

Editorial

Evidence for health effects of early life exposure to indoor air pollutants: what we know and what can be done

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The World Health Organization (WHO) recognises that environmental pollution is a major cause of global disease, death and disabilities with a toll greater than that caused by HIV/AIDS, malaria and tuberculosis combined. About 94% of pollution-related deaths occur in low-income and lower middle income countries; for example, childhood pneumonia and diarrhoeal diseases are directly linked to environmental pollution.

Globally, about 40% of the population relies on biomass fuels such as wood, charcoal, crop residues and animal dung for cooking and heating in their daily life (Bonjour et al. 2013). Combustion products of these fuels are a complex mixture of health-damaging pollutants comprising gases and fine particles, containing among others carbon monoxide (CO), suspended fine particulate matter (PM_{2.5}), nitrogen oxide, polycyclic aromatic hydrocarbons and volatile organic compounds, as well as toxic metals that are present in fossil fuels and are emitted during burning.

In 2012, more than four million deaths were attributable to household air pollution generated by the use of biomass fuels for cooking and heating, and it has been acknowledged that household air pollution is considered to be a major contributor to the global burden of disease (WHO 2016; Lim et al, 2012).

Thus, the negative impact of air pollutants on the environment and human health alike can be attributed to outdoor and indoor air quality. The negative health impacts of indoor air pollution affect poor populations mostly, who rely primarily on biomass fuels for their day to day living. It is important to note that the indoor environment also reflects the outdoor air quality and pollution. In addition, the populations which are most affected by environmental pollution are vulnerable populations such as pregnant women, their infants, and young children. In terms of exposure to solid fuels, it is well recognised that women and children are most exposed to particulate matter and gases at levels which may be 10 to 100 times above safety standards for ambient air.

It has been shown that exposure during pregnancy to particulate matter, gaseous compounds and inorganic and organic pollutants, even at very low concentrations and irrespective of sources, may have negative impacts on foetal development and birth outcomes, as well as on reproductive health in general. The negative impact of these pollutants becomes more pronounced in populations with low socio-economic status, and compromised dietary and health habits. Recent study performed in Tanzania have shown that prenatal exposure to inhaled particulate matter and carbon monoxide may be associated with foetal thrombosis (Wylie et al. 2017). Another study performed in coastal regions of South Africa have shown that using fossil fuels for cooking increased the levels of arsenic in maternal and cord blood, possibly due to its presence in fuels but also the ability of arsenic to attach to respirable particles present in indoor air (Röllin et al. 2017).

Air pollution health impacts in early life and during childhood development are of major concern worldwide, especially the health impacts due to pollutants present in indoor air as a result of fossil fuel combustion. Epidemiological research has shown that exposures to pollutants in early life are especially hazardous at conception, during pregnancy *in utero*, during the neonatal stage after birth, and in early childhood. One of the most vulnerable life stages is the time between conception and birth, when environmental pollutants exert constant and lasting toxicity on the developing foetus and the mother alike. During this period, rapid growth and organ development takes place. Consequently, not only does the health status of the expecting mother affect this process, but so too a range of external factors, including exposure to pollutants.

Exposure to pollutants in the embryonic, foetal, and early post-natal life stages can result in permanent alterations to organ function. When this happens, acute or chronic diseases may surface at any age, from infancy to old age. For example, exposure to CO in the second month of pregnancy (the period of foetal heart development) may increase the risk of the infant being born with heart defects.

Pre-term births, low birth weight, cognitive and behavioural disorders, and respiratory diseases including asthma, have all been linked to exposure to toxic air pollutants. Additionally, exposure to toxic pollutants may increase the risk of infant deaths at birth or during early infancy, or of infants being born with birth defects. Those who survive may suffer from brain, respiratory and digestive disorders. It has been reported recently that delays in foetal developmental may increase the risk of chronic conditions such as heart disease and diabetes in adulthood.

After birth, in the post-natal and childhood stages, maturation of organs such as brain, lung, and the immune system, continues to the age of six years and beyond, and exposure to specific toxic air pollutants during this period may further reduce lung function, exacerbate asthma, and increase the prevalence of wheeze and allergic rhinitis. In addition, neurodevelopmental disorders linked to exposure to specific indoor air pollutants remain an area of concern.

The scientific data indicate that reliance on fossil fuels should be significantly reduced to prevent the cumulative risks of illness and possible impairments in the affected populations, especially children. The effects of exposure to air pollutants are influenced by individual susceptibility which depends upon factors such as age, developmental stage, nutrition and social support. Indoor air pollutants are potentially more detrimental to children because their lungs are still growing and maturing; younger children breathe more air and require more oxygen than older children or adults; and they spend more time in indoor environments. These susceptibilities are known to be altered by contributing factors such as health, nutritional and socio-economic status.

Emissions from fossil fuels are also major contributors to climate change, resulting in heat stress disease, malnutrition, infectious disease, physical trauma, mental ill-health, and respiratory illness – all having the potential of becoming additional stressors in early life, childhood development and beyond.

Research to date has shown that there is a pressing need for proactive engagement between public health and environmental agencies, at both country and global levels, to drive the process of eliminating and/or controlling sources and generation of toxic air pollutants. Coupled to this process should be the identification and implementation of interventions at various levels (e.g. pollution source, home environment, user behaviour) to reduce indoor air pollution from solid fuels.

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