

## Exposure to mercury from dental amalgams: a threat to society

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The intention of this article is to call the reader's attention to the underestimated, yet very serious issue of chronic exposure to elemental mercury from dental amalgams.

Dental amalgam is an alloy used for tooth fillings that contains about 50 % of elemental mercury and has been used in hundreds of millions of patients for the last 160 years throughout the world (1). According to the 2001-2004 statistics, 181.1 million people in the US have 1.46 billion restored teeth, mostly with dental amalgam (2). As its use continues in dentistry, it is quite likely that the rate of exposure to mercury keeps increasing. Additionally, mercury is used as a preservative or antiseptic in pharmaceutical and cosmetic products and is present in the human food chain, especially in fish.

With each chewing and brushing of the teeth, dental amalgam releases low levels of elemental mercury, but due to its properties it goes undetected by the exposed person. It is generally considered safe for adults and children above six years of age by regulatory bodies such as the US Food and Drug Administration (US FDA). However, more and more evidence suggests that mercury-containing dental materials could be a source of chronic exposure to mercury (3). It is estimated that 30  $\mu\text{g}$  of mercury particles per  $\text{cm}^2$  of dental amalgam is released every day (4). The risk of exposure is greater in persons having more than one filling, and mercury toxicity is greater than that of lead. According to the World Health Organization (WHO) (5) no level of mercury exposure can be considered harmless. Furthermore, the WHO believes that dental amalgam accounts for 84 % of daily exposure to mercury.

Mercury release from dental amalgam has become a major risk factor for a number of diseases. It has been evidenced to produce neurological and renal impairments (6-8). It binds to the sulphhydryl groups of enzymes and may have toxic effects on the cardiovascular, gastrointestinal, respiratory, and reproductive system (7, 9). Epidemiological studies also suggest that mercury from amalgams may be harmful for humans and responsible for several chronic diseases (10). A cohort study in Swedish women established a link between mercury release and myocardial infarction, stroke, diabetes, and cancer (11). A study in humans conducted by Sandborough-Englund et al. (12) found high mercury concentrations in biological fluids such as plasma, blood, and urine of a population with dental amalgams.

Harmful effects of mercury from dental amalgams are in fact unavoidable. Its release is enhanced by chewing, brushing, and changes in the pH of saliva (13). In a study by Pizzichini et al. (14) mercury in the saliva lowered total antioxidant activity (TAA) and caused a number of diseases. A number of studies have proved that mercury released from dental amalgam reacts with many other metals to yield different bonds that generate reactive oxygen species and increase oxidative stress (14-16).

The effects of mercury after release from dental amalgam or other sources may affect human life very badly (17), and every action is called for to minimize human exposure (18).

Unfortunately, in general medical practice, no physician seeks to rule out mercury poisoning when they are trying to establish the cause of a chronic disease or other diagnosis. This is of course the case

with many environmental toxic substances that humans may be exposed to in concentrations high enough to cause chronic illnesses. The WHO has seriously taken the issue of monitoring mercury toxicity and has set a goal for mercury-free healthcare by the year 2020 (19). This is why we believe that the issue of mercury use in dental amalgam should not be underestimated. We hope that future epidemiological and evidence-based studies will convince health professionals about the role of mercury in causing human chronic diseases and health decision-makers to take appropriate action to replace mercury-containing amalgams with non-toxic compounds. Therefore, we hope that research shall take this direction as soon as possible.

