



# Toxics Link

# Mercury in Dentistry

Case for Phase out for Vulnerable Population

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Toxics Link is an Indian environmental not for profit organization set up in 1996, engaged primarily in research, policy advocacy and disseminating information to help strengthen the campaign against toxic pollution, provides cleaner alternatives and brings together groups and people affected by this problem. Toxics link (www.toxicslink.org) has been actively engaged in the implementation of Minamata Convention on Mercury, a global treaty designed to safeguard the planet from the dangers of Mercury. The treaty puts in control and ultimately bans production, export and import of a range of mercury-containing products by 2020. The use of dental amalgam was also agreed to be phased-down.

For the reason that, mercury is an acknowledged neurotoxin, concerns about the health effects of exposure to this chemical are widespread. A 2005, World Health Organization (WHO) report stated that exposure to mercury may cause developmental deficits during fetal development, and attention deficit and developmental delays during childhood. Recent studies suggest that mercury may have no threshold below which some adverse effects do not occur. The dangerous effects of Mercury on environment are well documented and all stakeholders are acting by reducing the use of mercury to protect human health.

Dental amalgam, which contains 50% mercury by weight, is widely used in restorative dentistry. Dental offices are known to be one of the leading consumers of inorganic mercury. Mercury is one of the most toxic metals known to mankind and the Minamata Convention has rightly identified dental amalgam as one of the products to be gradually phased down and promote the use of alternative fillings materials.

We at Toxics Link have compiled various studies highlighting "HEALTH EFFECTS OF DENTAL AMALGAM ON VULNERABLE POPULATION" and also information on "GLOBAL BANS ON USE OF MERCURY AMALGAM FOR VULNERABLE POPULATIONS". We hope that this will help the Ministry of Health and Family Welfare (MoHFW), and other stakeholders viz. Dental Council of India (DCI), Indian Dental Association (IDA), Dental Colleges, Clinicians and consumers to recognize the perils of continuing the usage of mercury amalgam, especially in vulnerable population. We would urge the MoHFW to give out a strong message by banning the use of mercury based fillings in vulnerable population.

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# 1. HEALTH EFFECTS OF DENTAL AMALGAM ON VULNERABLE POPULATION

Study abstracts

# Pregnant Women, Children, and Dental Amalgam Mercury fillings

by Amanda Just, MS, and Jack Kall, DMD, MIAOMT February 27, 2018

# Abstract:-

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Mercury is a neurotoxin, and a 2005 World Health Organization (WHO) report identified harmful effects of mercury exposure, including areas of risk specifically linked to mercury in fetuses and children: "Adverse health effects from mercury exposure can be: tremors, impaired vision and hearing, paralysis, insomnia, emotional instability, developmental deficits during fetal development, and attention deficit and developmental delays during childhood."

Scientific research about dental mercury damage in children Mercury's damaging influence on the developing brain and neurological system makes dental mercury amalgam fillings an inappropriate material for use in children, pregnant women, and women of childbearing age. In fact, research has repeatedly shown the potential for significant impacts to pregnant women, fetuses, and children as a result of dental mercury.

Some of the impacts that have been examined in science include the following:

• Fetal and infant exposure to mercury is known to have potentially serious health consequences, and the number of maternal amalgam fillings has been associated with mercury levels in cord blood; in the placenta; in the kidneys and liver of fetuses; in fetal hair; and in the brain and kidneys of infants.

• Mercury is excreted in breast milk of mothers with dental mercury amalgam fillings, and the mercury concentration in breast milk increases as the number of amalgam fillings in the mother increases.

• Additional research has likewise examined the potential dangers that dental amalgam mercury poses to pregnant women, their fetuses, and infants.

• Another area that has received much attention is the possibility of reproductive hazards to female dental personnel, including menstrual cycle disorders, fertility issues, and pregnancy risks.

