Social determinants of respiratory health from birth: still of concern in the 21st century?

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Shareable abstract (@ERSpublications)
Social determinants of lung health are of pivotal importance across the life course and across the world. Political action is essential to address these, and thus improve adult lung health and all-cause morbidity and mortality. https://bit.ly/49bjhpn

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Abstract

Respiratory symptoms are ubiquitous in children and, even though they may be the harbinger of poor long-term outcomes, are often trivialised. Adverse exposures pre-conception, antenatally and in early childhood have lifetime impacts on respiratory health. For the most part, lung function tracks from the pre-school years at least into late middle age, and airflow obstruction is associated not merely with poor respiratory outcomes but also early all-cause morbidity and mortality. Much would be preventable if social determinants of adverse outcomes were to be addressed. This review presents the perspectives of paediatricians from many different contexts, both high and low income, including Europe, the Americas, Australasia, India, Africa and China. It should be noted that there are islands of poverty within even the highest income settings and, conversely, opulent areas in even the most deprived countries. The heaviest burden of any adverse effects falls on those of the lowest socioeconomic status. Themes include passive exposure to tobacco smoke and indoor and outdoor pollution, across the entire developmental course, and lack of access even to simple affordable medications, let alone the new biologicals. Commonly, disease outcomes are worse in resource-poor areas. Both within and between countries there are avoidable gross disparities in outcomes. Climate change is also bearing down hardest on the poorest children. This review highlights the need for vigorous advocacy for children to improve lifelong health. It also highlights that there are ongoing culturally sensitive interventions to address social determinants of disease which are already benefiting children.

Introduction

All children have intermittent respiratory symptoms, many of which do not have immediate economic impact meaning that unfortunately, they are often not taken seriously. This is even though they may be a

harbinger of future COPD [1], adult bronchiectasis [2], and early morbidity and mortality from respiratory and all-cause disease [3]. Furthermore, it is not widely enough appreciated that early adverse exposures not merely have lifetime effects on the child, but also have effects on that child's children and even grandchildren [4–6]. Early means before birth and even pre-conception. For this review, paediatric respiratory physicians from several countries across the globe have come together to show that social determinants of health are hugely important in many settings across the developmental course; it would be artificial to consider only postnatal influences. Space limitations mean we have had to be selective and to some extent arbitrary. We have asked authors with special knowledge of social determinants, and this has to some extent dictated the choice of countries and continents to be covered. We acknowledge that the author group does not cover many of the important areas of the world and ethnic groups, but we hope that the themes that emerge can stimulate action in all parts of the globe. The aim is to stimulate readers to consider social determinants and how to address them in their area of practice. This is important, because although genes cannot be changed, the child's environment can be modified if there is the political will to act. Children and their common diseases are often ignored or trivialised, as these diseases do not impact the sociopolitical constituencies that are influential. A stark example of this is the comprehensive worldwide response to the coronavirus disease 2019 (COVID-19) pandemic, which claimed fewer children's lives than the common paediatric infectious illnesses do annually; this paradox is not often highlighted.

Fetal adverse exposures, especially to nicotine and tobacco smoke and pollution, have important lifelong consequences (table 1; reviewed in Bush [7]). For the most part, lung function trajectories are determined for life before the child reaches school age, although in a minority, there is catch-up growth [8]. Traditional "adult" diseases such as COPD [9, 10], occupational asthma [11], lung cancer [12] and so-called late-onset asthma [13] all have their roots in early life. If adult respiratory disease is to be prevented, it is too late to start in adulthood; the focus must be on optimising the quality of early life. Adverse pre-school exposures, including passive smoking [14] and pollution [15], also lead to worse lung growth. Furthermore, the pre-pubertal years are a period of vulnerability; starting smoking before age 15 years is associated with a greater risk of COPD [16] and lung cancer [12], and less likelihood of giving up smoking [15], than in those who start to smoke later in life, even after controlling for pack-year smoking history.

Impaired spirometry is not merely a marker of poor respiratory outcomes. A low forced expiratory volume in 1 s (FEV_1) is associated with increased early all-cause morbidity and mortality [3], including sudden cardiac death [17], as well as bad respiratory outcomes. The mechanism likely includes common genetic and environmental risk factors for respiratory and systemic disease. To what extent improving FEV_1 will improve non-respiratory outcomes is not known, but clearly a low FEV_1 should always be taken very seriously.

