Current Tropical Medicine Reports
https://doi.org/10.1007/s40475-022-00271-8

PEDIATRIC GLOBAL HEALTH (D NGUYEN AND A MANDALAKAS, SECTION EDITORS)

Effects of COVID-19 Pandemic on Nutritional Status, Feeding Practices, and Access to Food Among Infants and Children in Lower and Middle-Income Countries: a Narrative Review

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Accepted: 22 September 2022

Abstract

Purpose of Review The COVID-19 pandemic has affected children across the planet and the consequences on their health, nutritional status, and social structure have been more pronounced in low- and middle-income countries (LMICs). This review will focus on the effects of the COVID-19 pandemic on infant growth and feeding practices and access to food and obesity prevalence among children in LMICs. An electronic search was performed on MEDLINE and Embase to identify relevant articles in the English language.

Recent Findings A higher prevalence of infections by the SARS-CoV-2 virus and a lower mortality rate were found in children in LMICs compared to western countries. In 2020, 22% and 52% of the wasting and deaths in children under 5 years of age in LMICS came from the sub-Saharan Africa region, respectively. Despite the decrease in stunting from 40% in 1990 to 24.2% in 2019, the prevalence remains above 30% in LMICs. Regarding breastfeeding practices in LMICs, many organizations recommend breastfeeding for infants and children born to infected mothers with SARS-CoV-2. This pandemic has resulted in higher food insecurity and disruption to access to health care and nutrition-related programs from schools; this situation has been more detrimental for younger children from LMICs.

Summary Given the devastating effects of the COVID-19 pandemic on the nutritional status, higher food insecurity, and lack of access to health care for infants and children in LMICs, efforts from government, world organizations, and non-for-profit institutions should be implemented to ameliorate the effects of this pandemic.

Keywords Infant · Child · Breast feeding · COVID-19 · Food insecurity · Malnutrition · Obesity

Background

On January 5, 20,222, the World Health Organization (WHO) reported a total of 293,750,692 confirmed cases of COVID-19 infection with a fatality rate of 1.86%, and the number of COVID-19 cases and deaths ranked first in the Americas [1]. Other authors reported a higher proportion of infections by the SARS-CoV-2 in the group under 20 years of age in sub-Saharan Africa compared to western countries, 52.7% vs 23% [2, 3]; this might explain the lower fatality rate of COVID-19 in this younger population, although an underreporting of cases was most likely present.

Most of the reports of COVID-19 cases in children are from China, the USA, and Europe [4]. These reports indicated up to 5% of the cases in children from 1 to 19 years of age, with most of the children with milder disease, better outcomes, and lower mortality compared to adults [5–9, 10••]. The infection with SARS-CoV-2 has been reported in pregnant women and neonates, and these studies described a severe disease presentation among pregnant compared to non-pregnant women [11–14].

This article will review the effects of the COVID-19 pandemic on infant growth and feeding practices, as well as

This article is part of the Topical Collection on *Pediatric Global Health*

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Published online: 10 October 2022

access to food and obesity prevalence among children and adolescents in low- and middle-income countries (LMICs).

Methods

A comprehensive literature search was performed on April 30, 2022, for all papers published up to this date, using PubMed and Embase databases. The terms searched (MeSH heading) included the following: infant, child, breast feeding, COVID-19, food insecurity, malnutrition, and obesity. Conference abstracts, case reports, editorials, and non-English language articles were not included. Review papers were searched comprehensively to identify relevant articles. All articles relevant to the objectives of this review were approved by all the authors.

Nutrition and Growth of Infants and Children

The effects of the COVID-19 pandemic on the social and economic structure have affected the nutritional status and survival of infants and young children in LMICs [15•], with an increased prevalence of malnutrition and in particular wasting; this decline in nutritional status is explained by a decreased household income, difficult access to food and lack of health, nutritional, and social services provided by institutions [16].

