Indoor Air Quality

Source document:
SCHER (2008)

Summary & Details:
GreenFacts

Context - Air pollution – be it indoors or outdoors – is a major environmental health concern as it can lead to serious health effects, such as respiratory diseases, including asthma and lung cancer.

Much progress has been made in Europe in improving outdoor air quality and limit values have been set for several pollutants. However, indoor air quality also requires attention because this is where we spend most of our time.

Which indoor air pollutants raise concern? How can indoor air quality be determined?

An assessment by the European Commission Scientific Committee on Health and Environmental Risks (SCHER)

The answers to these questions are a faithful summary of the scientific opinion produced in 2008 by the Scientific Committee on Health and Environmental Risks (SCHER):
"Opinion on risk assessment on indoor air quality"

The full publication is available at: https://copublications.greenfacts.org/en/indoor-air-pollution/
and at: http://ec.europa.eu/health/opinions/en/indoor-air-pollution/

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- Each question is answered in Level 1 with a short summary.
- These answers are developed in more detail in Level 2.
- Level 3 consists of the Source document, the internationally recognised scientific opinion which is faithfully summarised in Level 2 and further in Level 1.

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1. Introduction – assessing health risks of indoor air pollution


Several household cleaning products emit chemicals
Credit: Sanja Gjenero

Indoor exposure to air pollutants may occur in both private and public indoor environments such as homes, offices, schools and transport systems.

Some **indoor air pollutants** come from the outside, but most are released inside the building, for example when cleaning or when burning fuel for cooking and heating. Furniture and construction materials can also emit pollutants. Dampness and lack of ventilation may further increase indoor air pollution.

Because indoor air can contain a mixture of many different pollutants, it is very difficult to assess the associated risks to health. Moreover, there is no such thing as a "typical indoor environment".

This opinion considers how health risks of indoor air pollutants are currently evaluated and how they should be assessed in the future, taking into account simultaneous exposure to multiple pollutants and particularly vulnerable groups of population such as children, pregnant women and elderly people.

2. What are the main factors in indoor air quality?


Pets and pests are sources of allergens
Credit: Katya Foldvaryove

Certain **chemicals** from household products and home appliances are known to irritate the eyes, nose and throat. However, for many chemicals present in indoor air information is lacking on possible health effects of long term exposure, such as cancer or reproductive effects.

Radon occurs naturally in parts of Europe. It can get inside buildings and may lead to lung cancer.

Suspended particles can cause harmful effects on health, particularly on the respiratory system.

Microbes, such as moulds and viruses, can contribute to the development of asthma and allergies.

Pets and pests such as dust mites, cockroaches, and mice, are important indoor sources of allergens.

Low **humidity** causes eye irritation, dryness of the skin and the nose, and rashes, while high humidity fosters the growth of moulds and dust mites.

Insufficient **ventilation**, one of the most important factors in poor indoor air quality, may affect health and work performance.

Indoor **temperatures** that are too high or too low are unpleasant and can be unhealthy.

3. How can scientists determine whether indoor air pollutants pose a health risk?

To determine whether pollutants may cause health effects, it is necessary to consider four aspects:

- **Toxicity of pollutants and their concentrations** in indoor air. Indoor air can for instance contain organic compounds, particles, or microbes that may cause allergies or other health effects.
- **Exposure**. People are mainly exposed to air pollutants when breathing but may also be exposed via other routes, such as dust ingestion. Since exposures can vary, even very low and very high exposures should be considered and not only average ones.
- **Exposure-response relationships**. To assess the risk posed by a given pollutant, it is important to know how the body responds to different concentrations in air. Health effects observed in people who have been exposed to pollutants at work are valuable in determining the risks posed by a particular pollutant. However, such findings may not be directly applicable to the general public.
- **Risk characterisation**. In the final step of the risk assessment process, all the collected scientific evidence is analysed to determine the probability that a specific pollutant will cause illness.

4. Are certain people more vulnerable than others to indoor air pollution?

Population groups that are potentially more vulnerable than others to indoor air pollution are children, pregnant women, elderly people, and people suffering from cardiovascular or respiratory diseases.

Depending on their age, children may be more vulnerable than adults to certain toxic substances, like lead and tobacco smoke. Even at low levels, air pollutants may disrupt the development of their lungs, cause cough, bronchitis and other respiratory diseases, and make asthma worse.

Factors other than age and presence of cardiovascular or respiratory diseases that may render some people more vulnerable are genetic traits, lifestyle, nutrition and other health problems.

Some people are more vulnerable than others to indoor air pollution
Credit: Stephan Czuratis

5. Why are the combined effects of indoor air pollutants hard to measure?

Like outdoor air, indoor air contains a complex mixture of pollutants (chemical substances, allergens and microbes) from different sources that changes with time.

Findings on the health effects of single air pollutants cannot necessarily be extended to mixtures. Indeed, different chemicals may interact with each other and cause more (or less) harmful effects than the sum of the effects caused by each chemical separately. Very little is known about the combined effects of indoor air pollutants.

Risk assessments which take into account the combined exposure and cumulative effects of the pollutants in indoor air are seldom possible. Nonetheless, the possibility of combined effects should be considered in the risk assessment taking a case-by-case approach.