Also importantly, there are transgenerational effects of adverse exposures (reviewed in Svanes *et al.* [18]). If the child with a low FEV_1 becomes a parent, his/her children will have impaired spirometry; approximately 30% of offspring spirometry is determined by parental spirometry [3]. If a woman smokes, even if her daughters do not smoke, her grandchildren are more likely to develop asthma [4, 5]. Men who are passively exposed to tobacco are more likely to father children with asthma [6]. Urgent action is needed to break these transgenerational cycles of disease. The approaches across the globe may need to vary (see the following sections) but they are equally important wherever children are raised. Inevitably, given the space constraints, only some countries and environments are considered, but it is hoped that these examples are widely useful.

The UK situation

The UK has the sixth largest economy in the world [19]. Wealth is unequally distributed, however, leaving many families "priced out" of a healthy lifestyle in a high-cost society [20, 21]. The inevitable health inequalities are particularly evident in respiratory disease, which appears more inextricably linked to poverty than diseases of other body systems [22] and contributes significantly to the unprecedented reduction in life expectancy in the poorest decile of the population [23].

TABLE 1 Adverse consequences of antenatal exposures (reviewed in Bush [7])

Premature delivery and low birthweight
Altered lung structure
Altered immune function in cord blood, correlating with subsequent wheeze outcomes
Vulnerability to later adverse stimuli, *e.g.* personal smoking and occupational exposures
Premature ageing (telomere shortening in cord blood)

Determinants of respiratory health in the early years are disparate across the UK. There are inequalities in the rates of antenatal smoking (varying from less than 1% in affluent towns to more than 30% in deprived towns [24]), breastfeeding rates (89% in affluent areas *versus* 73% in deprived areas [23]) and the proportion of infants born with low birthweight (in 2019, 8.2% in the Midlands *versus* 5.5% in the Southwest [25]).

The UK has deep-rooted problems with housing due to misguided policies since the 1980s. An estimated 3.6 million UK children live in poor quality accommodation [26], and fuel poverty driven by high fuel costs, inadequate financial stability and substandard housing are significant additional burdens [27]. Shamefully, it took the death from respiratory disease of a young boy (Awaab Ishak), with the family's mould-ridden social housing being implicated as a factor in his death, to drive legislative change [28].

Discussions around neighbourhood environment and air pollution were galvanised by the death of another child (Ella Kissi Debrah) who died from an asthma attack adjudged by a coroner to be caused by pollution [29]. Exposure to pollution is highest in areas with more deprivation and higher proportions of Black residents [30]. Efforts to reduce traffic pollution have met with opposition from those championing "motorists' rights" and progress stalled because of political reluctance. Other inhalational threats to the developing airway of children also reflect poor policy. Unlike the rest of the world, the UK continues with the un-evidence-based message that "vaping is 95% safer than smoking" [31], continues to downplay consistent epidemiological trends of rising use in young people and has condemned another generation to an unacceptable incidence of nicotine addiction.

Inadequate access to healthy nutrition is illustrated by the steep rise in the use of food banks and the alarming rates of obesity in children, with particularly worrying trends in the most deprived quintile of the population. Poverty means that only cheap, obesogenic junk food can be afforded. The impacts on sleep disordered breathing in children, impaired cardiorespiratory development and obesity asthma (also in adults) are obvious.

The key themes are societal, governmental and corporate vectors of respiratory disease, with fatal consequences. There is a rich economy in the UK, but this is does not counteract the aforementioned policy failures, which will have consequences for decades to come, especially in the poorest communities.

The North American situation

In the USA, social determinants of health have been operationalised into five broad categories that are often interconnected: economic stability, neighbourhood and built environment, access to quality healthcare, access to quality education, and social community context [32]. The Canadian government has outlined a similar list of social determinants of health with the addition of Aboriginal status, gender, race and disability [33]. Asthma is the most notable respiratory condition in the USA and Canada to be associated with social determinants of health. However, social and environmental conditions have also been implicated in disparities in lower respiratory tract infections (LRTIs) [34], acute respiratory distress syndrome [35], cystic fibrosis [36] and lung function [37]. Unfortunately, disparate social and environmental conditions continue to persist well into the 21st century, particularly for childhood asthma.

Economic stability is a component of socioeconomic status that encompasses income, employment and education, and is one of the key drivers of asthma disparities. Children from lower socioeconomic backgrounds often face higher rates of asthma due to higher exposure to environmental pollutants, inadequate housing conditions, increased stress levels and limited access to quality healthcare. In many communities, poverty is segregated into specific neighbourhoods that bear a disproportionate burden of environmental hazards. For example, highways, bus routes and waste transfer stations that contribute to traffic-related air pollution are often located in low-income neighbourhoods and contribute to asthma disparities [38]. Additionally, indoor sources of air pollution that are more common in rural communities, such as biomass combustion for heating and cooking, have been linked to greater risk of LRTIs [39].