The countries from the sub-Saharan Africa region account for 23% of children with wasting (low weight for age) and up to 36% of stunting (low height for age) in children under 5 years of age worldwide [17]. Worsening nutritional status particularly wasting is characterized by an immunologically compromised condition leading to an increased risk of mortality, while stunting leads to learning difficulties with a high likelihood of not reaching full cognitive potential [18, 19]. A report by Headey et al. [15•] reported in 2020 an increased cases of wasting and additional deaths among children younger than 5 years of age in LMICs, with the sub-Sharan Africa region accounting for 22% and 52% of the wasting and deaths reported cases.

A study by Jayatissa et al. [20] evaluated the changes and factors associated with child wasting, stunting, and overweight after the first wave of the COVID-19 pandemic in underserved areas of Sri Lanka. This was a prospective follow-up study that included 109 children; height/length and weight were obtained at baseline and 6 months after the pandemic. The mean age of the children at baseline and follow-up study was 26.4 ± 16.3 (SD) months and 39 ± 16.4, months respectively. The results showed an increase in wasting and overweight in the follow-up study compared to the baseline data from the Urban Health and Nutrition Study 2019 18.3% vs 13.7% ($p=0.26$) and 8.3% vs 3.7% ($p=0.12$), respectively. The prevalence of stunting decreased from 14.7 to 11.9% ($p=0.37$) during the same period. The authors concluded that this vulnerable population would benefit from suitable interventions to minimize the effects of the COVID-19 pandemic.

A report by Bahatheg [21] evaluated children's nutritional changes during the COVID-19 lockdown period via an 18-item questionnaire applied to 330 parents of children aged 4–7 years. The study was conducted in three countries (Saudi Arabia, Turkey, and Britain) and addressed three questions: (1) Was children's nutrition affected? (2) Did children's weight increase? and (3) Any differences in children's diet based on gender? The results showed a parental concern for their children's nutrition with up to 96.1% of the meals prepared at home with 63% of the parents stating that their children did not gain weight. Also, there were significant differences in children's nutrition based on gender, with boys getting better nutrition compared to girls. The authors recommended that public health and social services and social media outlets should support healthy eating practices and address food insecurity during pandemic conditions.

Given that chronic malnutrition (stunting) in children is challenging in the World Health Organization (WHO) Eastern Mediterranean Region with millions of children under 5 years being stunted and suffering long-term consequences, Jawaldeh et al. [22] published data on the Eastern Mediterranean countries; the report was extracted from the 2020 database joint malnutrition study by the UNICEF, WHO, and World Bank Group. The results indicated that the prevalence of stunting declined from 40% (24.5 million) in 1990 to 24.2% (20.6 million) in 2019. The prevalence of stunting varied widely across the region with the mean prevalence being the highest in low-income countries (38.2%), compared to lower middle-income countries (26.1%), upper middle-income countries (19.5%), and high-income countries with an 8.9% prevalence. The study concluded that the implementation of comprehensive strategies aimed at decreasing the burden of the COVID-19 pandemic on the nutritional status of children in this region is needed.

The high rates of infant and young children malnutrition before the COVID-19 pandemic in LMICs became worse during and after the pandemic, this situation has prompted a response from leaders of four United Nations agencies [23], and this action represents an important first step for the international community.

Obesity is a type of malnutrition [24], and its prevalence has increased during the COVID-19 pandemic as reported by many studies [25–30]. One of the main causes of increased weight in addition to lack of physical activity is the consumption of junk food as reported among school-aged children in India, with an increase in overweight prevalence from 0.7 to 13.9% in the last decade [31]. A similar

