



Covid-19 in Children with Emphasis on Prevention: A Rapid Review

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Abstract

Children of all ages can be infected with coronavirus disease (COVID-19) and can experience complications. Children with COVID-19 might present with many symptoms, a few symptoms, or be asymptomatic. The most common symptoms in children are fever and cough, and other common symptoms include nasal congestion or a runny nose, fatigue, and headache. Research indicates that most children recover from COVID-19 in one to two weeks with at-home care. Children and adolescents are generally at a lower risk of infection, and if an infection occurs, it is likely to be mild. However, some children and young people have had severe experiences with the disease, and a few have died. COVID-19-related measures have a profound effect on health and well-being, and for some, the impact may be lifelong.

Key Words: COVID-19, Children, Symptoms, Prevention, Vaccine.

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1- INTRODUCTION

In recent times, outbreaks of SARS in 2003, MERS in 2012 (both caused by a coronavirus), H1N1 swine flu in 2009-2010, Ebola in 2014-2016, Zika in 2015-2016, and the recent COVID-19 have occurred (1). The virus causing COVID-19 is the third coronavirus that has raised global concern in the last two decades with a sudden epidemic and increase in hospitalizations following pneumonia and involvement of various organs. COVID-19 was first identified in December 2019 after an outbreak of pneumonia of unknown cause in patients in Wuhan, China. By July 2020, it had spread to more than 200 countries (2). The disease presents with milder symptoms in children. It can occur in four forms: respiratory involvement, gastrointestinal involvement, multi-systemic inflammatory syndrome (MIS-C), and fever and rash (3-5). Shen et al. identified the disease as a significant threat to physical and mental health, as the outbreak of COVID-19 disease has changed the normal life of families and, in particular, their lifestyle (6).

Children's higher susceptibility and vulnerability to infectious and contagious diseases compared to adults warrants greater attention. A likely reason for this vulnerability is their specific behavior patterns that increase exposure to infectious diseases, such as the habit of putting things in their mouths and sucking on fingers during infancy, which provide easy routes for infection. Additionally, children under five are highly dependent on their caregivers, and their need for love, comfort, and nutrition makes social distancing more challenging, thus increasing the likelihood of disease transmission. Children are also less likely to consistently follow health measures and adhere to hygienic protocols, such as handwashing and using face masks or gloves. Furthermore, children's immune and defense systems are still developing

and are therefore weaker, potentially leading to long-term effects from infectious diseases that can persist into adulthood. Children are also more susceptible to malnutrition, as proper nutrition is crucial in their early years, and malnutrition can further increase the risk of developing various diseases (7-9). The pandemic and related measures have also had a significant impact on the psychosocial well-being of children and their caregivers, with many children experiencing an increase in negative feelings (10). Caregivers reported increases in child symptoms such as boredom, loneliness, frustration, irritability and anxiety (11).

Children and adolescents from lower socioeconomic backgrounds, those facing prolonged school closures, and those lacking essential support structures have been disproportionately negatively impacted by the COVID-19 pandemic. Furthermore, preterm children who experienced the COVID-19 pandemic are at higher risk of abnormal neurodevelopmental outcomes in the first 3 years of life. Pediatricians and other healthcare professionals need to consider the child's "COVID-19 pandemic experience" as an important factor that can affect their neurodevelopment, academic performance, and physical and mental health (12). This study aimed to investigate the effects of the COVID-19 pandemic on children, as well as coping strategies and treatment approaches for this disease.

2- MATERIALS AND METHODS

2-1. Search Strategy and Study Selection

This review study conducted a systematic search across multiple electronic databases, including Medline (via PubMed), Scopus, Web of Science, ProQuest, Cochrane Library, SID, Magiran, CIVILICA, and Google Scholar. The search was performed without any

time limit up to May 2021 using keywords such as "COVID-19", "Vaccines", "Treatment", "Symptoms", "Children", "Child", "Infants," and "Baby," either alone or in combination in English or Persian. Two reviewers independently conducted the search in duplicate to ensure thoroughness. Any disagreements between them were resolved by a supervisor.

The database search identified suitable studies for further evaluation. Abstracts were screened to identify eligible studies; full-text articles were obtained and assessed to create a final list of eligible studies. This process was also conducted independently in duplicate by two reviewers, with any disagreements resolved by a third reviewer. References were organized using EndNote software (version X8). Ethical approval was not required since the study analyzed only publicly available articles. The research adhered to ethical standards by respecting copyright and ensuring transparency in methods and sources.

3- RESULTS

Children and youth, a vulnerable population, have experienced the effects of the COVID-19 pandemic across various domains, including education, mental health, safety, and socioeconomic stability. Family infections have led to separation from or loss of caregivers. As with other crises, the COVID-19 pandemic has exacerbated existing vulnerabilities and inequalities experienced by children (13-15).