Methyl Mercury and Inorganic Mercury in Swedish Pregnant Women and in Cord Blood: Influence of Fish Consumption K. Ask Björnberg,1 M. Vahter,1 K. Petersson-Grawé,2,3 A. Glynn,2 S. Cnattingius,4 P.O. Darnerud,2 S. Atuma,2 M. Aune,2 W. Becker,2 and M. Berglund1

#### Abstract:-

Studied exposure to methyl mercury (MeHg), in Swedish pregnant women (total mercury [T-Hg] in hair) and their fetuses (MeHg in cord blood) in relation to fish intake. The women were recruited at antenatal care clinics in late pregnancy to participate in an exposure study of environmental pollutants. Fish consumption was evaluated using food frequency questionnaires including detailed questions on fish consumption. In addition, we determined inorganic mercury (I-Hg) and selenium (Se) in cord blood. On average, the women consumed fish (all types) 6.7 times/month (range 0–25) times/month) during the year they became pregnant. They reported less consumption of freshwater fish—species that might contain high concentrations of MeHg—during than before pregnancy. T-Hg in maternal hair (median 0.35 mg/kg; range 0.07-1.5 mg/kg) was significantly associated (R2 = 0.53; p < 0.001) with MeHg in cord blood (median 1.3  $\mu$ g/L; range 0.10–5.7  $\mu$ g/L). Both hair T-Hg and cord blood MeHg increased with increasing consumption of seafood (r = 0.41; p < 0.001 and r= 0.46; p < 0.001, respectively). Segmental hair analysis revealed that T-Hg closer to the scalp was lower and more closely correlated with MeHg in cord blood than T-Hg levels in segments corresponding to earlier in pregnancy. We found a weak association between Se (median 86  $\mu$ g/L; range 43–233  $\mu$ g/L) and MeHg in cord blood (r = 0.26; p = 0.003), but no association with fish consumption. I-Hg in cord blood (median 0.15  $\mu$ g/L; range 0.03–0.53  $\mu$ g/L) increased significantly with increasing number of maternal dental amalgam fillings.

Maternal amalgam dental fillings as the source of mercury exposure in developing fetus and newborn

Lubica Palkovicova, Monika Ursinyova, Vlasta Masanova, Zhiwei Yu & Irva Hertz-Picciotto

Journal of Exposure Science and Environmental Epidemiology volume18, pages326–331 (2008)

#### Abstract

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Dental amalgam is a mercury-based filling containing approximately 50% of metallic mercury (Hg<sup>0</sup>). Human placenta does not represent a real barrier to the transport of Hg<sup>0</sup>; hence, fetal exposure occurs as a result of maternal exposure to Hg, with possible subsequent neurodevelopment disabilities in infants. This study represents a sub study of the international NIH-funded project "Early Childhood Development and polychlorinated biphenyls Exposure in Slovakia". The main aim of this analysis was to assess the relationship between maternal dental amalgam fillings and exposure of the developing fetus to Hg. The study subjects were mother–child pairs (*N*=99). Questionnaires were administered after delivery, and chemical analyses of Hg were performed in the samples of maternal and cord blood using atomic absorption spectrometry with amalgamation technique. The median values of Hg concentrations were 0.63  $\mu$ g/l (range 0.14–2.9  $\mu$ g/l) and 0.80  $\mu$ g/l (range 0.15–2.54  $\mu$ g/l) for maternal and cord blood, respectively. None of the cord blood

Hg concentrations reached the level considered to be hazardous for neurodevelopment effects in children exposed to Hg *in utero* (EPA reference dose for Hg of 5.8 µg/l in cord blood). A strong positive correlation between maternal and cord blood Hg levels was found ( $\rho$ =0.79; P<0.001). Levels of Hg in the cord blood were significantly associated with the number of maternal amalgam fillings ( $\rho$ =0.46, P<0.001) and with the number of years since the last filling ( $\rho$ =-0.37, P<0.001); these associations remained significant after adjustment for maternal age and education. Dental amalgam fillings in girls and women of reproductive age should be used with caution, to avoid increased prenatal Hg exposure.

#### Inorganic Mercury and Methyl mercury in Placentas of Swedish Women

Karolin Ask, Agneta Åkesson, Marika Berglund, and Marie Vahter Division of Metals and Health, Institute of Environmental Medicine, Karolinska Institutet, Stockholm, Sweden