situation has been reported in the USA with an increase in obesity among children and adolescents during the COVID-19 pandemic. A retrospective study by Brooks et al. [25] evaluated changes in body mass index (BMI) in children from 6 to 17 years of age (a total of 96 501 individuals for a total of 191 846 paired data) before and after the COVID-19 pandemic, using data from a US electronic health record (EHR). The results showed a mean [95% confidence interval] adjusted delta BMI (change between two well-child checks) for September-December of 2020 of 0.62 [0.59–0.64] kg/m^2, compared to 0.31 [0.29–0.32] kg/m^2 in previous years. This increase was more pronounced in children with pre-existing obesity, Hispanic children, and children without health insurance. Another study by Woolford et al. [30] conducted a retrospective study using Kaiser Permanente Southern California HER. Children 5–17 years of age and with at least two office visits with recorded BMI before and after the COVID-19 pandemic were included. The cohort included a total of 191,509 with a mean age of 11.6 ± 3.8 (*SD*) years and a mean BMI before the pandemic of 20.7 ± 5.4 kg/m^2. The greatest change in BMI happened in the 5 to 11 years old with a delta BMI increase of 1.57, compared to 0.91 for the 12 to 15 years, and 0.48 for the 16 to 17 years old group, with the highest increase in overweight and obesity in the 5 to 11 years old group (from 36.2 to 45.7%). Both studies highlighted the importance of monitoring weight changes during conditions of lockdown and pandemics, and these results should guide the implementation of policy decisions critical for children's wellbeing.

COVID-19 During Pregnancy and Breastfeeding

The COVID-19 pandemic has manifested in a shifting pattern with a worldwide spread and varied evidence regarding the manifestations of the SARS-CoV-2 infection in pregnancy, newborns, infants, and young children [32]. Several studies concluded a low risk of intrauterine infection by vertical transmission in pregnant women infected with SARS-CoV-2 [33–35], with reports of possible vertical transmission [36, 37]. Two reviews by Zimmermann et al. [14, 38] reported the manifestations of COVID-19 in pregnant women, neonates, and children; fetal distress was reported in 30% of the pregnancies with a 37% prevalence of preterm deliveries. The neonates had respiratory distress or pneumonia in 18%, disseminated intravascular coagulation in 3%, asphyxia in 2%, and 2 deaths reported in the perinatal period. A total of 4 neonates were positive for SARS-CoV-2 infection implying a vertical transmission.

Breast milk is the gold standard resource for the nutrition of neonates and infants, and the WHO recommendation is for infants to be fed exclusively breast milk during the first 6 months of life [39]; unfortunately, the percentage of breastfeeding in infants during the first 6 months of the majority of LMICs is below the 90% WHO target [40].

The COVID-19 pandemic that initiated in Wuhan, China, in 2019 raised several questions and issues regarding the safety of breastfeeding for infants born from mothers infected with SARS-CoV-2. A review by Soku et al. [39] published data from 22 studies that reported results of reverse transcriptase-polymerase chain reaction (RT-PCR) for SARS-CoV-2 in the milk of 55 mothers infected with the virus; all the tests were negative for the virus implying that the breast milk was not an infection source for the infant. Two studies by Dong Y. et al. [41] and Gao X. et al. [42] reported the presence of IgM and IgG antibodies for SARS-CoV-2 in human milk. Another issue of concern is the presence of SARS-CoV-2 RNA in the human milk; the consensus is that the possibility of infection or spread is zero because the detected component is the virus particle, not the live virus [39].

Many studies have reported the challenges of breastfeeding practices in LMICs before and during the COVID-19 pandemic [40, 43–49]; despite all these issues reported, human milk is an essential nutrient with positive effects on the infant immune system. The WHO, the United Nations International Children's Emergency Fund (UNICEF), the US Centers for Disease Control, the Academy of Breastfeeding Medicine, the International Lactation Consultant Association, and many neonatal and pediatric scientific societies advocate for breastfeeding during the COVID-19 pandemic [39]. These recommendations also pointed out the importance of the mother to breastfeed after the information has been given to aid in the decision-making process [50]. Based on the most recent published data, the use of human milk and breastfeeding is recommended for infants born to infected mothers with COVID-19.

