



## **Indoor air pollution and health**

### **Scope of the problem**

More than half of the world's population rely on dung, wood, crop waste or coal to meet their most basic energy needs. Cooking and heating with such solid fuels on open fires or stoves without chimneys leads to indoor air pollution. This indoor smoke contains a range of health-damaging pollutants including small soot or dust particles that are able to penetrate deep into the lungs. In poorly ventilated dwellings, indoor smoke can exceed acceptable levels for small particles in outdoor air 100-fold. Exposure is particularly high among women and children, who spend the most time near the domestic hearth. Every year, indoor air pollution is responsible for the death of 1.6 million people - that's one death every 20 seconds.

The use of polluting fuels thus poses a major burden on the health of poor families in developing countries. The dependence on such fuels is both a cause and a result of poverty as poor households often do not have the resources to obtain cleaner, more efficient fuels and appliances. Reliance on simple household fuels and appliances can compromise health and thus hold back economic development, creating a vicious cycle of poverty.

According to the 2004 assessment of the International Energy Agency, the number of people relying on biomass fuels such as wood, dung and agricultural residues, for cooking and heating will continue to rise. In sub-Saharan Africa, the reliance on biomass fuels appears to be growing as a result of population growth and the unavailability of, or increases in the price of, alternatives such as kerosene and liquid petroleum gas. Despite the magnitude of this growing problem, the health impacts of exposure to indoor air pollution have yet to become a central focus of research, development aid and policy-making.

### **The health impact: A major killer**

The World Health Organization (WHO) has assessed the contribution of a range of risk factors to the burden of disease and revealed indoor air pollution as the 8th most important risk factor and responsible for 2.7% of the global burden of disease. Globally, indoor air pollution from solid fuel use is responsible for 1.6 million deaths due to pneumonia, chronic respiratory disease and lung cancer, with the overall disease burden (in Disability-Adjusted Life Years or DALYs, a measure combining years of life lost due to disability and death) exceeding the burden from outdoor air pollution five fold. In high-mortality developing countries, indoor smoke is responsible for an estimated 3.7% of the overall disease burden, making it the most lethal killer after malnutrition, unsafe sex and lack of safe water and sanitation.

Indoor air pollution has been associated with a wide range of health outcomes, and the evidence for these associations has been classified as strong, moderate or tentative in a recent systematic review. Included in the above assessment were only those health outcomes for which the evidence for indoor air pollution as a cause was classified as strong. There is consistent evidence that exposure to indoor air pollution increases the risk of pneumonia among children under five years, and chronic respiratory disease and lung cancer (in relation to coal use) among adults over 30 years old. The evidence for a link with lung cancer from exposure to biomass smoke, and for a link with asthma, cataracts and tuberculosis was considered moderate. On the basis of the limited available studies, there is tentative evidence for an association between indoor air pollution and adverse pregnancy outcomes, in particular low birth weight, or ischaemic heart disease and nasopharyngeal and laryngeal cancers.

While the precise mechanism of how exposure causes disease is still unclear, it is known that small particles and several of the other pollutants contained in indoor smoke cause inflammation of the airways and lungs and impair the immune response. Carbon monoxide also results in systemic effects by reducing the oxygen-carrying capacity of the blood.

### **Pneumonia and other acute lower respiratory infections**

Globally, pneumonia and other acute lower respiratory infections represent the single most important cause of death in children under five years. Exposure to indoor air pollution more than doubles the risk of pneumonia and is thus responsible for more than 900 000 of the 2 million annual deaths from pneumonia.

### **Chronic obstructive pulmonary disease**

Women exposed to indoor smoke are three times as likely to suffer from chronic obstructive pulmonary disease (COPD), such as chronic bronchitis, than women who cook and heat with electricity, gas and other cleaner fuels. Among men, exposure to this neglected risk factor nearly doubles the risk of chronic respiratory disease. Consequently, indoor air pollution is responsible for approximately

700 000 out of the 2.7 million global deaths due to COPD.

