

# Potential health effects of amalgam fillings: a structured literature review



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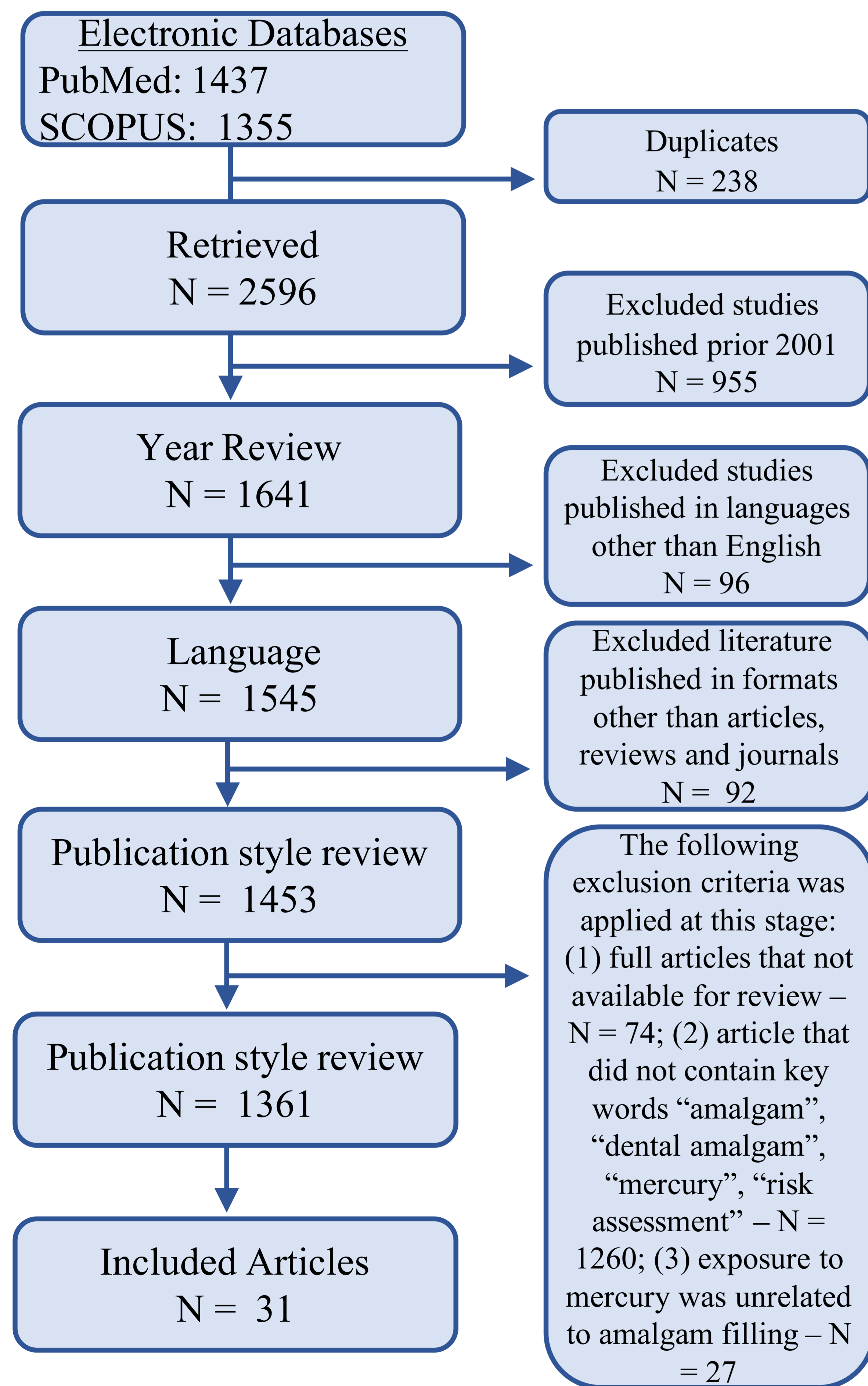