Substandard housing conditions, including inadequate ventilation, dampness and the presence of aeroallergens, *e.g.* mould, dust mites, cockroach and pet dander, can worsen asthma symptoms. Furthermore, stress from dealing with housing-related concerns, such as the presence of rodents and difficulty paying utility bills, is associated with increased symptoms of asthma [40]. Low-income households may face challenges in improving their living conditions or accessing the housing that supports respiratory health.

Limited access to healthcare services, including preventive care and asthma management, can hinder early diagnosis, treatment and ongoing management of asthma. Disparities in insurance coverage and financial

constraints can also impact the timely utilisation of healthcare resources. For example, novel biological treatments for asthma are utilised less often for patients with public compared with private insurance [41]. Furthermore, adequate knowledge about asthma triggers, proper medication usage and asthma management techniques are crucial for children and their caregivers. Disparities in health literacy and education can affect the ability to effectively control and prevent asthma symptoms.

In North America there is a strong association between poverty, race and ethnicity due to historical and contemporary systemic racism. Thus, children from minority groups often experience greater environmental and social triggers of respiratory diseases. For example, recent studies have highlighted the inequitable distribution of pollution sources in the USA, with non-Whites polluting less but exposed to greater sources of pollution [42].

The North American First Nation situation

Social determinants of health include poverty, diet, environment, and access to preventive and responsive prenatal and postnatal healthcare, and more broadly include racism, historical trauma and disenfranchisement, and cultural identity and traditions [43]. This is well illustrated among American Indian, Alaskan Native and First Nation peoples residing in North America. Socioeconomic issues among all three groups include poverty, poor healthcare access and insurance coverage, obesity, unemployment, smoking and vaping, and in the northern latitudes, poor indoor quality, household crowding and availability of potable water [44]. 33% of American Indian/Alaskan Native children live in poverty compared with 18% in the general US population [45]. Socioeconomic disparities are obviously not limited to Alaskan Native/American Indian/First Nation populations, but they nonetheless present a salient example of disparities in health and the associated socioeconomic factors linked with poor respiratory health outcomes [46].

There are higher rates of smoking during pregnancy among American Indian/Alaskan Native populations and premature birth is unsurprisingly also more frequent [47]. After birth, continued passive smoke exposure, household crowding, woodstove use and poor ventilation in homes predispose young children to higher rates of LRTIs [48]. Hospitalisations for respiratory syncytial virus (RSV) bronchiolitis are five times more frequent among American Indian/Alaskan Native infants than the general US population [49]. These respiratory insults early in life lead subsequently to a high burden of recurrent wheezing, pneumonias and bronchiectasis [50]. American Indian children were found to be nearly twice as likely to be diagnosed with asthma than Caucasian children, but rates were similar to US Black and Puerto Rican children [51]. Post-infectious bronchiectasis rates among First Nation/Alaskan Native children are among the highest reported worldwide [52].

Higher rates of active smoking and vaping are reported among American Indian/Alaskan Native adolescents and adults [53]. These populations develop COPD at twice the rate of Caucasians in the USA [54]. In a population-based study of more than 2000 American Indian adults, 21% had spirometric evidence of obstructive lung disease and 14% had results consistent with restrictive lung disease [55]. The high prevalence of obesity among American Indian/Alaskan Native/First Nation children and adults is also adverse [56]. Of note, the rates of smoking during pregnancy, premature birth, hospitalisations for bronchiolitis and incident cases of childhood bronchiectasis among American Indian/Alaskan Native groups have all declined over time but remain higher than among non-Whites [57, 58]. Improved immunisation programmes for children, prenatal care and breastfeeding programmes, improved indoor air quality measures, and culturally specific smoking prevention and cessation programmes may have contributed to these trends [59, 60].

The South American situation

Survival, life expectancy and health outcomes have improved across the globe in recent decades, mostly related to improvements in sanitation, vaccines and medical advances. In the 21st century, life expectancy has increased by more than 6 years worldwide, and more than 4 years in Brazil, from 71.5 years in 2000 to 75.9 years in 2019 [61]. Deaths from tuberculosis (TB) declined by almost 50% in the same period worldwide [62]. However, disparities within and between countries continue to impact health outcomes. Data have shown the negative effects of early-life social determinants of health on adult health, especially the impact of poverty on survival, nutrition and cognitive development of children and adolescents [63]. Most of the data on the impact of social determinants of health are from high-income countries (HICs), in particular the USA, where racial, ethnic and economic disparities contribute to a disproportionate burden especially in minority groups. However, it is likely that similar patterns occur worldwide and likely play an even larger role in areas where economic inequality is more pronounced.

