United Nations ECE/EB.AIR/WG.1/2010/11

Economic and Social Council

Distr.: General
13 July 2010

Original: English

Economic Commission for Europe

Executive Body for the Convention on Long-range Transboundary Air Pollution

Working Group on Strategies and Review

Twenty-ninth session
Geneva, 22–24 September 2010
Item 4 of the provisional agenda
Recent results and updating of scientific and technical knowledge

Effects of Air Pollution on Health

Report by the Joint Task Force on the Health Aspects of Air Pollution[1]

I. Introduction

1. This report comprises the results of the discussion on health impacts of particulate matter (PM) and ozone held at the thirteenth session of the Joint Task Force on the Health Aspects of Air Pollution (Task Force on Health). It also provides a summary of other workplan items discussed by the Task Force on Health, which are presented in accordance with item 3.8 of the 2010 workplan for the implementation of the Convention on Long-range Transboundary Air Pollution (ECE/EB.AIR/99/Add.2) adopted by the Convention's Executive Body at its twenty-seventh session in December 2009.

2. The thirteenth meeting of the Task Force was held in Bonn, Germany, on 26 and 27 April 2010. Altogether 28 experts from 20 Parties to the Convention attended the meeting, which was chaired by a representative from the European Centre for Environment and Health of the World Health Organization (WHO). An observer from the European Commission (Directorate General Environment) attended the meeting as well.

[1] The Joint Task Force on the Health Aspects of Air Pollution of the World Health Organization's European Centre for Environment and Health and the Convention on Long-range Transboundary Air Pollution's Executive Body.

II. Workplan items common to all Programmes

A. Targets and ex post application

3. Current levels in the *WHO Air Quality Guidelines — Global Update 2005*[2] should be considered as the health-related targets for air quality. Considering that future, more sensitive studies may continue to reveal health effects at pollutant concentrations lower than the current guidelines, it is likely that these targets will refer to lower pollution levels in the future.

B. Robustness

4. The body of evidence on the health effects of particulate matter (PM) and ozone is increasing, supporting and strengthening the conclusions of the assessment presented in the *WHO Air Quality Guidelines — Global Update 2005*. Details of the progress are summarized in the following sections of this report.

C. Trends in selected monitored/modelled parameters

5. The European Topic Centre on Air and Climate of the European Environment Agency (EEA) maintains a database of results of air quality monitoring performed by national monitoring networks in Europe. Though focussed on European Union (EU) member States, the database is open to other countries, allowing for the most comprehensive evaluation of air quality, population exposure and their trends. The most recent data available for analysis relate to 2008 and cover 32 European countries. A small decrease of coarse PM (PM10) levels has been observed in 2007–2008 compared with the period 2000–2006. However, about 90 per cent of the urban population of Europe continues to live in cities where *WHO Air Quality Guidelines* levels for annual mean PM10 are exceeded. Monitoring of fine PM (PM2.5) is expanding and is conducted in about 500 locations. Monitoring of PM10 and PM2.5 is very limited in the countries in Eastern Europe, the Caucasus and Central Asia. Ozone levels tend to decrease in rural locations but increase in urban areas.

6. The analysis of the potential reduction of the health impacts of pollution (measured as years of life lost) indicates that the achievement of the exposure reduction target would benefit human health more, and in more countries, than compliance with the limit values only. The exposure reduction target has been introduced as a not legally binding parameter by EU Directive 2008/50/EC on Ambient Air Quality and Cleaner Air for Europe and follows the spirit of the *WHO Air Quality Guidelines*.

III. Ozone

7. The recent reports from research on the health effects of ozone, particularly epidemiological time series studies, have confirmed the association between that pollutant and daily mortality, independent of the effects of PM. Those studies confirm and strengthen the conclusions of the *WHO Air Quality Guidelines — Global Update 2005*. Recent observations in both North America and Europe have shown that as concentrations of ozone

[2] *WHO Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulfur dioxide — Global update 2005: Summary of risk assessment* (WHO/SDE/PHE/OEH/06.02).

increase (due to human activities or episodes of very hot weather), health effects become increasingly numerous and severe. Though there are only a few studies on effects of long term exposure to ozone, they suggest that chronic exposure increases the risk of adverse health effects, including experiencing asthma symptoms and asthma-related hospitalizations. The analysis of the American Cancer Society (ACS) cohort of 448,000 subjects followed during 18 years indicated effects of ozone on mortality independent of PM. In two-pollutant models, ozone was significantly associated with death from respiratory causes, and a concentration increase of 10 parts per billion (ppb) in long-term ozone level was estimated to increase respiratory mortality by 4 per cent. More research is needed to confirm effects of long-term exposure on respiratory outcomes.

