

Indoor Air Pollution - Five Times Greater than Outdoor Air Pollution

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For many years now doctors, particularly pediatricians, have known about the impact of air pollution in the home - particularly from cigarettes smoke and house dust mite, affecting lungs - especially children.

However, with the climate change agenda accelerating, and a decrease in smoking in the UK, a lot of emphasis has been on outdoor pollution e.g. the death of Ella Kissi Debra, a 9-year-old, from asthma was recorded by the coroner in 2013, as the primary cause of death from living next to the South Circular in London. Potential outdoor polluting gases, and particulate matter that impacted on her death are in table 1.

Outdoor pollutants
Nitrogen dioxide - cars and industry
Sulfur dioxide - less with decrease use of Coal in the UK
Low level Ozone from photo-oxidation of oxides of nitrogen and volatile organic compounds
Carbon monoxide - exhaust fumes
Volatile organic compounds
Particulate matter especially < 2.5 microns

Table 1

Since then, nine years on, death of Awaab Ishak in Rochdale (UK) has highlighted the importance of indoor pollution - in his case fungal spores in a damp house.

In order to preserve heat and energy, modern buildings such as homes and offices are designed from synthetic materials, making them more airtight. This creates a chronic state of indoor air pollution from organic substances known as Volatile organic compounds (VOC) exuding e.g. from paints, varnishes, preservatives and resins that bind wood, which find difficulty in escaping (Table 2).

Gases	Biological/household agents
From outside - as from table 1	Dust mites - bedding, sofas, woven material
Second-hand and thirdhand (from clothes) cigarette smoke. For every 8 that die from second hand smoking, one dies from inhaling smoke	Mold - dragged in from the outside into homes and schools etc.
Carbon Monoxide- leaks from boilers, gas fires, wood stoves	Cockroaches - in the urban environment - especially in the USA
Nitrogen Dioxide - gas cooking stoves, kerosene heaters	Formaldehyde - in wood binding materials, resins, paints, preservatives
Radon - ubiquitous radioactive gas in rocks and soil that seeps into homes.	Other household cleaning products - such as bleach.

Table 2: Indoor air Pollution. Worse in poor resourced countries.

Indoor air pollution is 4 - 7 times greater than outdoors as we spend most of our time indoors - perhaps, for adults up to 80% of the time on average. Although circulation of outdoor air is important in flushing out indoor air, what is even more important is that with windows open, indoor pollution within homes is compounded by outdoor pollution shown in table 1.

The gases and household/biological agents shown in table 2, with the added effect of outdoor pollution, have a potential for impacting on the immune system, cause infectious diseases and have a direct toxic effect on lungs and other tissues. Particulate matter < 2.5 is an integral part of polluted air and can travel thousands of kilometers. This PM2.5, is present both indoors and outdoors, having a potential to enter human circulation reaching e.g. the brain, heart, and the pancreas. As one would expect the impact of air pollution is most on the elderly, children and pregnant mothers - the latter having a sizeable percentage of miscarriages.

In addition, the concentration of people in a given area, e.g. schools, offices and shops, is also an important factor, leading to a syndrome, called 'Sick building Syndrome' where individuals describe vague and chronic health problems, such as fatigue and shortness of breath. Globally where coal and wood are used for heating and indoor cooking, the impact of indoor pollution is magnified, with the added factor of indoor smoking, through perhaps ignorance.

More emphasis and research is needed into indoor air pollution and its impact on humans. This may perhaps lead to a new generation of text books citing air pollution as a cause, in some cases, of dementia, strokes, heart attacks and diabetes in those children of today who will have had longer exposure throughout their lives compared to adults.

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