

## Frequently Asked Questions

### Ambient and Household Air Pollution and Health

#### Update 2014

#### **SECTION I HEALTH IMPACTS OF AMBIENT AIR POLLUTION**

##### **Q.1 What is ambient air pollution versus urban outdoor air pollution?**

Ambient air pollution is a broader term used to describe air pollution in outdoor environments. Poor ambient air quality occurs when pollutants reach high enough concentrations to affect human health and/or the environment.

Urban outdoor air pollution is a more specific term referring to the ambient air pollution experienced by populations living in urban areas, typically in or around cities.

##### **Q.2 What are the health consequences of ambient air pollution?**

Exposure to high levels of air pollution can cause a variety of adverse health outcomes. It increases the risk of respiratory infections, heart disease, stroke and lung cancer. Both short and long term exposure to air pollutants have been associated with health impacts. More severe impacts affect people who are already ill. Children, the elderly and poor people are more susceptible. The most health-harmful pollutants – closely associated with excessive premature mortality – are fine **PM<sub>2.5</sub>** particles that penetrate deep into lung passageways.

Although air quality in developed countries has been generally improved over the last decades, the adverse health effects of particulate air pollution, even at relatively low levels, remain a global public health concern.

##### **Q.3 What is particulate matter - PM<sub>2.5</sub> and PM<sub>10</sub>?**

Particulate matter, or PM, is the term for particles found in the air, including dust, dirt, soot, smoke, and liquid droplets. Large concentrations of particulate matter are typically emitted by sources such as diesel vehicles and coal-fired power plants. Particles less than 10 micrometers in diameter (PM<sub>10</sub>) pose a health concern because they can be inhaled into and accumulate in the respiratory system. Particles less than 2.5 micrometers in diameter (PM<sub>2.5</sub>) are referred to as "fine" particles and pose the greatest health risks. Because of their small size (approximately 1/30<sup>th</sup> the average width of a human hair), fine particles can lodge deeply into the lungs.

##### **Q. 4 How large is the disease burden associated with ambient air pollution?**

Worldwide 3,7 million premature deaths are attributable to ambient air pollution in 2012.

About 88% of these deaths occurs in low and middle income countries.

**Regional breakdown (low and middle income countries)**

The Western Pacific	1 670 000 deaths
South East Asians regions:	936 000 deaths.
Eastern Mediterranean region:	236 000 deaths
Europe	203 000 deaths
Africa	176 000 deaths
Americas	58 000 deaths

**Regional breakdown (high income countries)**

Europe	279 000 deaths
Americas	94 000 deaths
Western Pacific	68 000 deaths
Eastern Mediterranean countries	14 000 deaths

**Q. 5 What information does WHO collect on ambient (outdoor) air pollution exposures?**

WHO maintains a worldwide, public database on urban outdoor air pollution in its Global Health Observatory.

The database contains measured outdoor air pollution levels of PM<sub>2.5</sub> and PM<sub>10</sub> from 1100 cities in 92 countries for the years 2003-2010. These are used for estimating mean annual exposures of the urban population to fine particulate matter. Links to the database and further information on how the data is collected can be found here: [http://www.who.int/phe/health\\_topics/outdoorair\\_aqg/en/index.html](http://www.who.int/phe/health_topics/outdoorair_aqg/en/index.html) and [http://www.who.int/gho/phe/outdoor\\_air\\_pollution/en/](http://www.who.int/gho/phe/outdoor_air_pollution/en/)

In 2013, WHO began collaborating with major institutions and agencies worldwide in the development of a global air pollution platform that includes data on air pollution concentrations based on satellite monitoring, chemical transport models and ground measurements, inventories of pollution emissions from key sources, and models of air pollution drift – permitting estimates of air pollution exposures even in areas where there are no ground level monitoring stations.

**Q. 6 How is WHO responding to ambient air pollution effects on health?**

WHO's main function is to identify and monitor those air pollutants with the greatest impact on people's health. This helps the WHO Member States to focus their actions on the most effective way to prevent, or reduce health risks. WHO's task is to review and analyze the accumulated scientific evidence, and use expert advice to draw conclusions on how much different air pollutants affect health as well as identify effective measures to reduce the air pollution burden.