COVID-19 Disease and Mortality

COVID-19 pandemic has been identified as an unprecedented global economic and health concern. The pandemic has been associated with deleterious effects on nutrition provision due to various economic and health factors. Multiple international entities, including the United Nations System Standing Committee on Nutrition (UNSCN), WHO, and the European Society of Parenteral and Enteral Nutrition (ESPEN), have been concerned about the grave economic risks of the pandemic on the nutritional status and mortality of young children, especially in LMICs. The pandemic has led to a detrimental impact on the economic and health systems resulting in malnutrition and mortality. One of the major effects of the pandemic on nutrition has been the effects on income, affordability, and job opportunities. These

effects were more obvious among vulnerable populations in LMICs where the pandemic negatively impacted the per capita gross national income (GNI) [51].

In circumstances of poor nutrition quality where underweight and overweight coexist, undernutrition has been estimated to increase by an additional 6.7 million children in the first year of the pandemic especially in regions affected by humanitarian crises during the pre-pandemic era, adding to the 47 million children under 5 years old who are already suffering from underweight, and the 144 million children affected by chronic malnutrition mostly in Asia and Sub-Saharan Africa [15•, 51]. These financial hardships have led to decreased access to affordable nutritious food with a long shelf life. That has led to higher levels of food insecurity, undernutrition, and obesity in LMICs [51–54]. These effects were manifested in various degrees of severity depending on the duration and severity of restriction measures, the socio-economic status, presence or absence of community protection programs, availability of resilient short-chain suppliers, and the government policies towards mitigating the adverse economic conditions [51].

In LMICs, women and children under 5 years are the most vulnerable populations to be affected by a fall in the nutritious food supply. It has been estimated that the prevalence of malnutrition among children < 5 years has increased by 14.3% across 118 LMICs [15•]. Malnutrition combined with already overwhelmed and vulnerable health systems has contributed to a tremendous risk of severe COVID-19 infection and poor health outcomes among women and children in LMICs [10••].

The evidence of malnutrition correlation with COVID-19 outcomes in the pediatric population is very scarce, but it is well established that malnutrition is associated with poor outcomes including longer hospital stay, longer mechanical support, and overall higher risk of mortality [55–58]. Several studies have reported that children with comorbidities including obesity are at greater risk of developing symptomatic illness or requiring admission to the hospital [59, 60]. Research has shown that patients are at high risk of developing malnutrition during acute COVID-19 illness. The malnutrition associated with COVID-19 infection is multifactorial. First are the preceding gastrointestinal tract symptoms, i.e., loss of appetite, loss of smell, and vomiting [61, 62]. Therefore, COVID-19 was reported to be associated with weight loss before hospital admission. During the acute phase, SAR-COV-2 elicits an acute phase inflammatory cascade involving angiotensin-converting enzyme receptor 2, CD8 cytotoxic cells, natural killer cells, interleukin protein family, and TNF-alpha resulting in a cytokine storm. This intense inflammatory reaction eventually results in increased muscle proteolysis, albumin consumption, and impaired metabolism of macronutrients which can contribute to the onset of malnutrition and sarcopenia. Many observational studies in high- and middle-income countries have shown a strong correlation between SAR-COV-2 infection and cachexia, a complex metabolic syndrome associated with underlying illness and characterized by loss of muscle with or without loss of fat mass. This phenomenon was associated with a prolonged hospital stay and higher mortality [63, 64].

A disproportionate high burden of disease has been reported in adult ethnic minority groups, described as higher infection rates, higher admission rates to the hospital, and higher mortality [65–67]. The data published on ethnic and racial minorities children with COVID-19 is very limited, but it is plausible to assume that the reasons for this disparity in adult minorities (e.g., social determinants of health, racial discrimination, access to health care, educational shortcoming and health conditions) also explain the same situation in children [68].

COVID-19 Effects on Nutrition Programs and Food Insecurity

The United Nations 2030 Agenda for Sustained Development Goals has food security as the main central objective aimed at ending poverty and protecting the environment [53]. Global Report on Food Crises estimated in 2019 that approximately 135 million people were classified as food insecure, but recent projections indicate that this figure may reach up to 265 million people in 2020 because of the COVID-19 pandemic including financial and supply chain disruptions [53, 69].

