

# **Manganese in drinking-water**

**Background document for development of  
WHO *Guidelines for drinking-water quality***

This document replaces document reference number WHO/SDE/WSH/03.04/02



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## Preface

Access to safe drinking-water is essential to health, a basic human right and a component of effective policy for health protection. A major World Health Organization (WHO) function to support access to safe drinking-water is the responsibility “to propose ... regulations, and to make recommendations with respect to international health matters ...”, including those related to the safety and management of drinking-water.

The first WHO document dealing specifically with public drinking-water quality was published in 1958 as *International standards for drinking-water*. It was revised in 1963 and 1971 under the same title. In 1984–1985, the first edition of the WHO *Guidelines for drinking-water quality* (GDWQ) was published in three volumes: Volume 1, Recommendations; Volume 2, Health criteria and other supporting information; and Volume 3, Surveillance and control of community supplies. Second editions of these volumes were published in 1993, 1996 and 1997, respectively. Addenda to Volumes 1 and 2 of the second edition were published in 1998, addressing selected chemicals. An addendum on microbiological aspects, reviewing selected microorganisms, was published in 2002. The third edition of the GDWQ was published in 2004, the first addendum to the third edition was published in 2006, and the second addendum to the third edition was published in 2008. The fourth edition was published in 2011, and the first addendum to the fourth edition was published in 2017.

The GDWQ are subject to a rolling revision process. Through this process, microbial, chemical and radiological aspects of drinking-water are subject to periodic review, and documentation relating to aspects of protection and control of drinking-water quality is accordingly prepared and updated.

Since the first edition of the GDWQ, WHO has published information on health criteria and other information to support the GDWQ, describing the approaches used in deriving guideline values, and presenting critical reviews and evaluations of the effects on human health of the substances or contaminants of potential health concern in drinking-water. In the first and second editions, these constituted Volume 2 of the GDWQ. Since publication of the third edition, they comprise a series of free-standing monographs, including this one.

For each chemical contaminant or substance considered, a background document evaluating the risks to human health from exposure to that chemical in drinking-water was prepared. The draft health criteria document was submitted to a number of scientific institutions and selected experts for peer review. The draft document was also released to the public domain for comment. Comments were carefully considered and addressed, as appropriate, taking into consideration the processes outlined in [Policies and procedures used in updating the WHO guidelines for drinking-water quality](#) and the WHO [Handbook for guideline development](#).

The revised draft was submitted for final evaluation at expert consultations.

During preparation of background documents and at expert consultations, careful consideration was given to information available in previous risk assessments carried out by the International Programme on Chemical Safety, in its Environmental Health Criteria monographs and Concise International Chemical Assessment Documents; the International Agency for Research on Cancer; the Joint Food and Agriculture Organization of the United Nations (FAO)/WHO Meeting on Pesticide Residues; and the Joint FAO/WHO Expert Committee on Food Additives (which evaluates contaminants such as lead, cadmium, nitrate and nitrite, in addition to food additives).

Further up-to-date information on the GDWQ and the process of their development is available on the WHO website and in the current edition of the GDWQ.

## Acknowledgements

The background document on manganese in drinking-water for the development of the World Health Organization (WHO) [\*Guidelines for drinking-water quality\*](#) (GDWQ) was initially prepared by Dr Ruth Bevan, independent consultant, United Kingdom, and was finalized by Dr Jane MacAulay and Ms Andrea Cherry, Health Canada, Canada, under the coordination of WHO as described further below.

The work of the following experts was crucial in the development of this document and others in the second addendum to the fourth edition:

Dr M Asami, National Institute of Public Health, Japan  
Dr RJ Bevan, independent consultant, United Kingdom  
Mr R Carrier, Health Canada, Canada  
Dr J Cotruvo, Joseph Cotruvo & Associates and NSF International WHO Collaborating Centre, United States of America  
Dr D Cunliffe, South Australian Department of Health, Australia  
Dr L d'Anglada, Environmental Protection Agency, United States of America  
Dr A Eckhardt, Umweltbundesamt (Federal Environment Agency), Germany  
Professor JK Fawell, Cranfield University, United Kingdom  
Dr A Hirose, National Institute of Health Sciences of Japan  
Dr A Humpage, University of Adelaide (formerly South Australian Water Corporation), Australia  
Dr P Marsden, Drinking Water Inspectorate, United Kingdom  
Professor Y Matsui, Hokkaido University, Japan  
Dr E Ohanian, Environmental Protection Agency, United States of America  
Professor CN Ong, National University of Singapore, Singapore  
Dr J Strong, formerly Environmental Protection Agency, United States of America  
Dr E Testai, National Institute of Health, Italy

The draft text was discussed at the expert consultations for the second addendum to the fourth edition of the GDWQ, including on 28–30 March 2017, 13–14 July 2018 and 2 March 2021. The final version of the document takes into consideration comments from both peer reviewers and the public, including P Aggett, Emeritus University of Central Lancashire, United Kingdom; C Alzamora, International Manganese Institute, France; V Bhat, formerly NSF International, United States of America; P Brandhuber, Brandhuber Water Quality & Treatment, United States of America; H Costa, Departamento da Qualidade, Portugal; J Donohue, Environmental Protection Agency, United States of America; JO Falkinham, Virginia Tech, United States of America; J Hunt, Drinking Water Inspectorate, United Kingdom; WR Knocke, Virginia Tech, United States of America; B Lampe, NSF International, United States of America; D Lee, PUB, Singapore; L Lejon, Flemish Agency for Care and Health, Belgium; O Loebel, European Federation of National Association of Water Services, Belgium; C Nishida, WHO, Switzerland; S Robjohns, Public Health England, United Kingdom; L Rogers, WHO, Switzerland; J Tobiason, University of Massachusetts Amherst, United States of America; and M Valcke, Institut National de Santé Publique du Québec, Canada.

The coordinator was Ms J De France, WHO. Strategic direction was provided by Mr B Gordon, WHO. Dr E Petersen and Dr S Madsen provided liaisons with the Joint FAO/WHO Expert Committee on Food Additives and the Joint FAO/WHO Meeting on Pesticide Residues. Dr R Brown and Ms C Vickers, WHO, provided liaisons with the International Programme on Chemical Safety. Dr M Perez contributed on behalf of the WHO Radiation Programme. Dr A Faragher, Biotext, Australia, was responsible for the scientific editing of the document.

Many individuals from various countries contributed to the development of the GDWQ. The efforts of all who contributed to the preparation of this document are greatly appreciated.

## Acronyms and abbreviations

bw	body weight
CI	confidence interval
CNS	central nervous system
EFSA	European Food Safety Authority
GABA	gamma-aminobutyric acid
GI	gastrointestinal
GV	guideline value
LD <sub>50</sub>	The dose of a chemical that has been calculated to cause death in 50% of a defined experimental animal population
MMT	methylcyclopentadienyl manganese tricarbonyl
Mn	manganese
LOAEL	lowest-observed-adverse-effect level
NOAEL	no-observed-adverse-effect level
OR	odds ratio
PM <sub>2.5</sub>	particulate matter less than or equal to 2.5 µm in diameter
PM <sub>10</sub>	particulate matter less than or equal to 10 µm in diameter
PND	postnatal day
TDI	tolerable daily intake
UF	uncertainty factor
USA	United States of America
WHO	World Health Organization



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