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## Introduction

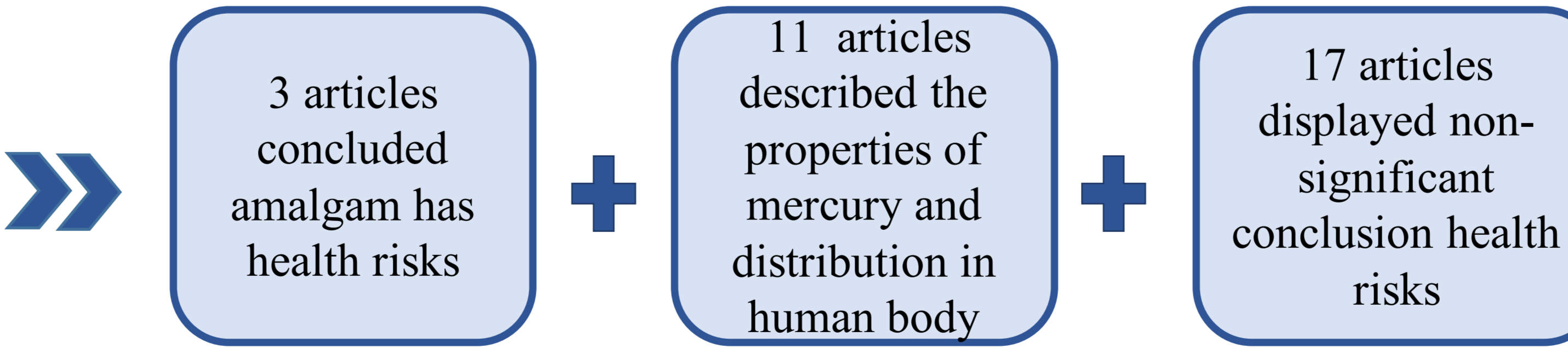
Mercury is known to be toxic; however, it continues to be used in dental restorative materials, which contain about 50% mercury by weight.<sup>1</sup> Though Health Canada maintains that dental amalgam fillings are safe, studies show that amalgam fillings are associated with higher mercury levels in the body.<sup>1</sup> This literature review will examine and answer the following question: Does mercury exposure from dental amalgam-fillings lead to identifiable adverse health outcomes in individuals?

## Methodology



## Results

Themes	Findings
Amalgam and mercury concentrations in urine, hair, saliva, and blood	<ul style="list-style-type: none"> <li>According to WHO, concentrations greater than 20µg/L affect cognitive functioning,<sup>2</sup> but there are no definitive safe levels determined for levels below this value<sup>1</sup></li> <li>Higher mercury concentrations are found in saliva of individuals with amalgam fillings than those without fillings (average concentration was 4.14 g/l<sup>3</sup>)</li> <li>Mercury concentrations in urine are doubled in those with amalgam fillings<sup>1</sup></li> <li>Methylmercury exposure is associated with higher level of inorganic mercury in hair<sup>3</sup></li> </ul>
Mercury concentrations in relation to Multiple Sclerosis and Alzheimer's disease (AD)	<ul style="list-style-type: none"> <li>Mercury is the only metal compound that is able to produce neurofibrillar tangles (NFT) associated with AD<sup>4</sup></li> <li>The risk of AD is associated with an increase in tooth decay<sup>4</sup></li> <li>Studies suggest that even with safe exposures, mercury cause diseases including multiple sclerosis<sup>4</sup></li> <li>Experiments on animals demonstrate the loss of Schwann cells due to elevated mercury levels<sup>4</sup></li> <li>7.5 fold increase in mercury concentrations in cerebrospinal fluids of MS patients<sup>4</sup></li> <li>Several studies have concluded there is a lack of evidence suggesting that amalgams are a cause of MS and AD<sup>4,5,6</sup></li> </ul>
Dental amalgams and risks during pregnancy	<ul style="list-style-type: none"> <li>Mercury vapour is the main source of exposure from dental amalgams<sup>7</sup></li> <li>Mercury vapour readily passes the placental barrier and has been associated with increased mercury concentrations in the placenta<sup>7</sup></li> <li>Greater amalgam results in greater mercury levels in the fetal liver, kidney and breast milk<sup>8</sup></li> <li>Placement of amalgam does not result in increased risk of low birth weight in babies<sup>9</sup></li> </ul>
Distribution of mercury in the body	<ul style="list-style-type: none"> <li>Association with increased mercury concentrations in liver, kidney and pituitary glands<sup>8</sup></li> <li>Mercury concentration in the brain is correlated with increased number of amalgam fillings. Those with 12 fillings have 10-times higher mercury levels in the brain<sup>1</sup></li> <li>Increased mercury concentrations from amalgam fillings correlate with increased GST-p and GST-a levels in kidneys. However, no significant deleterious effects on tubule and glomeruli of kidneys<sup>10</sup></li> </ul>



## Discussion

Considering dental amalgam is composed of up to 50% mercury,<sup>1</sup> it is not surprising that individuals with amalgam fillings correspondingly display higher levels of mercury. Higher levels of mercury were consistently detected in urine, hair, saliva, blood, breast milk and certain organs. Despite these findings; however, no study could connect these higher concentrations to adverse health outcomes with statistical significance.

