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Mercury

Assessing the environmental burden of disease at national and local levels

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A Microsoft Excel spreadsheet for calculating the estimates described in this document can be obtained from WHO/PHE. E-mail contact: EBDassessment@who.int

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Preface

The disease burden of a population and how that burden is distributed across different subpopulations (e.g. infants, women), are important pieces of information for defining strategies to improve population health. For policy-makers, disease burden estimates provide an indication of the health gains that could be achieved by targeted action against specific risk factors. The measures also allow policy-makers to prioritize actions and direct them to the population groups at highest risk. To help provide a reliable source of information for policy-makers, WHO analysed 26 risk factors worldwide in the *World Health Report* (WHO, 2002).

The Environmental Burden of Disease (EBD) series continues this effort to generate reliable information, by presenting methods for assessing the environmental burden of mercury at national and local levels. The methods in the series use the general framework for global assessments described in the *World Health Report* (WHO, 2002). The introductory volume in the series outlines the general method (Prüss-Üstün et al., 2003), while subsequent guides address specific environmental risk factors. The guides on specific risk factors are organized similarly, first outlining the evidence linking the risk factor to health, and then describing a method for estimating the health impact of that risk factor on the population. All the guides take a practical, step-by-step approach and use numerical examples. The methods described in the guides can be adapted both to local and national levels, and can be tailored to suit data availability.

This document was reviewed in Geneva at the Informal preparatory meeting for the Chemical Task Force of the Foodborne Disease Epidemiology Reference Group (FERG), held by the World Health Organization Department of Food Safety, Zoonoses, and Foodborne Diseases on 29 June 2007. For a list of invited experts and other attendees, see Appendix 1.

Affiliations and acknowledgements

Herman Gibb and Jessie Poulin are from Sciences International, Alexandria, USA, and Annette Prüss-Üstün is from the World Health Organization.

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Glossary and abbreviations

ATSDR	Agency for Toxic Substances and Disease Registry
CI	Confidence interval
DALYs	Disability-Adjusted Life Years
DHA	Docosahexaenoic acid
EPA	Eicosapentaenoic acid
IPCS	International Programme on Chemical Safety
IOM	Institute of Medicine
IQ	Intelligence Quotient
µg	Micrograms
MMR	Mild mental retardation
NRC	National Research Council
OR	Odds ratio
PTWI	Provisional tolerable weekly intake
RfD	Reference dose
RR	Relative risk
US EPA	Environmental Protection Agency of the USA
WHO	World Health Organization
WISC	Wechsler Intelligence Scales for Children

Summary

This document provides a review of the health effects of elemental, inorganic, and methylmercury and methods for estimating the burden of disease for methylmercury. Elemental mercury can cause a variety of health effects. Methylmercury has been associated with adult neurological problems, and there is some evidence that methylmercury exposure affects the adult cardiovascular system. However, the data for these effects are insufficient for a quantitative analysis. As a result, the quantitative aspect of this report focuses on the neurodevelopmental toxicity of methylmercury.

Cognitive deficits in infants are represented as IQ point deficits caused by prenatal exposure to methylmercury. The disease burden is assessed using the distribution of hair mercury concentrations among pregnant women or women of childbearing age as a measure of infant exposure. Although small IQ deficits may not be visible on an individual basis, they can be significant in a population with high exposure or among those affected by endemic diseases that impair neurological function. IQ deficits have the greatest population impact among children with IQ scores just above 69 points, for whom lowered IQ score would result in mild mental retardation (defined as an IQ between 50 and 69 points). The rate of mild mental retardation caused by methylmercury-related IQ loss and the resulting number of disability-adjusted life years (DALYs) lost are calculated from the exposure distribution. DALYs measure the health impact in a population as the number of healthy years of life lost based on the severity and length of the illness.

This report estimates the disease burden for several populations, including subsistence fishers, sport fishers, and indigenous communities near industrial and mining activities. The incidence rate for mild mental retardation is estimated to be as high as 17.37 per 1000 infants born among a subsistence fishing population in the Amazon, resulting in a loss of 202.8 disability-adjusted life years per 1000 infants. Due to the lack of exposure data from representative populations in the various regions throughout the world, the global burden of disease could not be estimated. Quantification of the disease burden in subpopulations for which exposure is known, however, provides an important basis for targeting populations at risk for significant health deficits.

Because elemental mercury can be transported long distances in air, regions with little or no mercury emissions may have high environmental mercury levels. Minimizing the amount of mercury emitted into the environment to reduce methylmercury concentrations in fish and seafood requires global cooperation. Furthermore, some elemental mercury is emitted as a result of natural processes (e.g. volcanoes, forest fires). Thus, reducing the consumption of seafood with high methylmercury concentrations is the most direct way to reduce the risk of methylmercury-related cognitive deficits in a highly exposed population. However, consumption recommendations must also consider the nutritional value of fish and shellfish, particularly in populations without access to alternative sources of protein. Additionally, there is evidence that omega-3 fatty acids in fish and shellfish have a beneficial effect on neurodevelopment. The risks and benefits of fish consumption depend on the amount and species of fish consumed and must be weighed carefully for each subgroup in the population.