One example of inequality as a driver for poorer respiratory outcomes is TB in Brazil. Despite a decline in TB incidence and deaths overall in Brazil over the past decade, the disease has been on the rise among the more vulnerable populations, especially in large urban centres, where disadvantaged populations face challenges in obtaining timely diagnosis, higher odds of treatment abandonment and higher mortality rates [64]. In large urban centres in Brazil, disparities in TB incidence and incomplete treatment have been linked to areas with lower socioeconomic status [65], lower literacy and less access to primary care [66].

The impact of lower income and nutrition on lung function has been documented in a birth cohort in southern Brazil. Lower income, lower mother's pre-gestational body mass index (BMI), lower birthweight and lower BMI in childhood, among other factors, were associated with a lower lung function trajectory, which was also linked to hospitalisations due to respiratory diseases in childhood and wheezing in adolescence [67].

There is a growing body of literature linking social determinants of health with asthma disparities [68], but most of the data come from paediatric populations in the USA. Studies have shown that environmental exposures, including air pollution, housing conditions, access to healthcare access and chronic psychosocial stress, among other factors [69], are associated with asthma exacerbations, measured by emergency department visits, and asthma control among vulnerable populations. In Latin America, at least one large ecological study found that asthma prevalence was positively associated with income inequality, the Human Development Index and adequate sanitation, which suggests that the impact of social determinants of health on asthma is a global phenomenon [70].

The burden of COPD is also disproportionately high in low- and middle-income countries (LMICs) and linked to social determinants of health, with LMICs being responsible for 71% of the global COPD burden, 84% of global COPD deaths and 84% of global COPD disability-adjusted life years (DALYs) [71]. In Latin America, a large population prevalence study conducted in five major cities, the PLATINO study, found that the prevalence of COPD ranged from 8% to 20% and that 26% of individuals with airflow obstruction were never-smokers. For these individuals, the biggest risk factor for COPD development is air pollution and biomass use for cooking and heating, which is in turn associated with low income and housing conditions in early life that in many cases continue throughout life [72].

The Australian situation

That social determinants impact the respiratory health of Australians in the 21st century is reflected in higher rates of chronic conditions for people living in the lowest socioeconomic areas compared with those living in the highest socioeconomic areas, *e.g.* the higher rates of smoking (18% *versus* 5.0%, respectively), COPD (7.1% *versus* 3.6%, respectively) and death (33 *versus* 13 COPD-related deaths per 100 000 population, respectively) [73]. Australia-wide data have also shown that the overall burden of the most common diseases (respiratory diseases, mental, injuries, cardiovascular diseases and cancer) was 2.4 times higher in those living in areas of high socioeconomic disadvantage compared with the lowest socioeconomic disadvantage [74]. The impact of social determinants relating to lung health begin early in life. In 2018, babies born to mothers living in the lowest socioeconomic areas were 1.6 times more likely to be of low birthweight [75]. In addition to the importance of low birthweight on future reduced lung function, among Indigenous children with bronchiectasis, those born prematurely have an increased frequency and earlier onset of acute LRTIs (ALRTIs) compared with their respective local Indigenous population [76]. Any reduction of z-score below normal (*i.e.* even within the normal range) is associated with future increased mortality and cardiovascular disease in Indigenous Australians [77], as previously described in a global study [78].

The detrimental effects of social determinants on respiratory health are most obvious among First Nation Australians (Aboriginal and Torres Strait Islander peoples). In the 2023 Aboriginal and Torres Strait Islander Health Performance Framework report on nationwide data, 29% of First Nation Australians self-reported having a long-term respiratory disease and their respiratory-related hospitalisation rate was 2.4 times that of non-Indigenous Australians [79]. A prospective North Australian cohort study found that the most important influences on lung function of Indigenous children aged 8–14 years (n=547) were factors relating to childhood environment, specifically poor living conditions associated with non-urban dwelling, as well as current cough and past respiratory hospitalisations; these factors were more important than antenatal and perinatal factors [80]. Social determinants are known to impact on the incidence of pneumonia; among Indigenous children, early childhood pneumonia (before age 5 years) is associated with lung function deficits in later childhood and early adulthood [81], confirmed in a global systematic review that included 14 studies [82].

However, it is important that while we wait for social determinants to improve, clinicians do not lose hope as effective and high-quality evidence-based respiratory service can substantially and positively improve respiratory health. The Queensland-based Indigenous Respiratory Outreach Care multidisciplinary service recently was associated with significant spirometry improvements within the first and second year of management of these children. Among the 141 Indigenous children managed by the team, FEV_1 and forced vital capacity improved, including in those with bronchiectasis. The improvement in adults (n=709) was somewhat smaller but still significant [83]. Importantly, the improvement was similar to children treated in the state's sole specialist children's hospital [84].

