

## IAQ IMPACTS ON HEALTH AND WELLBEING

When we hear the term “air pollution”, we usually associate it with a risk we face outdoors. However, the air we breathe indoors can be contaminated as well. In this sense, research studies suggest that indoor air pollutant concentrations are increasing, driven by different factors such as the use of chemical substances in household products, inadequate ventilation, warmer temperatures, and increased humidity, among others. These factors affect indoor air quality and consequently, our health since we spend 90% of our lives indoors<sup>1</sup>.

Indoor air quality refers to the quality of air in and around buildings and structures, especially as it relates to the health and comfort of building occupants<sup>2</sup>. In other words, the quality of indoor air dictates how pollutants, temperature, humidity, and other environmental elements influence the health and well-being of individuals who spend time, whether temporarily or permanently, in a closed space.

When indoor air quality is inadequate due to the presence of common pollutants, significant effects on human health can occur<sup>3</sup>. Moreover, these effects have a more severe impact on some vulnerable groups. In fact, children, older people, people with pre-existing illnesses, and people of low socioeconomic status are often exposed to higher levels of indoor pollutants.

### Factors contributing to poor indoor air quality

Among the pollutants that contribute to poor indoor air quality are included those which penetrate from outdoors and sources that are specific to the indoor environment<sup>4</sup>. Most of these sources can be grouped in i) human activities indoors, such as smoking, burning solid fuels, cooking, and cleaning; ii) vapours from building materials, equipment, and furnishings; and iii) biological contaminants, such as mold, viruses, or allergens.

The relationship between some of the most common indoor air pollutants and health effects has been well characterised. For example, radon, a gas that can enter buildings through the ground and can accumulate to higher levels indoors, is well-known as a human carcinogen, being the second leading cause of lung cancer<sup>5</sup>. Legionellosis, bacteria naturally found in freshwater environments, can multiply and become a health concern when they contaminate man-made water systems, such as cooling towers, hot water tanks, plumbing systems, and air conditioning systems<sup>6</sup>. Several indoor air pollutants such as dust mites, mold, pet hair, tobacco

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<sup>1</sup> 10.1016/j.jclepro.2019.01.307

<sup>2</sup> 10.1016/B978-0-12-809582-9.00008-6

<sup>3</sup> 10.3390/ijerph17082927

<sup>4</sup> 10.1016/j.buildenv.2021.108050

<sup>5</sup> 10.1183/16000617.0230-2020

<sup>6</sup> 10.1016/j.ijheh.2022.114023

smoke, or tiny airborne particles are considered asthma triggers<sup>7</sup>. Finally, short-term exposure to high indoor levels of carbon monoxide can be fatal<sup>8</sup>.

However, although advancements have been made in the attribution of adverse health effects to some specific pollutants, scientific understanding is still evolving. Aspects such as the synergistic effect among various pollutants, the impact of smaller particles that reach the interior of our lungs, and the effects of new contaminants arising from newly developed materials are currently some of the most intriguing.

### Health effects of indoor air quality

Some health effects such as the irritation of eyes, nose and throat, headache, fatigue, or dizziness can appear shortly after a single exposure or repeated exposures to a pollutant. These symptoms may become more severe and worsen, leading to more serious symptoms, such as asthma. The likelihood of these immediate reactions to indoor air pollutants depends on several factors, such as age, pre-existing diseases, and even individual sensitivity, so they can vary considerably from one person to another<sup>9</sup>.

However, it is not only immediate effects that result from exposure to indoor air pollutants. There are other health effects that might appear even several years after exposure has occurred and/or only after long or repeated periods of exposure. Respiratory and cardiovascular diseases, as well as cognitive effects or cancer, are some of these indoor air quality -related consequences<sup>10</sup>.

Furthermore, to add additional complexity to the issue, the health effects of indoor air quality can be divided into: acute effects suffered mainly by people with previous health problems (such as cardiac and cerebrovascular disorders, respiratory diseases, and cancer, among other multimorbidities); and chronic short-, medium- and long-term effects which can affect everyone according to their specific conditions, population group, level of exposure, etc.

### Awareness and Measures to improve indoor air quality.

The benefits of outdoor air are widely known. In fact, in many Nordic countries, it is common to let babies nap outdoors, even when temperatures are very low. With the COVID-19 pandemic, we are even more aware of the importance of outdoor air but also of maintaining adequate indoor air quality. Ensuring good indoor air quality offers advantages beyond lowering the chance of highly contagious respiratory illness, such as COVID-19, transmission; it also lowers the risk of other illnesses like influenza and other respiratory viruses.

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<sup>7</sup> [10.3390/ijerph17176212](https://doi.org/10.3390/ijerph17176212)

<sup>8</sup> [10.1016/j.toxrep.2020.01.005](https://doi.org/10.1016/j.toxrep.2020.01.005)

<sup>9</sup> [10.3389/fpubh.2020.00014](https://doi.org/10.3389/fpubh.2020.00014)

<sup>10</sup> [10.3389/fpubh.2020.00014](https://doi.org/10.3389/fpubh.2020.00014)

Specific measures can be undertaken to improve the quality of the air we breathe indoors. These measures consist of strengthening five fundamental cornerstones of indoor air quality: monitoring, source control, ventilation, filtration and disinfection<sup>11</sup>. The combination of these precautions measures is the most effective way to minimize the risk of poor indoor air quality-related diseases.

### Need for further research

Apart from the actions we can individually take as citizens, the pivotal approach to mitigating health risks associated with inadequate indoor air quality lies in our knowledge and management of prevalent indoor pollutants. Although much progress has been made in understanding what the most common indoor air pollutants are and the effects they can cause, the current studies are focused on specific parameters or specific scenarios (mainly related to the well-being, safety, and health of people in the workplace). So, we need more research and develop user-friendly monitoring tools to understand how much and how long people need to be exposed to indoor air pollutants to cause specific health problems. The exposome, the totality of environmental exposures that an individual experiences over time, is particularly important, especially for long-term effects on health due to indoor air quality.

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<sup>11</sup><https://www.epa.gov/indoor-air-quality-iaq/improving-indoor-air-quality>