**Q. 7 What steps should be taken to prevent the health impacts from ambient air pollution?**

Governments can identify their main sources of ambient air pollution, and implement policies known to improve air quality, such as: promotion of public transport, walking, and cycling (rather than transport relying on private motor vehicles); promotion of power plants that use clean and renewable fuels (e.g. not coal), and improvements in the energy efficiency of homes, commercial buildings and manufacturing.

Essential accompanying steps include increasing awareness about the high disease burden from ambient air pollution and its main sources, as well as highlighting the importance of taking action now to implement country-specific interventions. In addition, the use of effective monitoring to evaluate and communicate the impact of interventions is also an important tool in raising awareness. It can help drive policy action that brings benefits for health, climate and the environment.

**Q. 8 WHO maintains that reducing ambient air pollution can lead to substantial reductions in mortality. Is this true and where might I find further information?**

By reducing the annual mean ambient concentration of PM<sub>10</sub> from 70 to 20 µg/m<sup>3</sup>, and PM<sub>2.5</sub> from 35 to 10 µg/m<sup>3</sup>, in line with the target levels by the 2005 WHO Air Quality Guidelines.

[http://www.who.int/phe/health\\_topics/outdoorair/outdoorair\\_agg/en/](http://www.who.int/phe/health_topics/outdoorair/outdoorair_agg/en/)

WHO estimates that 12.7% of deaths could be averted by improving air quality worldwide. Lower levels of air pollution will reduce the burden of respiratory and cardiovascular disease-related illnesses, health-care costs, and lost worker productivity due to illness, as well as increasing life expectancy among local populations.

In addition, actions that reduce ambient air pollution will also cut emissions of short-lived climate pollutants, particularly black carbon which is a major component of soot emissions from diesel vehicles, and other sources, as well as greenhouse gases (CO<sub>2</sub>) contributing to longer-term climate change impacts. Climate change produces a number of adverse effects on health. This includes those from drought and extreme weather events (e.g. windstorms, floods), such as water-borne and food-borne diseases. It also increases the prevalence of vector-borne diseases like dengue or malaria.

**Q.9 What are the implications for public health?**

Public health recognizes air pollution as an important determinant of health. Today this is especially the case in developing countries where exposure to air pollution is now higher than in developed countries, where mitigation measures led to reductions in exposure. There is significant inequality in the exposure to air pollution and related health risks: air pollution combines with other aspects of the social and physical environment to create a disproportional disease burden in less affluent parts of society.

Exposure to air pollutants is largely beyond the control of individuals and requires action by public authorities at the national, regional and even international levels.

The health sector can play a central role in leading a multisectoral approach to the prevention of exposure to air pollution. It can engage and support other relevant sectors (transport, housing, energy production and industry) in the development and implementation of long-term policies to reduce the risks of air pollution to health.

**Q.10 Are there are other risk factors that could contribute to these deaths from outdoor air pollution?**

Mortality from ischaemic heart disease and stroke are also affected by risk factors such as high blood pressure, unhealthy diet, lack of physical activity, smoking, and household air pollution. Some other risks for childhood pneumonia include suboptimal breastfeeding, underweight, second-hand smoke, and household air pollution. For lung cancer, and chronic obstructive pulmonary disease, active smoking and second-hand tobacco smoke are also main risk factors. These risk factors may contribute to deaths that are caused by ambient air pollution.

## **SECTION II PUBLIC HEALTH POLICY FOR AMBIENT AIR POLLUTION**

### **Q1: What are public policies that can reduce the health impacts of ambient air pollution?**

Reducing the public health impacts of ambient air pollution requires addressing the main sources of the air pollution, including inefficient fossil fuel combustion from motor vehicle transport, power generation and improving energy efficiency in homes, buildings and manufacturing.

Reducing the health effects from ambient air pollution requires action by public authorities at the national, regional and even international levels. Individuals can contribute to improving air quality by choosing cleaner options for transport or energy production.