The New Zealand situation

In Aotearoa New Zealand (AoNZ), social determinants of health have an impact from antenatal care, continuing throughout the lifespan, intertwined with underserved Indigenous and marginalised communities. Between 2000 and 2019, hospitalisation rates increased for bronchiectasis and bronchiolitis, remained static for childhood pneumonia, and declined for asthma and COPD [85]. Differences between the most and least deprived New Zealand Index of Deprivation (NZDep) quintiles gave rate ratios of 2.0 for childhood pneumonia, 2.0 for childhood asthma, 3.1 for bronchiolitis, 3.5–5.5 for bronchiectasis and 4.9 for COPD [86]. The effect of deprivation was near exponential for all disease, with differences across the first four quintiles which were not always significant, but all showed significant differences between the fourth and fifth quintiles. There were also clear inequities by ethnicity, with Pacific peoples' hospitalisation rates highest for most respiratory diseases except for asthma and COPD, where Māori rates were higher [85].

Housing is poorly constructed for the AoNZ climate (especially rental housing). Of nearly 1.5 million child hospitalisations in just over 683 000 individual children (71% re-presentations), the majority were potentially avoidable and associated with poor environmental conditions [87]. Retrofitting insulation, heating, reduction of injury hazards and fuel poverty policies reduce inequities and reduce the number of children hospitalised for housing-sensitive conditions [88]. AoNZ regional differences of 267 cases of sudden unexplained death in infancy were also explained by demographic socioeconomic deprivation [89]. Of the 3.5% children aged under 14 years requiring dental extraction in the preceding 12 months, those most deprived had three times the number of teeth removed compared with those least deprived [90].

Using cohort study data from over 6500 children, ethnicity and socioeconomic resources also explained the likelihood of mothers to have a preferred lead maternity caregiver, be more satisfied with the family general practitioner, and have higher timeliness and completeness of immunisation when reviewed at 9 months, 2 and 4 years of age [91]. Despite AoNZ offering free, women-centred continuity of maternal care, this has not ameliorated inequity, with utilisation influenced by socioeconomic, mobility and social factors [92]. Primary care visits are free only for those aged under 14 years, with 17% from a survey of 79 000 reporting not visiting in the last 12 months because of cost, the largest group being 15–24 years of age [93].

Conversely, a scoping review to address social disadvantage-driven health inequities, particularly for Indigenous peoples, showed initiatives with Indigenous ownership were more likely to improve health by increasing self-determination, strengthening culture and promoting healing [94]. Similarly, a review including 54 studies of Māori consumer experiences relating to direct health service interactions recommended health literacy interventions, increased resources in cultural competencies, and increased Māori capacity in health service development and workforce [95].

The African situation

Respiratory illness remains a major cause of morbidity and mortality in African children despite advances in prevention and improvements in socioeconomic conditions in the last decade. There is a huge burden of ALRTIs or pneumonia; chronic illness is largely due to asthma, the commonest non-communicable disease in African children and adolescents. TB contributes both to the acute and chronic burden, often presenting as ALRTI and progressing to chronic disease [96]. New, improved immunisations, effective HIV prevention or therapy and improvements in living conditions have reduced the burden of ALRTI and of severe disease, but ALRTI remains the major single cause of mortality in children aged under 5 years outside the neonatal period, with a disproportionately high burden in African children. In Africa, Nigeria and the Democratic Republic of Congo are among the five high-burden countries, reflecting their large childhood populations, susceptibility of children and lack of access to care. Early-life ALRTI as well as TB in childhood may also lead to chronic morbidity with impairment of lung function that tracks through adulthood [97], associated with the development of chronic lung disease and premature mortality [98]. The prevalence of asthma in African children and adolescents has been rising in both urban and rural areas,

with prevalence rates similar to or higher than the global prevalence. Disease is often more severe than that in HICs [99].

The social determinants of health remain key drivers of the prevalence and severity of these respiratory diseases in Africa even now. Respiratory diseases are closely linked with poverty and influenced by a range of social determinants. Important environmental exposures associated with socioeconomic disadvantage in Africa include high exposure to tobacco smoke (from the antenatal period onwards), air pollution and poor living conditions with overcrowding or lack of good ventilation which exacerbate transmission of respiratory infectious diseases including TB. Limited access to clean drinking water and sanitation contributes to the spread of respiratory infections. Food insecurity and malnutrition, common in poor communities, increase vulnerability to ALRTI and TB, and are associated with more severe disease. Psychosocial stressors, frequently present in socially disadvantaged settings, have also been associated with disease and disease severity. Further socioeconomic disparities may impede access to education and health information, impacting on parental or family awareness of preventive measures and disease management.