After analyzing multiple articles, it can be concluded that aspects surrounding the toxic effects of amalgam fillings still require further research. There are many limitations as it is hard to determine the exact amount of Hg released *in vivo* and consequently it is almost impossible to detect acute and sub clinical symptoms of Hg exposure in individuals. Limitations of the study included: limited data from other countries due to language barriers. We restricted our search to free articles published within the last fifteen years, leading to possible exclusion of relevant data. Additionally, few studies were found to actively measure mercury levels and possible symptoms.

To improve results, studies should focus on specific demographics including those who are at greater risk, such as pregnant women and children. Similarly, improvements could increase the sensitivity of tools and methods to allow measurements of mercury directly from amalgam. In addition, a greater number of longitudinal and experimental studies must be conducted to account the ability of mercury to accumulate in the body as well as amalgam size and surface area. It seems that risks of dental amalgam must be proven before any action is taken to change policy around its use. Such studies will be beneficial in assuring the safety of amalgam fillings and whether the risk truly outweighs the benefit.

## Conclusion

Overall, studies indicated a definitive increase in mercury levels in individuals with amalgam fillings, but there was no statistically significant link made to adverse health outcomes. Further studies need to be conducted in order to assure patients and providers that dental amalgam does not contribute to any health risks that could possibly outweigh the benefits of its use.

Figure 1. Flow-chart diagram of information through the different phases of the structured literature review