3-1. Infection with COVID-19 in children

Women infected with the coronavirus can, in very rare cases, pass the disease to their babies. Infants can also become infected shortly after birth. According to the U.S. Centers for Disease Control and Prevention (CDC), most newborns who test positive for COVID-19 have mild

symptoms or are asymptomatic and recover quickly (16). Pregnant women should take extra precautions against COVID-19 by considering vaccination during pregnancy.

When children contract COVID-19, they are more likely to be asymptomatic or have mild to moderate symptoms compared to adults (16-19). They are less likely to require hospitalization but may still experience severe illness if they have underlying health conditions such as asthma or compromised immune systems (17, 18). Severe cases among children can lead to respiratory complications requiring ventilator support and, rarely, multiple organ failure. Children generally have a lower mortality rate from COVID-19 than adults but may experience gastrointestinal symptoms more frequently than adults do (19). There is no evidence that SARS-CoV-2 is present in breast milk; however, breastfeeding mothers should follow safety guidelines due to potential transmission via respiratory droplets while feeding their infants.

3-2. How COVID-19 affects children?

Children, even at a very young age, can contract COVID-19. Many children have no symptoms, and those who do become ill typically experience mild symptoms, such as low-grade fever, fatigue, and cough. Some children develop severe complications, but this is relatively rare. Children with underlying health conditions are at an increased risk for severe illness. A severe and potentially life-threatening complication in children is Multisystem Inflammatory Syndrome in Children (MIS-C), which can lead to serious inflammation in various body parts including the heart, lungs, kidneys, brain, skin, eyes, or gastrointestinal system (20).

3-3. Symptoms of MIS-C can include:

- Fever lasting more than a few days
- Rash

- Bloodshot eyes (redness of the sclera)
- Abdominal pain
- Vomiting, diarrhea
- Swollen lymph nodes in the neck
- Neck pain
- Red and cracked lips
- Unusually red, strawberry-looking tongue
- Swollen hands and feet
- Irritability, unusual sleepiness, or weakness.

A systematic review notes that children with COVID-19 generally have milder effects and better prognoses than adults (16, 21). However, children are susceptible to multisystem inflammatory syndrome in children (MIS-C), a rare but life-threatening systemic illness involving persistent fever and extreme inflammation following exposure to the SARS-CoV-2 virus (22, 23).

3-4. Signs and symptoms of COVID-19 in children

COVID-19 in children can manifest as mild, severe, or no symptoms, with symptoms potentially appearing 2 to 14 days after infection (24-26). The most frequent symptoms include fever and cough (24). It is important to note that fever and respiratory symptoms are not always present in children with COVID-19 (25-26).

The common signs and symptoms include (24-26):

- Fever
- Cough (can be dry or productive)
- Sore throat
- Stuffy or runny nose
- Headache
- Fatigue
- Nausea and vomiting
- Diarrhea
- Muscle or body aches
- Loss of taste or smell
- Shortness of breath

- Abdominal pain
- Rashes
- Chills.

Emergency symptoms that require immediate medical attention include breathing difficulties (such as grunting, flared nostrils, rapid breathing, or wheezing) or signs of Multisystem Inflammatory Syndrome in Children (MIS-C) (24-26). MIS-C is a rare condition that can occur 2 to 6 weeks after a COVID-19 infection, characterized by fever, inflammation, and potential organ involvement (25). Emergency warning signs of MIS-C include abdominal pain, bloody diarrhea, chest pain or pressure, confusion, dizziness, rash, and trouble breathing (26).

3-5. Risk Factors for severe COVID-19 in Children

Data from CDC studies indicate that some children may be at a higher risk for a severe case of COVID-19 and require medical care in a hospital (27), including:

- Infants: Infants, especially those younger than 6 months, are at higher risk of COVID-19-associated hospitalization. Children less than 1 year old account for the highest percentage of hospitalizations among pediatric patients with COVID-19.
- Children with underlying medical conditions: Children with chronic lung disease, neurologic disorders, cardiovascular disease, prematurity, or airway abnormality are at higher risk. Additionally, children with feeding tube dependence, diabetes mellitus, and obesity are also at increased risk.
- Children from racial and ethnic minority groups: Severe COVID-19 occurred more often among Hispanic and non-Hispanic Black children.
- Children aged 2-17 years: Airway abnormality, asthma, blood disorders,

and cardiovascular disease are considered underlying conditions for this age group (27).