Socioeconomic disadvantage strongly influences access to care and availability or affordability of therapy. Limited access to healthcare services, particularly in remote or poor communities, leads to delayed diagnosis and inadequate prevention and management of disease. This is evidenced by a lack of infant immunisation particularly with pneumococcal conjugate vaccine (PCV), with overall coverage for Africa being 68% [100]. Current estimates are that only approximately 50% of African children with symptoms of pneumonia are taken to a health facility [101]. Even when healthcare is sought, diagnosis and treatment may be inadequate, *e.g.* lack of pulse oximetry to detect hypoxaemia and lack of oxygen therapy are common in primary care facilities. Similarly estimates are that more than 60% of children with TB are undiagnosed each year, and that contact tracing and preventive therapy occur only in a minority [102]. Underdiagnosis of asthma is common, even though disease may be severe, *e.g.* in many African countries almost half of the children who self-reported asthma had severe symptoms but almost a third were undiagnosed. Lack of affordability and access to appropriate inhaled asthma therapy remains a major challenge [73]. An analysis of asthma management in 13 sub-Saharan African countries found that only 46% and 38% had inhaled corticosteroids at a primary- and secondary-level health facility, respectively [103].

The Indian situation

The burden of respiratory disease in India is substantial and includes acute infections, asthma, tuberculosis and its sequelae, including bronchiectasis, as well as various diffuse lung diseases [104]. The ISAAC phase III study reported a prevalence of 7–20% for childhood asthma [105]. This prevalence is lower than in HICs; however, even an estimated 5% prevalence means that 20.4 million children in India suffer from asthma [106].

In 2016, COPD, diarrheal diseases and LRTIs were among the five leading causes of DALYs in India, while child and maternal malnutrition and air pollution were among the five leading risk factors [106]. The burden of some of the leading nutrition and infection-related diseases continues to be very high, especially in the poorer states, and there is significant variation, with at least a five-fold difference between the highest and lowest state-specific DALY rates for individual diseases. However, the magnitude and causes of the disease burden and the associated risk factors vary greatly between states. The average figures often conceal the hardships faced by the most marginalised populations, which exist across both poorer and more affluent states [106]. There is a social gradient whereby the lower an individual's socioeconomic status, the worse their health [107].

The aetiology and risk factors for ALRTIs are multifactorial, with indoor air pollution due to the use of biofuels and cookstoves, environmental tobacco smoke, and scrap and agricultural crop burning being important environmental risk factors for respiratory tract infections in Indian children. These factors remain key risks for ALRTIs and almost 50% of pneumonia-related deaths in children aged under 5 years are attributed to the inhalation of particulate matter (soot) stemming from indoor air pollution [108]. Increased admissions and emergency visits have also been reported following deterioration in ambient air quality of the city [109]. Many issues are linked to the overall social and physical environment of communities and sadly are largely beyond the influence of those disempowered communities. For example, the issue of air pollution, particularly ambient air pollution, is often considered a high-level concern for governments and regions. The World Health Organization recommendations for healthcare workers centres around raising awareness (both within communities and households), research and advocacy [110]. However, vested interests too often prevent words being translated into actions (and not just in India!). While environmental

degradation and air pollution affect people of all social strata, they present a more significant and additional disadvantage for the poorer populations.

Undernutrition, poor feeding practices, poor hygiene and lack of immunisation are among the many poverty-linked risk factors for respiratory morbidity in children [111]. The prevalence of these varies among different populations and is reflected in the burden of disease. Myths around diseases, their treatment and prevention are particularly prevalent in disadvantaged populations due to poor health intelligence at the family and community level [112].

Inadequate and inappropriate care for respiratory and other childhood illnesses often result from a poor quality of diagnosis and subsequent inappropriate prescriptions. The availability of healthcare services remains inconsistent and, due to the challenges in accessing the inconsistent child health services in the public sector, families often turn to private sector services, which result in increased out-of-pocket expenditures that may impact family food budgets [113, 114]. These services may be more accessible but are not necessarily more reliable.

The Chinese situation

In China, rapid economic growth over the past few decades has led to significant improvements in healthcare infrastructure and access to medical technology. However, social determinants, such as environmental and lifestyle changes secondary to urbanisation, and health disparities continue to impact respiratory health outcomes in children.