The global COVID-19 pandemic has resulted in worsening food access for many LMICs; this situation is particularly detrimental for children under 5 years of age and women; in addition to lack of access to food, potential disruption to access to health care and nutrition-related programs might impact even more their overall health condition [10••]. With difficulties accessing food programs by government and non-for-profit organizations, this population of young children and women will worsen their nutritional status and expose them to a more serious COVID-19 disease resulting in a higher impact on stressed health care systems [51, 53, 69].

A study by Singh et al. [54] reported results of semi-structured qualitative research aimed to explore the food insecurity among low-income families ($n = 41$) from a disadvantaged community during the COVID-19 pandemic in Nepal. The results identified four main global themes: (1) impact of COVID-19 on food security, (2) food insecurity and coping strategies during the COVID-19 pandemic, (3) food relief and emergency support during the COVID-19 pandemic, and (4) impact of COVID-19 and food insecurity on health and wellbeing. The authors concluded that

food insecurity among low-income families was a serious problem during the pandemic and prompt implementation of strategies to alleviate this food insecurity among this vulnerable population should be instituted.

A longitudinal survey by Nguyen et al. [70] evaluated changes in household food insecurity (HFI) in a community in Uttar Pradesh, India; a total of 569 mothers with children < 2 years participated. The main outcomes were changes in HFI during the pandemic and evaluation of child feeding practices and coping strategies by HFI status. The results showed a sharp increase in HFI from 21% in December 2019 to 80% in August 2020, and 62% of the households had changed their status from food secure to food insecure during the study period. Children in food-insecure households were less likely to consume and diverse diet and more likely to engage in coping strategies (e.g., reduction of other essential non-food expenditures, borrowing money to buy food, or selling jewelry to get food). The results of this study underscore the need for investment in social protection interventions and the implementation of safety nets as part of a diverse approach from multiple sectors to decrease food insecurity during and after the COVID-19 pandemic.

A report by Bulucu Büyüksoy et al. [71] aimed to evaluate the incidence of food insecurity and contributing factors in households with children in Turkey during the COVID-19 pandemic. This was a cross-sectional study using a survey sent to participants' smartphone social media accounts; a total of 211 households with at least 1 child participated. The results showed that approximately 1 out of 5 households had food insecurity and that 80.6% of the household's monthly income was below the poverty level. Also, food insecurity increased 2 times when total monthly income fell below the poverty line, increased 2.5 times when the household had self-employed individuals, and increased 3 times when the monthly income decreased. The authors concluded that public health intervention strategies are necessary to make sure food is accessible to this population where almost half of them were food insecure.

Among the many disruptions caused by the COVID-19 pandemic, the closure of schools impacted children learning potential, nutritional status, and households' safety [16, 72–74]. Two studies conducted in Nigeria [75] and Ethiopia [76] found that COVID-19 disrupted educational and nutritional services with an increase in food insecurity and consequences on students and parents well-being. Both studies highlighted the importance of the implementation of alternative programs to improve nutritional services that will help vulnerable children and families during the pandemic. Two similar studies from two states in Brazil evaluated the effects of school closure on food insecurity during the pandemic. The report by Lourenço et al. [77] using a qualitative approach evaluated the strategies adopted by two municipalities in the state of Rio de Janeiro. The two interventions identified to maintain school feeding program goals were the distribution of food kits and sending cash transfers to the families. The authors concluded that communities and government institutions should work together to offer appropriate school feeding programs. The study by Rodriguez et al. [78] used a telephone survey of adults ($n = 612$) in two municipalities in the state of Minas Gerais. The results showed an 82% prevalence of food insecurity, and two factors were identified as associated with food insecurity: households with the highest number of children and households that receive food baskets from the government. The authors concluded that the food insecurity prompted by the COVID-19 pandemic could be alleviated by the Brazilian National School Feeding Program.

