



The indirect effects of COVID-19 upon global childhood pneumonia

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ABSTRACT

Objectives: The relative scarcity of paediatric COVID-19 disease infers protection from its direct harms. We aim to highlight the potentially severe indirect effects of COVID-19 upon global childhood pneumonia.

Study design: This is a discussion piece written from the authors' perspective.

Methods: We use the social determinants of health to describe the indirect impact of COVID-19 upon global childhood pneumonia.

Results: The social determinants of health are a range of social, economic, and environmental factors used to explore and explain global health differences and inequalities. Global childhood pneumonia is a significant public health problem with clear linkage to the social determinants of health. COVID-19 is a significant threat to the health and wellbeing of children around the world through its potentially severe effects on all strata of the social determinants of health.

Conclusions: The COVID-19 pandemic could undermine years of progress in reducing both global childhood pneumonia incidence and mortality, and most significantly affect vulnerable children living in poverty.

1. Introduction

Pneumonia causes more child deaths than any other infectious disease, and disproportionately affects those in low- and middle-income countries (LMICs). There were a staggering 138 million cases of pneumonia in children under the age of five in 2015, of which 921,000 died (higher than any other cause of death in children under five that year) [1,2]. COVID-19 threatens to undo the significant progress made in decreasing the global incidence of childhood pneumonia [1]. Whilst children are less likely to develop COVID-19 disease secondary to severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2), it is important to acknowledge and address the threat of its potentially severe indirect effects upon global childhood pneumonia, a health problem with clear links to Sustainable Development Goal 3.2 [3].

The social determinants of health are a broad range of social, economic, and environmental factors, widely used in public health practice to explore and explain differences in health outcomes across settings and social gradients [4]. We will use the social determinants of health (Fig. 1) to describe the indirect impact of COVID-19 upon global childhood pneumonia, describe gaps in evidence and provide recommendations for policy and global health research priorities in this context.

2. COVID-19 and the determinants of global childhood pneumonia

2.1. Constitutional factors

Low birth weight (LBW) and prematurity are the third and fifth highest contributing determinants for global childhood pneumonia deaths respectively, and are more common among babies born to malnourished and adolescent mothers [2]. Lockdowns and roadblocks to mitigate SARS-CoV-2 transmission have interrupted food supply chains and affected food affordability in LMICs [5]. When combined with school closures, increased sexual violence, exploitation, and child marriage during the pandemic, economic insecurity, and overburdened health systems, we could see more LBW and premature babies among vulnerable mothers, with a subsequent increase in childhood pneumonia mortality.

2.2. Lifestyle factors

Child wasting is the greatest risk factor for global childhood pneumonia deaths, and will be exacerbated by surging food prices, and restricted transportation of food and pesticide [5]. School closures withdraw school meals, which are the only stable source of nutritious

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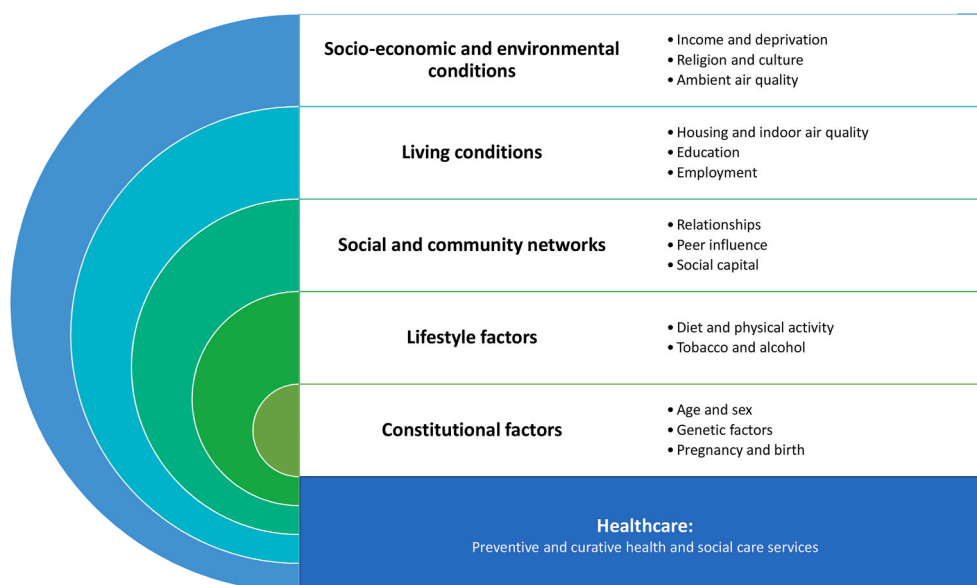


Fig. 1. The social determinants of health (adapted from Dalgren and Whitehead in relation to child pneumonia).

food for many children [6]. COVID-19 attributed economic losses have increased the prevalence of moderate to severe wasting in children under five years old [7]. This is most significant in sub-Saharan Africa and South Asia, which have the highest childhood pneumonia incidence and mortality.