Rapid industrialisation and urbanisation have led to severe air pollution, which remains a major contributor to respiratory health problems [115]. Children, when compared with adults, are more susceptible to the noxious effects of air pollution because of their dynamic developmental physiology and their immature detoxification and metabolic systems [116]. In China, studies have consistently reported that both short- and long-term exposures to particulate matter were associated with decreases in lung function parameters in children and adolescents [117]. High levels of air pollution have also been linked to an increased risk of asthma, pneumonia and other respiratory conditions [118]. Tobacco smoke is a major source of indoor air pollutants. China accounts for a third of the world's tobacco consumption. With the advent of the nationwide tobacco control programme, the overall prevalence of smoking in adults has decreased from 30.8% to 26.7% between 2007 and 2018. However, there were diverging trends between urban and rural areas, with a rising smoking prevalence in rural areas [119]. With economic growth, there has been a rapid increase in the prevalence of obesity among Chinese children [120]. Importantly, studies have suggested that rapid urbanisation and obesity may contribute to a decline in lung function in children [121]. There is a stronger association between air pollution exposure and lung function impairments among obese and overweight than normal-weight children [122].

Limited access to healthcare and education are also significant concerns for children's respiratory health, particularly in the rural parts of China. The regional disparities in access to healthcare reflect economic development. The provinces in the eastern region generally perform best, followed by the central and western provinces [123]. There is a strong health gradient by family income among children in China. Children from lower socioeconomic classes were more likely to experience multiple illnesses and poorer households were less likely to address health issues effectively [124]. A study performed in Shanghai reported evidence of socioeconomic disparities in pulmonary function in the adult population [125]. Vaccination is an important intervention to reduce respiratory morbidity and mortality in children. Taking PCV as an example, increased coverage leads to a decrease in mortality from ALRTI among children aged under 5 years [126]. In China, the coverage rate varies greatly by region and is especially limited in low-resource settings. Cost, insufficient vaccine knowledge and not being included in the National Immunisation Programme were found to be the major reasons for vaccine refusal and hesitancy [127]. Health disparities between low- and high-income provinces persist and remain an important target of China's health reform [128].

Summary and conclusions

This review demonstrates that across the globe, both in HICs (which contain areas of extreme poverty) and LMICs (in which there are pockets of opulence), postnatal, antenatal and pre-conception social determinants continue importantly to impact the health of young children, thus leading to lifelong consequences. In addition to wide discrepancies of incomes and exposures within a country, there may also be marked ethnic diversity, *e.g.* in South America. Such ethnic diversity is important, but discussion is precluded by space considerations. Although clearly across the globe determinants vary (*e.g.* TB and HIV being far more important in sub-Saharan Africa than White, HICs), it is important to realise that within a

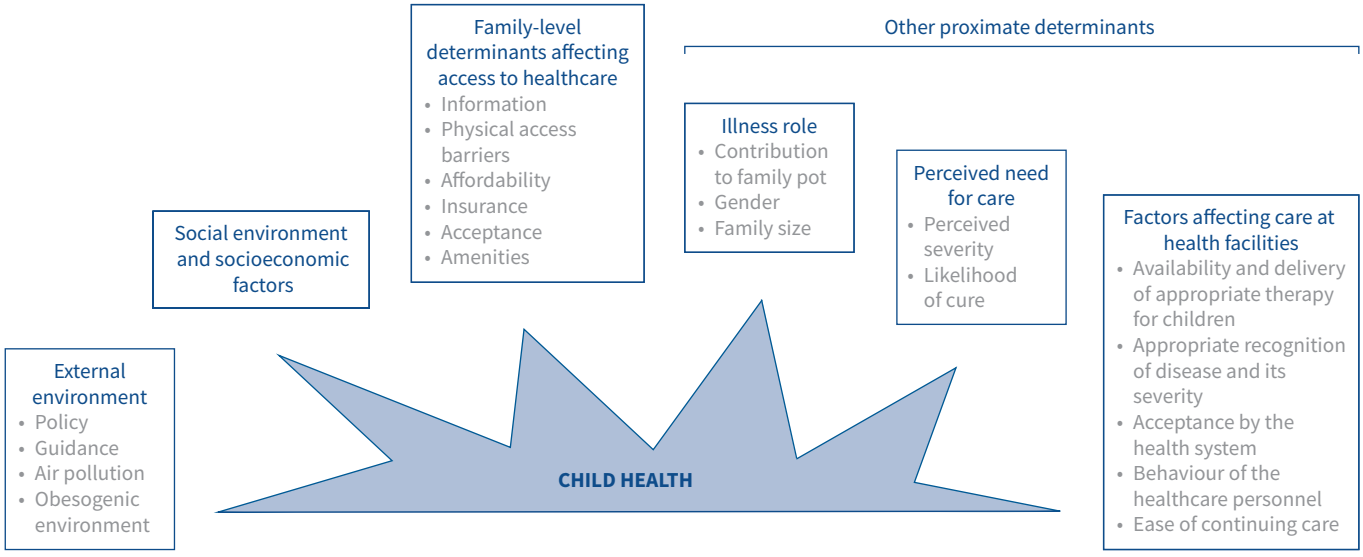

FIGURE 1 The complex interplay of social and other determinants of health.