#### REFERENCES

- Lorscheider FL, Vimy MJ, Summers AO. Mercury exposure from "silver" tooth fillings: emerging evidence questions a traditional dental paradigm. *FASEB J* 1995 ;9: 504-8.
- Richardson G, Wilson R, Allard D, Purtill C, Douma S, Gravière J. Mercury exposure and risks from dental amalgam in the US population, post-2000. *Sci Total Environ* 2011;409:4257-68. doi: 10.1016/j.scitotenv.2011.06.035
- Vimy MJ, Lorscheider FL. Intra-oral air mercury released from dental amalgam. *J Dent Res* 1985;64:1069-71. PMID: 3860538
- Brune D, Evje DM. Man's mercury loading from a dental amalgam. *Sci Total Environ* 1985;44:51-63. PMID: 4023695
- Grandjean P, Weihe P, White RF, Debes F. Cognitive performance of children prenatally exposed to "safe" levels of methylmercury. *Environ Research* 1998;77:165-72.
- Counter SA, Buchanan LH. Mercury exposure in children: a review. *Toxicol Appl Pharmacol* 2004;198:209-30. PMID: 15236954
- Nylander M, Friberg L, Lind B. Mercury concentrations in the human brain and kidneys in relation to exposure from dental amalgam fillings. *Swed Dent J* 1987;11:179-87. PMID: 3481133
- Barregård L, Svalander C, Schütz A, Westberg G, Sällsten G, Blohmé I, Mölne J, Attman PO, Haglind P. Cadmium, mercury, and lead in kidney cortex of the general Swedish population: a study of biopsies from living kidney donors. *Environ Health Perspect* 1999;107:867-71. PMID: 10544153
- Houston MC. Role of mercury toxicity in hypertension, cardiovascular disease, and stroke. *J Clin Hypertens* 2011; 13:621-7. doi: 10.1111/j.1751-7176.2011.00489.x
- Mackert J, Berglund A. Mercury exposure from dental amalgam fillings: absorbed dose and the potential for adverse health effects. *Crit Rev Oral Biol Med* 1997;8:410-36. doi: 10.1177/10454411970080040401
- Ahlqvist M, Bengtsson C, Lapidus L. Number of amalgam fillings in relation to cardiovascular disease, diabetes, cancer and early death in Swedish women. *Community Dent Oral Epidemiol* 1993;21:40-4. doi: 10.1111/j.1600-0528.1993.tb00717.x
- Sandborgh-Englund G, Elinder C-G, Langworth S, Schütz A, Ekstrand J. Mercury in biological fluids after amalgam removal. *J Dent Res* 1998;77:615-24. doi: 10.1177/00220345980770041501
- Brune D, Evje DM. Man's mercury loading from a dental amalgam. *Sci Total Environ* 1985;44:51-63. PMID: 4023695
- Pizzichini M, Fonzi M, Sugherini L, Fonzi L, Gasparoni A, Comporti M, Pompella A. Release of mercury from dental amalgam and its influence on salivary antioxidant activity. *Sci Total Environ* 2002;284:19-25. PMID: 11846163
- Stohs S, Bagchi D. Oxidative mechanisms in the toxicity of metal ions. *Free Radic Biol Med* 1995;18:321-36. PMID: 7744317
- Messer RL, Lockwood PE, Tseng WY, Edwards K, Shaw M, Caughman GB, et al. Mercury (II) alters mitochondrial activity of monocytes at sublethal doses via oxidative stress mechanisms. *J Biomed Mater Res B Appl Biomater* 2005;75: 257-63.
- Mostafalou S, Abdollahi M. Environmental pollution by mercury and related health concerns: renote of a silent threat. *Arh Hig Rada Toksikol* 2013;64:179-81. doi: 10.2478/10004-1254-64-2013-2325
- Sowlat MH, Abdollahi M, Gharibi H, Yunesian M, Rastkari N. Removal of vapor-phase elemental mercury from stack emissions with sulfur-impregnated activated carbon. *Rev Environ Contam Toxicol* 2014;230:1-34. doi: 10.1007/978-3-319-04411-8\_1
- WHO. WHO calls for the phase out of mercury fever thermometers and blood pressure measuring devices by 2020 [displayed 29 July 2014]. Available at: <http://www.who.int/mediacentre/news/notes/2013/mercury-medical-devices-20131011/en/>

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