Governments have been recommending regular hand washing to decrease risk of SARS-CoV-2 transmission, which could also mitigate risk of pneumonia causing pathogens. However, children living in poverty lack basic access to water and soap [5], and only half of schools have access to effective hand washing facilities [6]. Addressing inequitable access to hand washing and sanitization is a critical opportunity both to tackle the pandemic and reduce the spread of other infectious diseases.

In the early pandemic period, several countries implemented un-evidenced mother-infant separation policies and restricted access to breastfeeding support [8]. This could result in early breastfeeding cessation, withdrawing immune protection offered by breastmilk and potentially contribute to child malnutrition. There is international consensus that this policy is inappropriate given low risk of transmission to breastfeeding neonates, and the benefits of breastfeeding outweigh the mitigated risks [9].

2.3. Social and community networks

COVID-19 information sources and health beliefs are highly varied and may influence parental utilization of infection prevention measures that could also prevent child pneumonia [6]. Evidence suggests socio-economic status predicts COVID-19 information sources, with lower socio-economic status associated with use of sources more likely to contain incorrect information, including social media and non-government websites [10]. Caregiver fear of acquiring COVID-19 at health facilities may also dissuade timely and appropriate healthcare seeking, risking poorer outcomes.

Children whose primary caregivers are older co-morbid adults risk financial stressors, loss of nutrition, living location and health service access should their caregiver acquire severe COVID-19. This may also intersect with ethnicity, with ethnic minority children more likely to have an ethnic minority caregiver, who is less likely to be vaccinated against COVID-19 and more likely to experience severe COVID-19 disease and adverse outcomes [11]. This may increase the risk of exposure to social determinants and poor pneumonia health outcomes for ethnic minority children.

2.4. Living conditions

Stay at home orders and social distancing have been commonly implemented to reduce risk of SARS-CoV-2 transmission. Social distancing could mitigate transmission of other child pneumonia pathogens, but this is not realistic in crowded living conditions, especially prevalent in LMICs [5,6]. Stay at home orders may force people close together in poorly ventilated spaces, and increase secondhand smoke exposure at home, both important determinants of child pneumonia incidence and mortality.

Household air pollution is the second leading determinant of global childhood pneumonia mortality, mostly originating from burning heavily polluting solid fuels using a stove in shared living and sleeping areas. This may be exacerbated by COVID-19 because lockdowns and school closures force caregivers and children to stay at home, needing to heat their home for longer. In addition, the economic fallout of COVID-19 may push more households to use relatively cheap, heavily polluting solid fuels [12].

2.5. Socio-economic and environmental conditions

Changes in the proportion of children living in poverty could have the most damaging effect on childhood pneumonia. The International Labour Organization expects the rate of relative poverty to increase globally due to COVID-19, disproportionately affecting those in LMICs [12]. Poverty could affect a child's living location, food intake and use of health facilities, particularly in countries reliant upon out of pocket expenditure for healthcare financing.

Environmental air pollution is another important determinant of global childhood pneumonia. Air and road travel restrictions have resulted in local ambient air pollution improvements; however, these are often brief and intermittent. Air quality improvements have been inconsistent and most noticeable in heavily industrialized areas, and so may have little impact upon global childhood pneumonia incidence and mortality [13]. However, this may be an important opportunity to harness the momentum of the pandemic to sustainably reduce pollution levels.

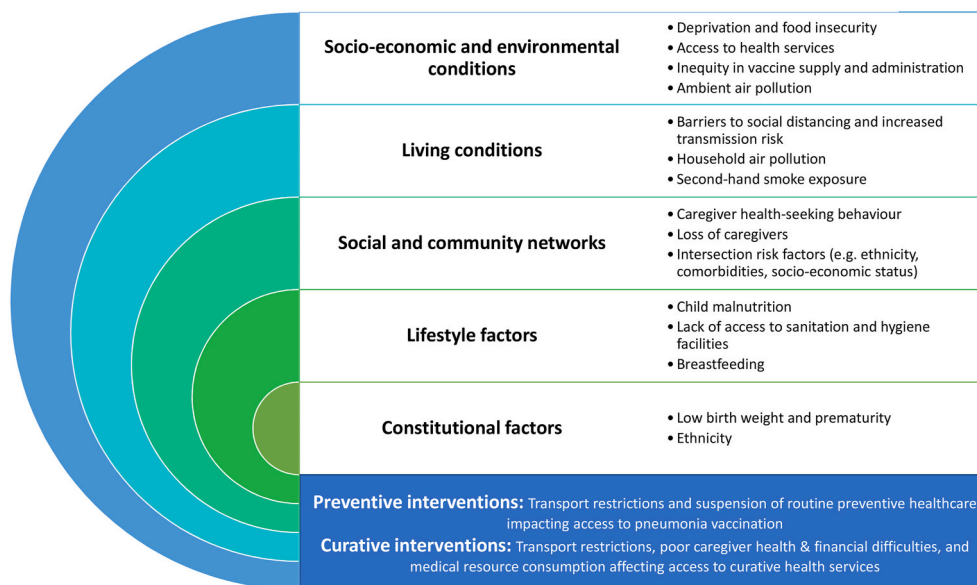


Fig. 2. The effects of COVID-19 on determinants of global childhood pneumonia.