The public health sector can play a leading role in instigating a multisectoral approach to prevention of exposure to ambient air pollution, by engaging with and supporting the work of other sectors (i.e. transport, housing, energy, industry) to develop and implement long-term policies and programs aimed to reduce air pollution and improve health.

### **Q2: What challenges do countries face, and what obstacles are preventing assistance in improving ambient air quality?**

Enough knowledge exists internationally about the health effects of ambient air pollution but what often can limit policy development for the improvement of air quality, is the lack of access to information on levels of air pollutants and their main sources of pollutants.

Also, there is often a lack of awareness about the health burden of ambient air pollution. This can be due to little awareness of the international evidence from both developed and developing countries linking ambient air pollution exposure and health, or due to a gap in information from air quality monitoring, or even due to an under-appreciation of the potential solutions and measures that can be taken to improve air quality.

Improving ambient air pollution is an inter-sectoral challenge. Improving air quality should be an important consideration in policy planning across different economic sectors (e.g. transport, energy, industry, urban development) to ensure the greatest benefits for health.

In addition, there is significant inequality in the exposure to air pollution and the related health risk: air pollution combines with other aspects of the social and physical environment, creating disproportional disease burden in populations with limited incomes and with minimal local resources to take action.

### **Q3: How can you give global and regional estimates if we don't have country estimates? How can the numbers be trusted?**

Exposure estimates for ambient air pollution are based on a global model using all available surface monitoring data, atmospheric transport models and satellite observations. One of the advantages of this approach is an ability to estimate risks in countries with no, or little, locally collected data.

Exposure distributions produced by such models for larger regions agree well with the distributions from surface observations and are more reliable than estimates for smaller ones. With the progress of the methods and better availability of locally collected data (from AQ monitoring and emission

inventories), as well as with improvement of the spatial resolution of atmospheric models and satellite data, national, and even sub-national, estimates will become available.

The global model does nevertheless produce country exposure to ambient air pollution and the burden of disease estimates are calculated at country level and aggregated into regions. However, country data are currently not released for the above-mentioned reasons.

Country exposure for household air pollution is already available at the Global Health Observatory, and country data on attributable mortality to household air pollution will be released at the same time as the ambient air pollution ones.

**Q4: How will reducing the number of cars in circulation in a large city reduce ambient air pollution and have a benefit on health and well-being?**

Although newer motor vehicles have more efficient engines and are using cleaner fuels, the absolute number of vehicles is still increasing in many cities worldwide -- and consequently so are levels of ambient air pollution in many urban regions. For example, in parts of Europe where stricter standards and regulations for vehicles have been enforced, ambient air pollution levels are stable or continue to rise. Per kilometer of travel, diesel vehicles also typically emit more particulate emissions than gasoline, gas-powered, or electric vehicles of comparable size and age --so that increased reliance on diesel vehicles in the vehicle fleet may be a contributing factor to health-harmful air pollution in many cities. Diesel emissions have also been defined by WHO's International Agency for Research on Cancer as a carcinogen.

Building cities around rapid public transport systems, complemented by dedicated walking and cycling networks, is more fuel efficient, in terms of transport. This also tends to facilitate a "virtuous cycle" of more compact cities, more energy efficient housing, fewer private car trips, and thus fewer air pollution emissions overall. This helps minimize the health burden from ambient air pollution -- as well as encouraging healthful active transport on safe walking and cycling networks, where people are at less risk of traffic injury.

However, it should be kept in mind that transport may be directly responsible for anywhere from 15-70% of urban ambient air pollution in urban areas, depending on the city, so a holistic approach involving energy, industry, and building sectors, together with the transport sector, is required to reduce the disease burden from ambient air pollution.

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### **Section III - HEALTH IMPACTS FROM HOUSEHOLD AIR POLLUTION**

#### **Q.1 What is household air pollution?**

Household air pollution (HAP) from the inefficient combustion of solid fuels (i.e. wood, coal, charcoal, crop waste, dung) is the leading environmental risk factor for death and disability in the world. It was previously described as indoor air pollution (IAP), but acknowledging that human exposure from the air pollution created by the household combustion of solid fuels is not limited to the indoor environment, this risk factor has recently been renamed HAP to more fully capture the health-based risks associated with it.