6. Which chemicals found in indoor air are causing the most concern?


Tobacco Smoke contains several types of harmful pollutants
Credit: Vildan Uysal

Among the combustion products that are generated by heating systems and other home appliances using gas, fuel, or wood, **carbon monoxide** (CO) and **nitrogen dioxide** (NO_2) are of special concern.

Tobacco smoke contains several types of harmful pollutants, including benzene and fine and ultrafine particles. In adults, passive smoking can cause irritation, aggravated respiratory symptoms, and coronary heart disease. In children, it can lead to sudden death syndrome and middle ear infections.

Radon occurs naturally in certain regions. It can get inside buildings and may lead to lung cancer.

Lead, which is still present in paintwork of some old houses, is harmful to children even at low level exposure.

Organophosphate pesticides, which are often used against insects in the home, can affect the development of the nervous system and could be of concern for children.

Volatile organic compounds (VOCs) such as **benzene**, **formaldehyde** and **naphthalene** which are known to have health effects are emitted by many consumer products. VOCs may react with ground-level ozone to form secondary pollutants that can cause irritation. Altogether, the concentrations of VOCs and ozone causing mixture effects are as yet poorly known.

7. What household chemicals and products can pollute indoor air?


Certain paints emit chemicals
Credit: Daniel Case

Several household consumer products emit chemicals into air, for instance cleaning products, floor care products, furniture and household fabrics, air fresheners, glues, paints, paint strippers, personal care products, printed matter, electronic equipment, candles and incense.

Some studies show a link between the use of consumer products and adverse health effects. However, it is not clear to what extent pollutants are responsible for the observed effects because other factors may also contribute to them.

A recent study investigated the emissions of chemicals from a large number of different consumer products. Although typical levels in indoor air were in most cases acceptable, in some occasions, accepted limits were exceeded.

8. Why is dampness in buildings a health concern?


Humidity promotes the growth of moulds
Credit: Infrogmation

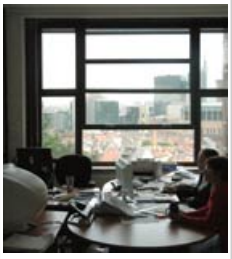
The majority of the health effects linked to dampness and moisture of buildings are those of the respiratory system. They range from irritation of mucous membranes, respiratory symptoms, and infections to diseases such as asthma and allergy. However, it is still not known precisely how dampness leads to these symptoms and which are the main substances responsible.

Humidity problems in buildings may originate from leaks, condensation, or the ground. Excess humidity promotes the growth of micro-organisms such as moulds and bacteria that lead to release of pollutants into indoor air.

Inadequate ventilation may increase humidity and the levels of pollutants.

Further research is needed to assess how serious or widespread the problem of building dampness and moisture is at EU level.

9. What kind of research on indoor air quality is needed?


It is necessary to investigate how people are exposed to pollutants in indoor air

9.1 The data available for risk assessment of indoor air pollution are scarce and often insufficient. Information is available on the concentrations in indoor air of some well-known pollutants but is lacking for others whose effects are unclear. Measurements of outdoor air quality cannot be extrapolated to predict the concentrations in buildings.

Monitoring of indicators other than concentrations may be helpful, for instance ventilation rates, general cleanliness, and signs of dampness. The development of health-based guideline values is recommended for key pollutants.

9.2 Existing data on **exposure** to indoor pollutants and information on risk assessment strategies should be collected and organised.

Research is needed to identify the main sources of indoor pollutants, including in damp and water-damaged buildings. In addition, it is necessary to investigate how people are exposed to pollutants in indoor air and how the exposure levels could be measured or estimated using computer models.

9.3 There is a need for research on the **health effects** of mixtures of pollutants and of less well known indoor air pollutants such as microbes. The contribution of indoor air pollutants to childhood respiratory diseases, as well as the exposure-response relationships, especially in vulnerable groups, should also be investigated further.

9.4 Existing measurement standards should be validated and harmonised.

10. Conclusions and recommendations

Assessing the health risks of indoor air pollution is very difficult as indoor air may contain over 900 chemicals, particles and biological materials with potential health effects. Factors like ventilation, cleaning conditions, building characteristics, products used in households, cultural habits, climate and outdoor environment all influence indoor air quality. Therefore, large variations can be expected across the EU.

The European Commission Scientific Committee on Health and Environmental Risks (SCHER) concludes:

- The principles used in the EU for risk assessment of chemicals should also be applied to indoor air.
- More research and data are needed, particularly on particles and microbes, volatile organic compounds from consumer products, building dampness, levels of exposure, and effects on vulnerable populations.
- Gaps in knowledge should be addressed by European-wide multidisciplinary research. (see question 9)
- Indoor air pollutants of particular concern are carbon monoxide, formaldehyde, benzene, nitrogen oxides, naphthalene, environmental tobacco smoke, radon, lead and organophosphate pesticides.

The SCHER also recommends:

- Data on combined effects of indoor pollutants should be gathered.
- All possible routes of exposure should be considered.
- Health-based guideline values for key pollutants and other practical guidance should be developed.
- The impact of indoor exposure should be considered when evaluating the health effects of outdoor air pollution.
- All relevant sources known to contribute to indoor air pollution should be evaluated.