3-6. Infectivity of COVID-19 in children

Most children infected with COVID-19 experience no symptoms or mild symptoms like low-grade fever, fatigue, and cough. Initial studies suggested children did not significantly contribute to the spread of the virus. However, more recent studies indicate that children can indeed spread the infection. Although the methodologies varied across studies, the findings converged: infected children can carry a viral load in their upper respiratory tracts comparable to or even higher than that of infected adults. A November 2021 study by Harvard researchers confirmed that children carry live viruses capable of infecting others. The viral load in children does not correlate with the severity of their symptoms, meaning even children with mild or no symptoms can harbor a high concentration of viral particles in their mouth and nasal passages. Therefore, a high viral load in infected children increases the likelihood of transmission, even in asymptomatic cases (28-33).

3-7. The probability of COVID-19 infection in children

While the probability of COVID-19 infection in children and adults is similar, children are less likely to become severely ill. Approximately 50% of children and adolescents might have COVID-19 with no symptoms. However, some children with COVID-19 require hospitalization and treatment in intensive care units or using a ventilator. Several medical conditions might increase the risk of serious illness with COVID-19 in children (34-39), including:

- Obesity
- Diabetes
- Asthma
- Congenital heart disease

- Genetic conditions
- Conditions affecting the nervous system or metabolism.

Research also indicates disproportionately higher rates of COVID-19 in Hispanic and Black children. Babies younger than one might be at higher risk of severe illness with COVID-19 than older children. Newborns can get COVID-19 during childbirth or exposure to infected caregivers after delivery (34-39).

3-8. COVID-19 vaccines, additional primary shots, and booster shots approved for children

In the U.S., COVID-19 vaccines are available to children in the following age groups:

- **6 months to 4 years:** The FDA has granted emergency use authorization for a Pfizer-BioNTech COVID-19 vaccine, administered as a three-dose primary series.
- **5 to 11:** The FDA has authorized the emergency use of the Pfizer-BioNTech COVID-19 vaccine for this age group, involving two doses administered three weeks apart. The dosage is lower (10 micrograms) than that used for individuals 12 years of age and older (30 micrograms). Clinical trials demonstrated the vaccine to be safe and effective for children in this age group.
- **12 to 15:** The FDA has expanded the emergency use authorization for the Pfizer-BioNTech COVID-19 vaccine to include adolescents 12 through 15 years of age. The vaccine is administered as a series of two doses, three weeks apart, with the same dosage and dosing regimen as for those 16 years of age and older. In one study, the vaccine showed 100% effectiveness in the vaccine group compared to the placebo group.

- **16 and older:** The FDA initially issued an emergency use authorization for the Pfizer-BioNTech COVID-19 vaccine for individuals 16 years of age and older². The vaccine is administered as a series of two doses, three weeks apart.
- **6 months and older:** COVID-19 vaccination is recommended for everyone in this age group in the United States. People ages 5 years and older should receive a 2-dose primary series.

An additional primary dose of a COVID-19 vaccine can help vaccinated individuals who did not develop a strong enough immune response. The CDC recommends that children aged 5 to 11 years with moderately or severely compromised immune systems receive an additional dose of the Pfizer-BioNTech COVID-19 vaccine, administered 28 days after the second dose. Booster doses can help vaccinated people whose immune response has weakened over time. Research suggests that a booster dose can decrease the risk of infection and severe illness from COVID-19. Children aged 12 to 17 years who have received both doses of the Pfizer-BioNTech COVID-19 vaccine should get a Pfizer-BioNTech COVID-19 vaccine booster shot at least five months after their second dose. The CDC also recommends a single-dose Pfizer-BioNTech COVID-19 booster shot for children aged 12 to 17 years, at least five months after receiving their second dose of the vaccine. In addition, the CDC advises that children aged five years and older who are moderately or severely immunocompromised should get an additional primary dose of the vaccine 28 days after their second shot (40-49).

4- CONCLUSION

Children are innocent victims of the pandemic, with their lives profoundly altered. Children of all ages and from all countries are affected, particularly by the socio-economic impacts and, in some

cases, by protective measures that may inadvertently do more harm than good. Coronavirus variants, including the highly contagious Omicron variant, continue to spread, especially in areas with low COVID-19 vaccination rates and among children under five who are not yet eligible for vaccination. For children too young to be vaccinated (and adults who have not received any coronavirus vaccine), it is crucial to follow proven COVID-19 precautions, such as wearing masks in public areas and limiting indoor activities, to reduce the chance of infection.

The CDC recommends that children aged 5 to 17 years receive the two-dose Pfizer-BioNTech COVID-19 vaccine. Children aged 12 to 17 years may be vaccinated with the standard Pfizer-BioNTech vaccine, while children aged 5 to 11 years should receive Pfizer-BioNTech's pediatric vaccine, which contains a lower dose (10 micrograms, compared to 30 micrograms for those 12 years and older). Currently, only the Pfizer-BioNTech vaccine is authorized in the US for individuals younger than 18 years.

5- CONFLICT OF INTEREST: None.

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