#### **Q.2 What are the health impacts from exposure to household air pollution?**

Exposure to household air pollution is associated with a wide range of child and adult disease outcomes, including respiratory conditions such as acute lower respiratory infections in children under 5, chronic obstructive pulmonary disease, lung cancer, stroke and cardiovascular diseases in adults.

Exposure has been linked with other health outcomes including other cancers (e.g. cervical), adverse pregnancy outcomes, cataract (especially among women) and tuberculosis.

#### **Q.3 How large is the disease burden from household air pollution?**

Household air pollution is world's largest environmental-health risk, estimated to be responsible for 4,3 million deaths in 2012 (7,7% of total mortality).

#### **Q.4 What are some of the major sources or causes of household air pollution?**

The incomplete combustion of solid fuels (i.e. wood, coal, charcoal, crop waste, dung) from the use of open fires or in poorly vented simple stoves for cooking and heating is one of the major sources of household air pollution. The use of kerosene lamps for lighting and kerosene stoves for cooking is another important contributor to pollution in the home as demonstrated by more recent evidence.

The amount and relative proportion of toxic air pollutants generated by incomplete combustion of solid fuels are dependent on a number of factors, including fuel type and moisture content, household ventilation, the behavior of the people using the stoves, and the stove technology. The emitted toxic pollutants include particles of varying sizes, carbon monoxide, volatile and semi-volatile organic compounds, and several others. Combustion of coal, in addition to the above pollutants, releases sulfur oxides, heavy metals such as arsenic, and fluorine which also have very negative consequences on health.

#### **Q.5 Are there health effects from both short and long term exposure to household air pollution?**

Both long and short term exposure to household air pollution has impacts on health. Long-term or chronic exposure over the lifetime increases the risk for non-communicable diseases like respiratory cancers, cardiovascular disease, stroke and chronic obstructive pulmonary disease. Shorter term exposure, days to months, can lead to more acute health outcomes like childhood pneumonia, and adverse pregnancy outcomes. Household members with pre-existing conditions like asthma and heart disease can see adverse health impacts from just hours of exposure to very high levels of household air pollution.

#### **Q.6 How does WHO estimate the population exposed to household air pollution?**

WHO uses the percentage of households in lower and middle income countries primarily cooking with solid fuels as a proxy indicator for exposure to household air pollution. The percentage of households cooking with solid fuels each year is estimated using a statistical model based on household survey

data from the WHO Household Energy database. This database contains compiled information on primary cooking fuel used and cooking practices from over 700 nationally representative data sources like national census, the USAID's Demographic Health Survey, UNICEF's Multiple Indicator Cluster Survey and the World Bank's Living Standards Measurement Survey (see <http://www.who.int/gho/database/en/>)

WHO's household air pollution exposure estimates have been a vital source of data for the tracking & monitoring of household energy use & health impacts for over a decade.

### **Q.7 Which regions and countries across the world are most affected?**

WHO uses the percentage of households in low and middle income countries primarily cooking with solid fuels as a proxy indicator for exposure to household air pollution. According to recent estimates for 2012, exposure to household air pollution is most prevalent in the lower and middle income countries (LMICs) of the Regional Office for Africa (AFRO) where on average 78% of households primarily use solid fuels for cooking. In LMICs of the Southeast Asia region, 63% of households cook with solid fuels and in other LMICs in other WHO regions, primary solid fuel use ranges from 45% in the Western Pacific region, to 34% in the Eastern Mediterranean and < 20% in the Americas and Europe.

In some countries like Ethiopia and Rwanda, WHO estimates that around 98% of the population relies on solid fuels, suggesting that almost the entire population of these countries is exposed to household air pollution. WHO estimates that over 1 billion people each in China and India rely primarily on solid fuels for cooking.

### **Q.8 How is WHO responding to household air pollution effects on health?**

Many efforts are underway to disseminate clean home energy solutions but there is a gap in our understanding of the most effective interventions at protecting health and data collection on the issue at both a national and global level. WHO is addressing these challenges by working to:

- (i) improve the monitoring tools (e.g. national surveys) of home energy solutions & their health impacts,
- (ii) enhance its global household energy database to include more indicators and tools for assessing health impacts,
- (iii) review and compile the scientific evidence on the health impacts of household air pollution,
- (iv) work with countries to implement effective monitoring of air quality and its health impacts in both permanent and transitional household settings.

