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Working Group on Effects

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HEALTH RISKS OF HEAVY METALS FROM LONG-RANGE TRANSBOUNDARY AIR POLLUTION

Report by the joint Task Force on the Health Aspects of Air Pollution of the World Health Organization (WHO)/European Centre for Environment and Health (ECEH) and the Executive Body

INTRODUCTION

1. The ninth meeting of the Task Force on the Health Aspects of Air Pollution was held in Berlin on 30–31 May 2006. Twenty-eight experts from 15 Parties to the Convention attended the meeting. The Chairman of the Working Group on Effects and the UNECE secretariat also attended the meeting, as well as WHO staff. Mr. M. Krzyzanowski (WHO/ECEH) chaired the meeting.

I. HEAVY METALS

2. Preliminary assessment of the health risks of heavy metals from long-range transboundary air pollution (LRTAP) was conducted in 2002. The draft report was revised by the previous meeting of the Task Force using new scientific evidence, such as effects of low levels of exposures, particularly in susceptible population groups. In addition, the Task Force took into account recent decreases in emissions, current environmental levels and the latest evidence from biomarkers of population exposure, including concentration levels in blood (lead, mercury and cadmium), urine (cadmium) and hair (mercury).

3. Cadmium (Cd), lead (Pb) and mercury (Hg) are common air pollutants emitted into the air from various industrial activities and, in particular lead, from traffic. This report reviews their sources and the spatial distributions of concentrations and deposition from LRTAP and evaluates potential health effects.

A. <u>Cadmium</u>

4. Kidneys and bones are the critical target organs after environmental exposure. The main critical effects include (a) increased excretion of low-molecular-weight proteins in urine as a result of proximal tubular cell damage and (b) increased risk of osteoporosis. An increased risk of lung cancer has also been reported following inhalation exposure in occupational settings.

5. The margin of safety between the daily intake of cadmium in the diet with no effects and the intake which can result in effects is very narrow, and for highly exposed subpopulations even non-existent. Population groups at risk include the elderly, diabetics and smokers. Women may be at increased risk because, due to their lower iron stores, they absorb more cadmium than men at the same level of exposure.

6. Food is the main source of cadmium exposure in the general population (more than 90% of the total intake in non-smokers). In heavily contaminated areas, resuspension of dust can constitute a substantial part of crop contamination and exposure via inhalation and digestion.

7. Annual inputs from LRTAP and mineral and organic fertilizers to topsoil are roughly of the same magnitude. They all continue to contribute to the already accumulated, often relatively large store of cadmium in the topsoil.

8. Despite decreasing cadmium emissions, ambient air concentrations and deposition, the recently published data do not show decreases of cadmium body burdens in non-smokers during the last decade. The studies of cadmium balance in top layers of arable soil indicate that the cadmium supply still exceeds removal. Cadmium is accumulating in soils and catchments under certain environmental conditions, thus increasing the risk of future exposure through food. Therefore, considering the narrow margin of safety, every effort should be made to further reduce cadmium emissions to the atmosphere and other inputs of cadmium to the soil.

B. Lead

9. Lead is a well-known neurotoxic metal. Impairment of neurodevelopment in children is the most critical lead effect. Exposure in the uterus, during breastfeeding and in early childhood may all be responsible for the effects. Lead accumulates in the skeleton, and its mobilization from bones during pregnancy and lactation causes exposure to the foetus and breastfed infants. Hence a woman's lifetime exposure to lead before pregnancy is important.

10. Epidemiological studies show consistently that effects in children are associated with lead levels in blood (Pb-B) of about 100–150 µg/l. There are indications that lead is harmful even at blood concentrations considerably below 100 µg/l and that there may be no threshold for the effects.

11. In many areas there has been a major decrease of Pb-B levels in recent decades, mainly because of phasing out of leaded petrol, but also owing to reductions in other sources of exposure. The current lowest average Pb-B level in several European countries is about 20 µg/l; however, reliable information on Pb-B levels is lacking for many parts of Europe.

12. The relative contribution of sources depends on local conditions. Food is the dominating source of lead uptake in the general population. Ingestion of contaminated soil, dust and lead-based (old) paint due to hand-to-mouth activities may also be an important source of lead intake for infants and young children. When tap water systems with leaded pipes are used, lead intake via drinking water can be an important source, especially for children. Inhalation exposure may be significant when lead levels in air are high.

13. Lead levels in ambient air have decreased during the last decades; between 1990 and 2003, lead levels in air in Europe decreased 50–70%. Similar decreases have been observed in the atmospheric deposition.

14. Annual lead inputs due to LRTAP and mineral and organic fertilizers to topsoils have roughly the same magnitudes, varying between countries and depending on agricultural activities. Those inputs are relatively small in comparison to stores already accumulated and due to natural sources and resuspension. However, the LRTAP may contribute significantly to the lead contents of crops through direct deposition. Though uptake via roots is relatively small, in the long term the rise of lead levels in soils is a matter of concern and should be avoided due to the possible health risks of low-level lead exposure. Lead emissions to the atmosphere should therefore be kept as low as possible.