8. New areas of research on health effects of ozone include the impacts on neurological effects (migraines, cognitive performance). Studies on pathological mechanisms by which ozone elicits effects have focused on effect modification by polymorphisms in antioxidant genes, molecular mechanisms associated with vascular disease and oxidation or interaction of surfactant and airway nerves.

IV. Particulate matter

9. Intensive research on the health effects of PM resulted in close to 500 research papers published in the last two years. This research continues to focus on the effects of PM on mortality and cardiopulmonary disease in children, adults and the elderly. Increased interest in the long-term effects has resulted in many epidemiological studies confirming that chronic exposure increases mortality and morbidity (heart disease, stroke, respiratory diseases) in the general population. This research confirmed and strengthened the conclusions of the *WHO Air Quality Guidelines — Global Update 2005*. The recent assessment of evidence conducted by the United States Environmental Protection Agency concluded that the relation of cardiovascular effects with short- and long-term exposure to PM2.5 is causal (earlier assessments classified this relation as “likely to be causal”). Associations of cardiovascular and respiratory effects with coarse fractions of PM (PM10-2.5), as well as with ultrafine particles, have been classified as “suggestive”.

10. Recent studies are increasingly utilising biomarkers (e.g., of oxidative stress, inflammation and coagulation) and investigating the interacting effects of temperature and humidity, socioeconomic deprivation, specific PM sources and composition, as well as spatial and temporal relationships. New studies also address reproductive outcomes (effects on preterm delivery and/or pre-eclampsia, cardiovascular malformations and foetal measurements). Negative neurological effects have also been associated with long-term exposure to PM. A study on the link between changes in life expectancy for persons in the United States during the 1980s and 1990s with exposure to air pollution concluded that the reductions in PM2.5 accounted for as much as 15 per cent of the overall increase in life expectancy.

11. Epidemiological studies into the heterogeneity of risk associated with specific PM components have investigated the role of elemental carbon, metals (e.g., vanadium, nickel, zinc), as well as size distribution and/or total number concentration of particles in contributing to cardiopulmonary morbidity. Studies using wood smoke, diesel exhaust, particles from tyre and break wear and concentrated airborne particles exposure have examined the mechanisms underlying the effects on reproductive health, the cardiac and central nervous systems, oxidative stress and molecular alterations associated with airway and vascular disease. Toxicological studies have focused on the particle size and metal component of samples. The results indicate that a broad range of chemical and physical characteristics of particles play a role in generating health effects related to mass concentration of PM10 or PM2.5.

12. The Netherlands has undertaken a systematic analysis of available evidence to assess if black smoke, measured by reflectometric methods, could be a health-relevant indicator of air pollution from combustion sources additional to PM10 or PM2.5 mass concentration. Preliminary results confirmed that that that indicator could be a sensitive health- and policy-relevant exposure metric to assess the health effects of traffic-related air pollution and to assess the effectiveness of traffic-related policy measures. However, the specificity of black smoke for health effects attributable to PM needs to be further evaluated.

V. Reporting on monitoring and modelling of health effects of air pollution

13. To assure the comparability of the results from air quality monitoring conducted by various national networks, intercomparison of methods for assessment of concentrations of inorganic gaseous pollutants is routinely performed. It is carried out by the WHO Collaborating Centre for Air Quality Management and Air Pollution Control at the Federal Environment Agency in Berlin, Germany, together with the European Commission's Joint Research Centre (JRC) in Ispra, Italy, managing the AQUILA network of national laboratories in the EU. A JRC mobile monitoring unit is used for intercomparison field campaigns of PM10 and PM2.5 measurements at local PM stations in Europe. National networks from all member States in the WHO European Region can join that programme.