In this effort, WHO has recently completed new Indoor Air Quality Guidelines (IAQGs) for Household Fuel Combustion, which includes an extensive review of the evidence on the health risks of household air pollution exposure and the performance of a wide range of stove technologies and devices.

### **Q.9 Are there are other risk factors that could contribute to these deaths from household air pollution?**

Mortality from ischaemic heart disease and stroke are also affected by risk factors such as high blood pressure, unhealthy diet, lack of physical activity, smoking and ambient air pollution. Some other risks for childhood pneumonia include suboptimal breastfeeding, underweight, and second-hand smoke. For lung cancer, and chronic obstructive pulmonary disease, active smoking and second-hand tobacco smoke are also main risk factors.

## **SECTION IV WHO AIR QUALITY GUIDELINES AND OTHER INFORMATION RESOURCES**

### **Q1. How do the WHO Air Quality Guidelines support Member States?**

The WHO Air Quality Guidelines (AQGs) inform policy-makers about the health impacts of air pollutants, and provide appropriate targets for air quality that is safe for health. Countries can select among a broad range of policy options for the most appropriate to improve air quality and achieve a better protection of people's health.

The Guidelines are intended for a global audience. They have been developed to support actions for healthy air quality across different contexts. At the same time, they acknowledge the need for each country to set up its own air quality standards to protect the public health of their citizens based on local conditions.

WHO's Ambient Air Quality Guidelines are available at:

[http://www.who.int/phe/health\\_topics/outdoorair\\_aqg/en/index.html](http://www.who.int/phe/health_topics/outdoorair_aqg/en/index.html)

WHO's Indoor Air Quality Guidelines are available at:

<http://www.euro.who.int/en/health-topics/environment-and-health/air-quality/publications>

### **Q2: Have there been any new guidelines on the health impact of ambient air pollution since the WHO's *Air Quality Guidelines, Global Update 2005*?**

The Air Quality Guidelines, Global Update 2005 is still the most authoritative WHO document on air quality and health which provides a comprehensive review of the scientific evidence. The Guidelines set target outdoor concentrations for particulate matter (PM), nitrogen dioxide (NO<sub>2</sub>), sulfur dioxide (SO<sub>2</sub>) and ozone (O<sub>3</sub>) that would protect the large majority of individuals from the ill effects of air pollution on health. The Guidelines can be obtained by following the link:

[http://www.who.int/phe/health\\_topics/outdoorair\\_aqg/en/](http://www.who.int/phe/health_topics/outdoorair_aqg/en/)

The WHO REVIHAAP (Review of evidence on health aspects of air pollution) project was implemented in 2012-13 evaluated the newly accumulated evidence on health aspects of air pollution. Its results show that this new evidence supports the scientific conclusions of the WHO air quality guidelines, last updated in 2005, and indicates that the effects in some cases occur at **air pollution concentrations lower than those serving to establish these guidelines. The report from the project can be obtained by following the link:**

<http://www.euro.who.int/en/health-topics/environment-and-health/air-quality/publications/2013/review-of-evidence-on-health-aspects-of-air-pollution-revihaap-project-final-technical-report>

### **Q3. Are there are guidelines on the health impacts on indoor air quality or household air pollution?**

Two sets of guidelines on indoor air quality have been published by WHO. They address health problems related to (1) dampness and mould and (2) the selected pollutants common indoors. These Indoor Air Quality Guidelines are available at:

<http://www.euro.who.int/en/what-we-do/health-topics/environment-and-health/air-quality/publications>

In 2014, new Indoor Air Quality Guidelines for household fuel combustion will be released. These guidelines provide technical guidance on the necessary performance of fuels and technologies used in the home to protect health. They also give recommendations on the steps needed to be taken by decision-makers and implementers to ensure that such technologies are effectively adopted in a sustained manner by households.

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