the COVID-19 pandemic on children and adolescents, and their implications for the future. Unfortunately, to the extent that the pandemic is not yet behind us, its true impact is not yet fully known. Continued research is needed to identify and evaluate any additional, COVID-related challenges and concerns that adversely impact the healthy growth and development of children.

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Conflicts of interest

There are no conflicts of interest.

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- of outstanding interest

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