given country, one size does not fit all in terms of social determinants. However, it is hoped that the general principles outlined here will be useful in improving the specific circumstances of such groupings. Overall, there is a complex interplay of social and other determinants of health, the components of this varying within and between countries (figure 1) [129]. Unsurprisingly, the chief burden falls on the already deprived, and especially also non-White and First Nation children in HIC settings. Addressing social determinants of general health such as obesity is essential for improving childhood respiratory health. Policies and interventions that focus on addressing poverty, enhancing environmental regulations, improving housing conditions, promoting access to quality healthcare, and increasing health and general education can make a significant impact on reducing respiratory health inequities. Whereas we are all rightly excited by the advent of new transformative biological medications in many fields, so much more could be achieved by political action. It should also be noted that new medical technologies and treatments, *e.g.* nirsevimab for prevention of RSV infection, may be priced beyond the budgets of LMICs where the greatest burden of disease falls. Ensuring that all children get appropriate treatments irrespective of personal or national incomes is another huge political challenge.

There are other important issues, not covered here for reasons of space. Climate change is the most serious global health threat of the 21st century, with the impact borne disproportionately by the most disadvantaged populations [130]. The effects of war, political persecution and forced migrations have also not been considered here for reasons of space. Of note, the effects of war may also be transgenerational [131]. Another important issue is access to highly effective but very expensive medications. Within-country disparities of access to inexpensive medications have been highlighted, but there are also issues related to health spending. New medications, such as highly effective modulator therapies for cystic fibrosis, are beyond the budget of many countries, another systemic reason for deprivation and worse outcomes [132]. The issue of refugee children is also important; usually they come from areas of profound danger and deprivation, *via* a hazardous journey, to a new country with new environmental hazards, where they are usually consigned to the most wretched conditions. There needs to be strong advocacy for these children, shaming governments into action [133].

However, not all is doom and gloom. There are positive actions that we as paediatricians can take. First, we need to build into our practice taking a “poverty history” considering the individual child and whether resources and services can be mobilised [134]. Encouraging expectations is surely important; it is (literally) fatally easy for the disadvantaged to feel nothing can be done and that trying to make changes is a waste of effort. Much can also be done on a community level, as documented in the previous sections. Crucially, imposed solutions from outside must be discarded in favour of working together with the community, with ethnic and cultural sensitivities being respected. Public health interventions that focus on improving nutrition, socioeconomic equity, education, housing and healthcare infrastructure have a key role in preventing or ameliorating childhood respiratory diseases. Better access to affordable care and to effective preventive interventions is urgently needed to reduce such global inequities in child health. We also know

that as pollution is reduced, lung growth improves [135]; these data are compelling and must be brought to the centre of the political arena by paediatricians.

Most importantly, it is imperative that we get across to the public and politicians that the effects of childhood deprivation are lifelong, and cross into the next generation and the generation after that. Too often, adults with lung disease are seen as the authors of their own misfortunes, related to active smoking. In reality, many are the victims of circumstances before they were born and in their early years, long before they could take decisions for themselves. If we are serious about preventing adult respiratory and all-cause morbidity and mortality, starting in adult life is way too late. Is there a will to do this or will we lapse into the mindset "something has to change, so long as everything stays the same"? Paediatricians must bring this centre stage to politicians and the public.

Points for clinical practice

- Social determinants of respiratory disease are important across the developmental spectrum and across the world.
- Countries are not uniform; there are islands of deprivation in high-income settings and areas of extreme opulence in LMICs.
- History taking should include determination of poverty status with focused and sensitive questioning.
- Paediatricians must advocate for the fetus and the child, to stimulate political action to address poverty, indoor and outdoor pollution, and nicotine exposure in tobacco and vapes.
- Access to basic and expensive medications, and to healthcare facilities, are other aspects of deprivation which must be addressed.
- The greatest burden of adverse exposures falls on those who are already suffering deprivation.
- We could achieve a step change in lung health without recourse to expensive medications with a strong political will; the roots of adult asthma, COPD and lung cancer lie pre-conception, antenatally and in childhood, and must be addressed well before adult life.

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