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List of abbreviations:

AI – Adequate daily intake

IOM – Institute of Medicine

LOAEL – Lowest observed adverse effect level

LSRO – Life Science Research Organisation

NOAEL – No observed adverse effect level

SCF – Scientific Committee on Food, European Commission

TDI – Tolerable daily intake

UL – Upper limit

U.S. EPA – U.S. Environmental Protection Agency

WHO – World Health Organisation

Section headings:

Abstract

Introduction

The current manganese guideline value for drinking water quality

How the NOAEL for manganese was established

Manganese metabolism in children

Neurotoxicity of manganese

Infant exposure to manganese

Upper limit and adequate daily intake of manganese for infants

Maximum value for manganese in infant formula

Rounding up

Time to re-evaluate the current guideline values for drinking water?

List of References

Table 1.

Table 2.

Abstract

Objective: To review the scientific background for the current health based WHO guideline value for manganese in drinking water.

Data sources and extraction: The initial starting point was the background document for the development of WHO's guideline value for manganese in drinking water as well as other regulations and recommendations on manganese intake levels. Data referred to in these documents were traced back to the original research papers. In addition, we searched for scientific reports on manganese exposure and health effects.

Data synthesis: The current health-based guideline value for manganese in drinking water is partly based on debatable assumptions, where information from previous reports has been used without re-visiting original scientific articles. At present, preparation of common infant formulas with water containing manganese concentrations equivalent to the WHO guideline value will result in exceeding the maximum manganese concentration for infant formula. However, there are uncertainties about how this maximum value was derived. Concurrently, there is increasing evidence of negative neurological effects in children from excessive manganese exposure.

Conclusions: The increasing number of studies reporting associations between neurological symptoms and manganese exposure in infants and children, in combination with the questionable scientific background data used in setting the manganese guideline value for drinking water, certainly warrant a re-evaluation of the guideline value. Further research is

needed to understand the causal relationship between manganese exposure and children's health, and to enable an improved risk assessment.