3. The impact on childhood pneumonia interventions

3.1. Preventive interventions

The most common global child pneumonia causative pathogens are vaccine preventable. The pandemic has resulted in closure of some health facilities delivering child vaccines and decreases in vaccines administered to children [14]. This is expected to be due to a combination of the World Health Organization advising for temporary suspension of routine vaccination programmes, roadblocks obstructing medical supply transport and health service accessibility, and caregiver fears of acquiring COVID-19 [6].

This could have detrimental implications for the incidence of child pneumonia and other vaccine preventable diseases, as demonstrated by the West African Ebola outbreak, during which risk mitigation decreased administration of childhood vaccines and outbreaks of vaccine preventable diseases [15]. A benefit-risk analysis of continued child immunization services in 53 African countries during the COVID-19 pandemic predicted deaths averted by pneumococcal and *Haemophilus influenzae B* vaccines were nine times (95% CI 2–29) and ten times (95% CI 2–30) greater respectively than excess deaths from COVID-19 secondary to immunization contact [15].

3.2. Curative interventions

Changes to healthcare seeking, transportation and personal finances may reduce use of medical services for child pneumonia. Children with chronic respiratory disease and HIV (which is more prevalent in LMICs [6]) rely on continued medical access to prevent complications including child pneumonia.

COVID-19 is consuming crucial medical resources including oxygen, also used for childhood pneumonia [6]. Countries with poorer healthcare infrastructure may be strongly affected by this, affecting their ability to prevent and manage paediatric pneumonia. Robertson et al. used the Lives Saved Tool to model child outcomes in 118 LMICs based on changes in health service workforce, supplies, demand, access, and coverage [16]. They project a 15–16% increase in child pneumonia deaths due to lack of antibiotics, and 18% increase in pneumonia or neonatal sepsis deaths.

As children are less prone to developing severe COVID-19, paediatric health resources have been commonly diverted to adult services. Though this could protect children by improving caregiver health

outcomes, it removes vital paediatric services (including rare commodities such as paediatric intensive care) [6]. This may limit capacity and render paediatric health facilities unable to adequately care for unwell children with pneumonia, increasing child pneumonia mortality.

4. Recommendations

It is clear COVID-19 is a significant threat to the health and wellbeing of children through its effects on every strata of the social determinants of health (Fig. 2). Though it is important for the harm of COVID-19 to be minimized, it is essential to safeguard interventions that address childhood pneumonia and its determinants.

4.1. Policy

The indirect effects of COVID-19 and its projected consequences for childhood pneumonia must become known to policy makers now, as discourse has largely been about child safety from the direct effects of COVID-19. It is important for political and health leaders to recognize and address indirect effects in future COVID-19 policy and in pandemic preparation, to avoid inadvertently exacerbating child pneumonia and other global health challenges.

4.2. Practice

Culturally sensitive, COVID-19 secure child pneumonia intervention delivery in low-resource settings could be improved by combining multiple interventions for child health (including pneumonia) into a single consultation, and supporting expansion of telehealth infrastructure. Governments could subsidize clean fuels to improve household air quality, safeguard child pneumonia vaccination programmes, and consider cash payments to avert poverty linked outcomes. High income country governments must support LMICs to facilitate this, and share COVID-19 vaccines for equitable protection of caregivers.

4.3. Research

There has been little research examining barriers to health services for child pneumonia during the pandemic from the caregiver perspective, and we lack fresh data to quantify global child pneumonia case rates since pandemic onset. Research prioritizing this would inform evidence-based multi-purpose interventions that reduce incidence and

mortality of global child pneumonia, whilst minimizing SARS-CoV-2 transmission. We also need better global surveillance data; estimates are often based on local survey data of variable methodological approach and quality. Robust and comprehensive surveillance is particularly important in light of COVID-19 to monitor and measure the indirect effects upon pneumonia determinants, incidence, and mortality.

Children are not in a place of absolute safety, and we must call for action before years of progress to improve global childhood pneumonia is swept away.

Author contributions

Both authors conceptualised this manuscript. MS wrote the initial manuscript draft. Both authors reviewed the manuscript, provided edits, and approved the final version.

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Ethical approval

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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