C. Mercury

15. Emissions of mercury to the air from both anthropogenic and natural sources are in the inorganic form, which can be biologically converted to methylmercury in soil and water. Methylmercury bioaccumulates and enters the human body readily via the dietary route.

16. Airborne concentrations of mercury in Europe, and also globally, are generally well below levels known to cause adverse health effects from inhalation exposure. Concentrations of inorganic mercury species in surface and groundwater are generally well below levels known to cause adverse health effects from drinking water.

17. Methylmercury is a potent neurotoxic chemical. Unborn children (i.e. foetuses) are the most susceptible population group and are exposed to this chemical mainly from fish in the diet of the mother. Methylmercury is also excreted in mother's milk. Human biomonitoring and diet modelling data indicate that tolerable dietary intakes of methylmercury are exceeded among subpopulations that consume large amounts of fish – for example, in Scandinavia, North America and France. For several species of (mainly large predatory) freshwater and marine fish and mammals the mercury level of 0.5 mg/kg, a value used as a guideline in many countries, is often exceeded.

18. Historical data (e.g. lake sediments from Scandinavia) show a two-to-fivefold increase in mercury concentrations compared to the pre-industrial era, reflecting anthropogenic emissions and long-range transport. Methylmercury in freshwater fish originates from inorganic mercury in the soil and direct atmospheric deposition. Anthropogenic emissions of mercury in Europe have decreased by approximately 50% since 1990. A similar decrease is predicted by modelling and limited monitoring data on mercury deposition in Europe. However, a concomitant decrease in the concentration of methylmercury in freshwater fish has not been observed.

19. Little information is available on the provenance of methylmercury in marine fish and on the contribution of long-range transport to the process. Evidence exists on increasing levels of mercury in marine fish and mammals in the Arctic, indicating the impact of long-range transport. In general, fish consumption has important health benefits. However, in some populations consuming large amounts of fish, or contaminated fish, the intake of methylmercury may reach hazardous levels. Thus decreasing the concentrations in fish should be treated as a high priority. Reducing emissions to the atmosphere and long-range transport of pollution is a means of reaching this aim.

II. UPDATE OF AIR QUALITY GUIDELINES

20. The process and results of the update of the WHO air quality guidelines was presented by a representative of WHO and discussed by the Task Force. The work in WHO in 2005 had resulted in recommendations on numerical guidelines for particulate matter (PM) (annual mean concentrations of 10 µg/m³ for the fine fraction PM2.5 and 20 µg/m³ for the coarse fraction

PM10), updated the guideline level for ozone (O_3) (to 100 µg/m³ as the maximum daily eight-hour average), retained the guideline value for nitrogen dioxide (NO_2) (annual average of 40 µg/m³) and significantly changed the guideline value for sulphur dioxide (SO_2) by establishing 20 µg/m³ as the 24-hour average. The meeting report is available as a WHO document at http://www.euro.who.int/Document/E87950.pdf. The Task Force recognized that these guidelines provided an important input to the Convention's work. They defined the air quality targets to be achieved everywhere in order to significantly reduce the adverse health effects of the pollution.

III. PERSISTENT ORGANIC POLLUTANTS (POPs)

21. The Co-Chair of the Task Force on Persistent Organic Pollutants had drawn attention to the Executive Body's decision 1998/2, paragraph 2(b). The Task Force on the Health Aspects of Air Pollution agreed to discuss the contents of the text.

22. The Task Force recognized that, according to the overall objectives of the Protocol on POPs and its text, actual observed health effects were not prerequisites for inclusion of a pollutant. The likelihood of such effects due to the potential of build-up in the environment and bioaccumulation of the levels was deemed to be sufficient reason for inclusion.

IV. ACTIVITIES IN EECCA COUNTRIES

23. Improvement of air quality is among the key objectives of the environmental strategy for countries in Eastern Europe, Caucasus and Central Asia (EECCA) adopted by the fifth Ministerial Conference "Environment for Europe" in 2003. The Task Force discussed the report on progress in achieving the objectives of the strategy stemming from a regional meeting convened by the Organisation for Economic Co-operation and Development in May 2006. The report confirmed that little progress had been achieved in improving air quality in the region. The problems identified by the strategy were still unresolved. The main problem identified was the lack or weakness of implementation mechanisms for the existing and sometimes recently updated legislation.

24. Participation by experts and representatives of the Parties to the Convention from EECCA in the Task Force's work was financially supported by the Government of Germany. The Task Force encouraged Parties in EECCA to participate actively in the Convention's activities.

25. The Task Force expressed concern regarding the air quality situation in the EECCA countries. It recommended continuing efforts to strengthen collaboration regarding air quality and reduction of emissions of air pollutants in the countries.

V. INPUT FOR THE REVIEW OF THE GOTHENBURG PROTOCOL

26. The Executive Body had asked its subsidiary bodies to support the review of the 1999 Gothenburg Protocol. The Task Force noted that it had provided information on the health impacts of particulate matter and ozone and would make necessary updates. It also agreed to provide requested information to the Expert Group on Particulate Matter, including its recent WHO report "Health risks of particulate matter from long-range transboundary air pollution" (available at http://www.euro.who.int/document/E88189.pdf).