Challenges in the Care of Children in LMICs

The impact of the pandemic on LMICs can be catastrophic when compared to that in higher-income countries. With large portions of the population living in overcrowded conditions and the lack of proper sanitation infrastructure, it is usually difficult to follow public health policies such as hang hygiene that reduce the spread of infections [79]. Health care facilities that are already overwhelmed and short on resources along with physician shortages only further the problem [79]. This is reflected in the proportion of global pediatric COVID-19 mortality reported from LMICs compared to high-income countries [80].

In LMICs, the effects of the pandemic on children have a more indirect effect, via increasing poverty and housing insecurity, disrupted schooling, food insecurity, reduced access to health facilities [81], and interruptions in normal vaccination schedules [82]. Health systems that are already under-resourced get their resources diverted to adults' services further compromising child health [81]. Confirmed COVID-19 pediatric cases in LMICs seem to be underreported as testing is limited and the collection of a nasopharyngeal or oropharyngeal swab in a child is difficult [83]. Children in LMICs are a population at risk with a higher prevalence of risk factors for severe lower respiratory tract infections such as severe malnutrition, exposure to smoke or air pollution, incomplete immunization, nutritional anemia, and HIV exposure or infection [84, 85]. Particularly in sub-Saharan Africa, children are already susceptible to an array of infectious diseases such as malaria, HIV, TB, and vaccine-preventable diseases including infectious diarrhea, pneumonia, and meningitis, along with a higher prevalence of undernutrition [4, 82, 86].

In some LMICs, conflict and political instability add to the challenges in preventing COVID-19 in children, resulting in suboptimal disease surveillance and a masked impact of the disease on children [4]. Fecal–oral

transmission and contamination are other important factors in disease propagation. In some LMICs, water scarcity and poor sanitation are important factors that facilitate disease propagation [81].

School closures have contributed to hunger, poor nutrition, and negative impacts on cognitive development as school-based meals for many children in LMICs are one of few consistent sources of food [4]. As some schools adopt alternative learning arrangements with technology, inequalities are worsened as the poorest of children lack access to such resources [83], as well as among disabled and disadvantaged children [87]. A wave of mental challenges was also predicted to occur due to the pandemic. School for children has an essential role in helping socioemotional development, friendship and social support networks, protection from risk-taking behaviors, delays in early marriage and childbearing, and early detection of child abuse [88]. Interruption of education also leads to increased risk of domestic violence, abuse, sexual exploitation, and neglect; loss of social protection results in increased rates of teenage pregnancy [4, 89•].

A slightly more positive caveat is the fact that vaccine hesitancy is less likely to occur in LMICs, as there is a predominance of young populations in these countries [90, 91]. However, the pandemic has altered parental health-seeking behavior with 73% of countries witnessing a reduction in demand for immunization, an 89% reduction in the African region, although a link with fear of viral exposure when attending to vaccination is a major concern [82, 90]. Overall, knowledge and understanding of COVID-19 vaccines were associated with willingness to vaccinate a child, showing that clear and transparent communication from community leaders and health experts is vital [91].

Interventions to Ease Impacts of COVID-19 on Child Health

Child health providers should advocate for an equitable response to COVID-19 that prioritizes the health of vulnerable children and furthers the gains made in global child health in the last few decades [89•]. Specific priority actions are listed in Table 1.

Timely rapid testing of children is needed to manage and isolate positive cases and prevent hospitalization and death; however, testing capacity in LMICs is limited and health care facilities are often lacking in space and resources [81]. Once detected, infection prevention measures to decrease or control transmission, as well as treatment such as oxygen, are needed, another challenging aspect [81]. Strengthening social security systems and poverty alleviation are critical and require government commitment [81]. Prompt implementation of food and financial support for the most vulnerable is vital [89•]. Preventive services such as immunization, maternity care, breastfeeding and nutrition programs, and HIV and malaria prevention are needed to strengthen the system of child health support [84]. The protection of healthcare workers through adequate PPE and enabling their engagement with their communities is essential [84].