14. Results of air quality monitoring conducted by many national or local monitoring networks are published on a daily basis on the Internet, sometimes in real time. That information has a strong communication value and is especially useful in the periods of increased air pollution or events potentially affecting it (such as a plume of volcanic ash or of pollution due to forest fires). Unfortunately, there is little coordination on the format, contents and interpretation of the data disseminated, in particular in relation to the interpretation of the health significance of the observed air pollution. The Task Force could initiate harmonization of the health-related messages concerning monitored air quality.

15. The Task Force discussed the methods of the health impact assessment (HIA) planned to support the revision of the 1999 Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone (Gothenburg Protocol) and the Directive 2001/81/EC of the European Parliament and the Council on National Emission Ceilings for certain pollutants (NEC Directive). It confirmed, in general, the validity of the approaches, using the inputs from the greenhouse gas and air pollution interactions and synergies (GAINS) model. PM2.5 and ozone were the two pollutants for which health impacts should be quantified. Cause-specific (cardiovascular, respiratory and lung cancer) estimates should be considered next to the all-cause mortality as a part of sensitivity analysis. The use of risk coefficients for PM2.5 from ACS is well justified as the study is based on the largest sample and has been a subject of thorough review and reanalysis. Support for its use was provided by the largest European cohort study to date (Dutch NLCS-AIR)[3], which gives a risk estimate for all-cause mortality close to that from the ACS study. The ozone HIA estimates should be based on the SOMO35 indicator (annual sum of daily maximum mean eight-hour concentrations above 35 ppb), even though health impacts of ozone may occur at levels below 35 ppb.

16. Several ongoing European and global projects have analysed the health impacts of outdoor air pollution, in particular the European Aphekom project and the WHO Global

[3] Beelen R., Hoek G., van den Brandt P.A., Goldbohm R. A., Fischer P., Schouten L. J., et al., "Long-Term Effects of Traffic-Related Air Pollution on Mortality in a Dutch Cohort" (NLCS-AIR Study), *Environmental Health Perspectives*, 116:196-202, 2008.

Burden of Disease project. More detailed HIA methods might be needed to address the variability of exposure, and health effects, on a small geographical scale, e.g., to estimate impacts of specific local pollution sources, in particular road traffic and residential heating with solid fuels (wood, coal). Agreement between the various HIA teams on the use of the most recent results of research, increasing robustness of the models used and increasing the precision of the HIA estimates would require a focused, well prepared expert discussion or workshop to develop a consensus on methods. Furthermore, there was a need to extend the analysis to countries in Eastern Europe, the Caucasus and Central Asia. That would require review and update of the GAINS model input data.

VI. Persistent organic pollutants

17. Following the request of the Working Group on Strategies and Review that it contribute to the hazard assessment of the five new substances considered for inclusion to the 1998 Protocol on persistent organic pollutants (POPs) — namely endosulfan, dicofol and hexabromocyclododecane, pentachlorophenol and trifluralin — the Task Force prepared a document based on evidence reviews preformed by international and national agencies. Taking into account the decisions made by the Executive Body at its twenty-seventh session in December 2009, and in particular its agreement to consider endosulfan, dicofol, hexabromocyclododecane and trifluralin as POPs, the review was presented in the form of additional information for the Parties to the Convention in preparing further details of the revised Protocol, in particular the management options of the new POPs. Participants of the Task Force were invited to provide any additional comments or additions to the hazard review.

VII. Cross-cutting issues

18. The discussion on the studies on impacts of various air pollution management options on health highlighted several completed studies demonstrating improvement of health following reduction of exposure to air pollution. Several further studies were being conducted in Europe and the United States. The Task Force confirmed the importance of such studies to support policymaking.

19. Based on the results of a special workshop convened by the Health Effects Institute in December 2009, the Task Force pointed to the methodological complexity of such studies and the potentially low sensitivity of small, local studies. Careful examination of the exposure contrasts, resulting from intervention as the first step of the study, was necessary. Reliable air quality monitoring networks were essential for that task. Interventions resulting in an abrupt change in air quality provided the best opportunity to assess their impact. Opportunities for coordinated (“pooled”) studies of the same action in multiple locations or time-periods should be explored. A system, or clearing house, to identify and disseminate information about planned actions, as well as anticipation of the wide-scale national and international regulatory actions would greatly enhance such opportunities.