WHO Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulfur dioxide

Global update 2005

Summary of risk assessment



World Health Organization

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Contents

Preface	5
Role of the guidelines in protecting public health	6
Air quality guidelines and their rationale	8
Particulate matter	8
Ozone	13
Nitrogen dioxide	15
Sulfur dioxide	16
References	18

Preface

Clean air is considered to be a basic requirement of human health and well-being. However, air pollution continues to pose a significant threat to health worldwide. According to a WHO assessment of the burden of disease due to air pollution, more than 2 million premature deaths each year can be attributed to the effects of urban outdoor air pollution and indoor air pollution (caused by the burning of solid fuels). More than half of this disease burden is borne by the populations of developing countries¹.

The WHO air quality guidelines are designed to offer guidance in reducing the health impacts of air pollution. First produced in 1987² and updated in 1997,³ these guidelines are based on expert evaluation of current scientific evidence. Given the wealth of new studies on the health effects of air pollution that have been published in the scientific literature since the completion of the second edition of the Air quality Guidelines for Europe, including important new research from low-and middleincome countries where air pollution levels are at their highest, WHO has undertaken to review the accumulated scientific evidence and to consider its implications for its air quality guidelines. The result of this work is presented in this document in the form of revised guideline values for selected air pollutants, which are applicable across all WHO regions. These guidelines are intended to inform

policy-makers and to provide appropriate targets for a broad range of policy options for air quality management in different parts of the world.

The new information included in this latest update of the *Air quality guidelines* relate to four common air pollutants: particulate matter (PM), ozone (O_3), nitrogen dioxide (NO_2) and sulfur dioxide (SO_2). The scope of this review reflects the availability of new evidence on the health effects of these pollutants and their relative importance with regard to current and future health effects of air pollution in each of the WHO regions. For air pollutants not considered in the present document the conclusions presented in the WHO *Air quality guidelines for Europe*³ remain in effect.

The process leading to the present revision of the air quality guidelines is summarized in the report of the WHO Working Group Meeting, which convened in Bonn, 18–20 October 2005⁴. This report lists the members of the Working Group who reviewed the available evidence and who recommended the guideline values presented here. A full report, to include a detailed assessment of the available scientific evidence, as well as the revised introductory chapters of the WHO *Air quality guidelines* will be published later in 2006.

¹ World health report 2002. Reducing risks, promoting healthy life. Geneva, World Health Organization, 2002.

² Air quality guidelines for Europe. Copenhagen, World Health Organization Regional Office for Europe, 1987 (WHO Regional Publications, European Series, No. 23).

³ Air quality guidelines for Europe, 2nd ed. Copenhagen, World Health Organization Regional Office for Europe, 2000 (WHO Regional Publications, European Series, No. 91).

Available at http://www.euro.who.int/Document/E87950.pdf.

Role of the guidelines in protecting public health

The WHO air quality guidelines (AQGs) are intended for worldwide use but have been developed to support actions to achieve air quality that protects public health in different contexts. Air quality standards, on the other hand, are set by each country to protect the public health of their citizens and as such are an important component of national risk management and environmental policies. National standards will vary according to the approach adopted for balancing health risks, technological feasibility, economic considerations and various other political and social factors, which in turn will depend on, among other things, the level of development and national capability in air quality management. The guideline values recommended by WHO acknowledge this heterogeneity and, in particular, recognize that when formulating policy targets, governments should consider their own local circumstances carefully before adopting the guidelines directly as legally based standards.

The WHO AQGs are based on the now extensive body of scientific evidence relating to air pollution and its health consequences. Although this information base has gaps and uncertainties, it offers a strong foundation for the recommended guidelines. Several key findings that have emerged in recent years merit special mention. Firstly, the evidence for ozone (O_3) and particulate matter (PM) indicates that there are risks to health at concentrations currently found in many cities in measures (e.g. changes in lung function, inflammation markers). Therefore the updated guidelines could be based both on these sensitive indicators, in addition to the most critical population health indicators, such as mortality and unscheduled hospitalizations.

Thirdly, as our understanding of the complexity of the air pollution mixture has improved, the limitations of controlling air pollution through guidelines for single pollutants have become increasingly apparent. Nitrogen dioxide (NO₂), for example, is a product of combustion processes and is generally found in the atmosphere in close association with other primary pollutants, including ultrafine (UF) particles. It is itself toxic and is also a precursor of ozone, with which it coexists along with a number of other photochemically generated oxidants. Concentrations of NO₂ are often strongly correlated with those of other toxic pollutants, and being the easier to measure, is often used as a surrogate for the pollutant mixture as a whole. Achieving guideline concentrations for individual pollutants such as NO2 may therefore bring public health benefits that exceed those anticipated on the basis of estimates of a single pollutant's toxicity.

The present revision of the WHO *Air quality* guidelines for *Europe* provides new guideline values for three of the four pollutants examined. For two of them (particulate matter and ozone), it is pos-

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