The growth and implementation of telemedicine allow for continued, remote healthcare delivery during the pandemic, along with social media and mobile health applications [4]. A specific example where children's mental health care was provided was seen in Pakistan where free, nationwide online training sessions of therapy were implemented to support children with disabilities [88].

LMICs should tailor their health access pathways to fit the needs of their population by establishing separate clinic areas for preventive care and home vaccination

Table 1 Priority actions to mitigate impacts of COVID-19 on global child health

1. Increase financial and technical support to high-need countries that foster local responses to mitigate the effects of COVID-19 on child health. Responses should be informed by shared evidence and international best practices but should be adapted to local contexts and must be driven by local health leadership and communities [92]
2. Rapidly and freely disseminate lessons learned and share best practices and guidelines, including open access to COVID-related scientific publications, so that practitioners in all settings can benefit from evolving knowledge and each other's experiences [92–97]
3. Ensure equitable distribution of PPE globally to protect all healthcare workers. Widely disseminate innovative methods to optimally create or reuse PPE, such as through safe decontamination. Support engineering and manufacturing of PPE locally, focusing on items that can be easily decontaminated and used safely and effectively multiple times
4. Support ongoing programs that provide non-COVID-19 priority preventive and curative care for children, such as antenatal and neonatal care, immunization programs, nutrition support, diagnosis and treatment of diarrheal illness, pneumonia, TB and HIV care, early childhood development programs, child protection services, and care of non-communicable diseases, including through innovative delivery models [10••]
5. Ensure timely, equitable inclusion of children in clinical trials of COVID-19 vaccines and therapeutics, and ultimately rapid, affordable, and equitable access for all children globally to any of these than prove to be effective
6. Fund COVID-19 research in children with comorbidities to characterize the risk of severe disease, establish care protocols, determine therapeutic interventions, and determine prioritization for COVID-19 vaccination

From Garcia-Prats A. et al. Mitigating the Impacts of COVID-19 on Global Child Health: a Call to Action. *Current Tropical Medicine Reports*. 2021;8 (3): 183-189

visits as examples [84]. Modeling has shown that if routine health care is disrupted along with food insecurity, there would be a devastating amount of child and maternal deaths [10••]. Essential non-COVID-19 healthcare should not be discontinued and prioritized; among them, the provision of sexual and reproductive health services; maternal and newborn health; treatment of HIV and STDs, malaria, TB, and infections in general; cancer treatment; care for cardiovascular, musculoskeletal, and neurological conditions; mental health disorders and substance use disorders management; provision of emergency care, acute surgical cases, palliative care, and pain control; nutrition; water supply, sanitation, and hygiene interventions; health education and behavioral change communication as well as health system services [93]. The lack of follow-up in children with chronic illnesses may increase the risk of morbidity and mortality from COVID-19 [83].

Conclusions

The COVID-19 pandemic has affected many children across the planet, and the devastating consequences on their health, nutritional status, and social structure have been more pronounced in children from low- and middle-income countries. A higher prevalence of infections by the SARS-CoV-2 virus and a lower mortality rate was found in children in LMICs compared to western countries. In 2020, more than half of the deaths in children under 5 years of age in LMICS came from the sub-Saharan Africa region. The prevalence of stunting remains high above 30% in LMICs. Many organizations have recommended breastfeeding for infants and children born to infected mothers with SARS-CoV-2. This pandemic has resulted in higher food insecurity and disruption to access to health care and nutrition-related programs from schools; this situation has been more detrimental for younger children from LMICs. Significant challenges remain for children in LMICs during and after the COVID-19 pandemic, and efforts from government, world organizations, and non-for-profit institutions should be implemented to ameliorate the effects of this pandemic.

Declarations

Conflict of Interest The authors declare no competing interests.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

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•• Of major importance

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