## Lung cancer

Coal use is widespread in China and cooking on open fires or simple stoves can cause lung cancer in women. Exposure to smoke from coal fires doubles the risk of lung cancer, in particular among women who tend to smoke less than men in most developing countries. Every year, more than one million people die from lung cancer globally, and indoor air pollution is responsible for approximately 1.5% of these deaths.

## Disproportionate impacts on children and women

Household energy practices vary widely around the world, as does the resultant death toll due to indoor air pollution. While more than two-thirds of indoor smoke deaths from acute lower respiratory infections in children occur in WHO's African and South East Asian Regions, over 50% of the COPD deaths due to indoor air pollution occur in the Western Pacific region.

In most societies, women are in charge of cooking and - depending on the demands of the local cuisine - they spend between three and seven hours per day near the stove, preparing food. 59% of all indoor air pollution-attributable deaths thus fall on females. Young children are often carried on their mother's back or kept close to the warm hearth. Consequently, infants spend many hours breathing indoor smoke during their first year of life when their developing airways make them particularly vulnerable to hazardous pollutants. As a result, 56% of all indoor air pollution-attributable deaths occur in children under five years of age.

In addition to the health burden, fuel collection can impose a serious time burden on women and children. Alleviating this work will free women's time for productive endeavours and child care, and can boost children's school attendance and time for homework.

## Millennium Development Goals are guiding international action

Tackling indoor air pollution in the context of household energy is linked to achieving the Millennium Development Goals, in particular to reducing child mortality (Goal 4), to promoting gender equality and empowering women (Goal 3), to opening up opportunities for income generation and eradicating extreme poverty (Goal 1), and to ensuring environmental sustainability (Goal 7). WHO reports the "proportion of the population using solid fuels for cooking" as an indicator for assessing progress towards the integration of the principles of sustainable development into country policies and programmes. Yet, the central role of household energy is not currently reflected in the political responses to achieve the Millennium Development Goals.

Measures to reduce indoor air pollution and associated health effects range from switching to cleaner alternatives, such as gas, electricity or solar energy, to improved stoves or hoods that vent health-damaging pollutants to the outside, to behavioural changes. There is an urgent need to investigate which interventions work and how they can be implemented in a successful, sustainable and financially viable way.

## What WHO is doing

WHO, as the global public health agency, is advocating for the integration of health in international and national energy policies and programmes. WHO collects and evaluates the evidence for the impact of household energy on health and for the effectiveness of interventions in reducing the health burden on children, women and other vulnerable groups. WHO's programme on household energy and health rests on four pillars:

- **Documenting the health burden of indoor air pollution and household energy:** WHO will provide a regular update of the links between household energy and health and, where feasible, offer support to key research undertakings.
- **Evaluating the effectiveness of technical solutions and their implementation:** Developing simple tools for monitoring the effectiveness of interventions in improving health and building the capacity to conduct such evaluations will help generate much needed information from ongoing small- and large-scale projects. This information will provide the basis for the development of a catalogue of options that review both the effectiveness of interventions, and lessons learnt in relation to their implementation.
- **Acting as the global advocate for health as a central component of international and national energy policies:** Ultimately, policy-makers will want to know whether it pays off to invest in large-scale operations to reduce indoor air pollution. In terms of health, a recent cost-effectiveness analysis of different interventions suggests that improved stoves and switching to kerosene and gas represent cost-effective solutions. In addition, WHO is working on a cost-benefit analysis of interventions that - beyond health - will take into account all the benefits associated with improved household energy practices.
- **Monitoring changes in household energy habits over time:** Information about the energy habits of poor, mostly rural households is scarce and WHO has the responsibility to work towards progress in this area and to report, on a yearly basis, the Millennium Development Goal Indicator 29 "percentage of population using solid fuels".

Key partners include the Partnership for Clean Indoor Air, the United Nations Environment Programme, the United Nations Development Programme and the World Bank as well as many research institutions and non-governmental agencies around the world. WHO is already actively taking part in projects in several developing countries, including the most sophisticated scientific indoor air pollution study to date undertaken in Guatemala, and work in China, Lao People's Democratic Republic, Mongolia, Nepal, Kenya and Sudan. In the future, work will focus even more on those countries and populations most in need.

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