References  
 1. Zwicker, J., Dutton, D., & Emery, J. (2014). Longitudinal analysis of the association between removal of dental amalgam, urine mercury and 14 self-reported health symptoms. *Environmental Health (London)*, 13(1), 95-2. Hrubá, F., Štěrbová, U., Černá, M., Chen, C., Harari, F., Harari, R., ... Bergdahl, I. (2012). Blood cadmium, mercury, and lead in children: An international comparison of cities in six European countries, and China, Ecuador, and Morocco. *Environmental International*, 41, 29-34. Fakour, H., Esmali-Sari, A., & Zayeri, F. (2010). Scalp hair and saliva as biomarkers in determination of mercury levels in Iranian women: Amalgam as a determinant of exposure. *Journal of Hazardous Materials*, 177(1), 109-113.  
 2. Mutter, J., Naumann, J., & Gruethlin, C. (2007). Comments on the Article: The Toxicology of Mercury and Its Chemical Compounds by Clarkson and Magos (2006). *CRC Critical Reviews in Toxicology*, 2007, Vol.37(6), P.537-549, 37(6), 537-549. S. Watson, G., Lynch, M., Myers, G., Shanthiye, C., Thurston, S., Zareba, G., ... Davidson, P. (2011). Prenatal exposure to dental amalgam: Evidence from the Seychelles Child Development Study main cohort. *Journal of the American Dental Association* (1939), 142(11), 1283-94. & Clarkson, T. (2002). The Three Modern Faces of Mercury. *Environmental Health Perspectives*, 110, 11-23. T. Watson, G., Evans, K., Thurston, S., Van Wijngaarden, E., Wallace, J., Meeseley, E., ... Myers, G. (2012). Prenatal exposure to dental amalgam in the Seychelles Child Development Nutrition Study: Associations with neurodevelopmental outcomes at 9 and 30 months. *Neurotoxicology*, 33(6), 1511-1517. & Richardson, G., Wilson, R., Allard, D., Parrill, C., Douma, S., & Graviera, J. (2011). Mercury exposure and risks from dental amalgam in the US population, post-2000. *Science of the Total Environment*, 408(20), 4257-4268. 9. Hujpel, P., Lydon-Rochelle, M., Bollen, A., Woods, J., Geurtsen, W., & Del Aguila, M. (2005). Mercury Exposure from Dental Filling Placement during Pregnancy and Low Birth Weight Risk. *American Journal of Epidemiology*, 161(8), 734-740. 10. Woods, J., Martin, M., Leroux, B., DeRoosen, T., Bernardo, M., Henrique, K., ... Korpak, A. (2008). Biomarkers of kidney integrity in children and adolescents with dental amalgam mercury exposure: Findings from the Casa Pia children's amalgam trial. *Environmental Research*, 108(3), Environmental Research, 2008, Vol.108(3). 11. Bates, M., Fawcett, J., Carrett, N., Curran, T., & Kjellstrom, T. (2004). Health effects of dental amalgam exposure: A retrospective cohort study. *International Journal of Epidemiology*, 33(4), 904-902. 12. Geier, D., Carnovsky, T., Ken, J., King, P., & Geier, D. (2011). A significant relationship between mercury exposure from dental amalgams and urinary porphyrins: A further assessment of the Casa Pia children's dental amalgam trial. *BioMed*, 2(4), 215-224. 13. Aminzadeh, K., & Einman, M. (2007). Dental Amalgam and Multiple Sclerosis: A Systematic Review and Meta-Analysis. *Journal of Public Health Dentistry*, 67(1), 64-66. 14. Bagchi, M., Bekturov, R., Esmali-Sari, D., & Ghazempour, A. (2012). Mercury Exposure Assessment in Iranian Pregnant Women's Hair with Respect to Diet, Amalgam Filling, and Location. *Biological Trace Element Research*, 148(3), 292-301. 15. Bellinger, David C., Daniel, David, Trachtenberg, Felicia, Tavares, Mary, & McKinlay, Sonja. (2007). Dental amalgam restorations and children's neuropsychological function: The New England Children's Amalgam Trial (Children's Health/Clinical report). *Environmental Health Perspectives*, 115(3), 440. 16. British Society of Paediatric Dentistry. (2005). Mercury Exposure from Dental Filling Placement during Pregnancy and Low Birth Weight Risk. *American Journal of Epidemiology*, 161(8), 734-740. 24. Iano, F., Santos Sobrinho, O., Silva, T., Pereira, M., Figueredo, P., Albuquerque, L., & Granjeiro, J. (2008). Optimizing the procedure for mercury recovery from dental amalgam. *Brazilian Oral Research*, 22(2), 119-24. 25. Lestivo, Jorma, Lestivo, Tiina, Heiskanen, Hans, Pyy, Lauri, Huovinen, Pentti, & Tenover, Monica. (2002). Mercury in Saliva and the Risk of Exceeding Limits for Sewage in Relation to Exposure to Amalgam Fillings. *Archives of Environmental Health*. An International Journal, 57(4), 366-370. 26. Medhart, D., Kober, W., Linde, K., Ziber, T., Kriemers, L., Sailer, R., & Halbach, S. (2008). Biomonitoring of mercury in patients with complaints attributed to dental amalgam, healthy amalgam bearers, and amalgam-free subjects: A diagnostic study. *Clinical Toxicology*, 2008, Vol.46(2), P.133-140. 46(2), 133-140. 27. Mutter, J., Naumann, J., & Gruethlin, C. (2007). Comments on the Article: The Toxicology of Mercury and Its Chemical Compounds by Clarkson and Magos (2006). *CRC Critical Reviews in Toxicology*, 2007, Vol.37(6), P.537-549, 37(6), 537-549. 28. Palkovicova, L., Ustinova, M., Masanova, V., Yu, Z., & Hertz-Piccolotto, I. (2007). Maternal amalgam dental fillings as the source of mercury exposure in developing fetus and newborn. *Journal of Exposure Science and Environmental Epidemiology*, 18(3), 326. 29. Woods, J., Martin, M., Leroux, B., DeRoosen, T., Bernardo, M., Luis, H., Leitão, J., Kushleka, J., Rue, T., & Korpak, A. (2008). Biomarkers of kidney integrity in children and adolescents with dental amalgam mercury exposure: Findings from the Casa Pia children's amalgam trial. *Environmental Research*, 108(3), Environmental Research, 2008, Vol.108(3). 30. Zwicker, J., Dutton, D., & Emery, J. (2014). Longitudinal analysis of the association between removal of dental amalgam, urine mercury and 14 self-reported health symptoms. *Environmental Health (London)*, 13(1), 95.