#### Abstract:-

Determined levels of inorganic mercury (I-Hg) and methyl mercury in placentas from 119 Swedish women, not selected with respect to high exposure of mercury. Our objective was to relate placental Hg species with maternal and fetal blood concentrations and to evaluate possible associations with selenium. We performed the analyses using automated alkaline solubilization/reduction and cold-vapor atomic fluorescence spectrophotometry. I-Hg levels in placenta increased with an increasing number of maternal dental amalgam fillings (p < 0.001). Despite placental accumulation (median, 1.3 µg/kg; range, 0.18–6.7 µg/kg wet weight), a substantial fraction of maternal blood I-Hg, probably as Hg0, reached the fetus. Although MeHg transferred easily to the fetus, it also accumulated in the placenta. On average, 60% of placental Hg was in the form of MeHg. The median concentration was 1.8 µg/kg (range, 0–6.2 µg/kg wet weight), more than twice the maternal blood concentration. We found significant associations between MeHg and selenium in both maternal and umbilical cord blood but not in the placenta. The associations were particularly obvious in freshwater fish consumers, probably reflecting that fish is a source of both MeHg and selenium. We found no correlations between I-Hg and selenium. This study increases the understanding of Hg, in its different forms, in human placenta and how they are related to maternal and fetal exposure.

#### Mercury burden of human fetal and infant tissues

G. Drasch, I. Schupp, H. Höfl, R. Reinke, G. Roider

European Journal of Pediatrics, August 1994, Volume 153, Issue 8, pp 607–610

#### Abstract:-

 $P_{age}4$ 

The total mercury concentrations in the liver (Hg-L), the kidney cortex (Hg-K) and the cerebral cortex (Hg-C) of 108 children aged 1 day-5 years, and the Hg-K and Hg-L of 46 fetuses were determined. As far as possible, the mothers were interviewed and their dental status was recorded.

The results were compared to mercury concentrations in the tissues of adults from the same geographical area. The Hg-K (n = 38) and Hg-L (n = 40) of fetuses and Hg-K (n = 35) and Hg-C (n = 35) of older infants (11–50 weeks of life) correlated significantly with the number of dental amalgam fillings of the mother. The toxicological relevance of the unexpected high Hg-K of older infants from mothers with higher numbers of dental amalgam fillings is discussed.

Concentrations of Mercury, Cadmium and Lead in Brain and Kidney of Second <u>Trimester Fetuses and Infants</u> <u>IE.Lutz<sup>1</sup>B.Lind<sup>1</sup>P.Herin<sup>1</sup>I.Krakau<sup>2</sup>T-H.Bui<sup>3</sup>M.Vahter<sup>a4</sup></u>

Journal of Trace Elements in Medicine and Biology, Volume 10, Issue 2, 1996, Pages 61-67

#### Abstract:-

The concentrations of mercury (Hg), cadmium (Cd) and lead (Pb) in brain (cerebrum) and kidney during fetal (second trimester terminations or abortions, n=20) and postnatal (infants deceased before three months of age, n=15) development have been studied. Information on possible sources of exposure was obtained from the mothers of the fetuses, but not from those of the infants. The median concentration of Hg in the brain was 4 µg/kg wet weights in both fetuses and infants (total range  $\leq 223 \,\mu g/kg$ ). The concentrations of Hg in the kidneys were significantly higher than in brain, median of Hg 6  $\mu$ g/kg (range  $\leq$ 534  $\mu$ g/kg) in fetuses and 10 $\mu$ g/kg ( $\leq$ 737) in infants. There was a tendency of increasing concentration of Hg in the fetal kidney, but not in the brain, with increasing number of amalgam fillings in the mothers. The concentration of Cd in the brain was less than 1 pg/kg in most cases, both in fetuses and infants. The concentration of Cd in the kidneys was significantly higher, with a median of about  $2 \mu g/kg$  (18 $\mu g/kg$ ) in both groups. There was no detectable association between tissue Cd concentrations and the smoking habits of the mothers. The concentration of Pb in brain was below 10µg/kg in most cases. In the kidneys, the concentrations of Pb were significantly higher, with a median of  $12\mu g/kg$  in the fetuses (range  $\leq 620 \mu g/kg$ ) and  $15\mu g/kg$  (1936  $\mu g/kg$ ) in the infants. In general, the concentrations of Cd and Pb were lower than in previously reported studies

Maternal and neonatal hair mercury concentrations: The effect of dental amalgam Stephen W Lindow, 37.76, Hull and East Yorkshire Hospitals NHS Trust, Robert Knight, 17.92, University of Hull J Batty , S J Haswell

Article in BJOG An International Journal of Obstetrics & Gynaecology 110(3):287-91 · April 2003

#### Abstract:-

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To evaluate maternal and fetal hair mercury levels in relation to the placement of dental amalgam tooth restorations. Cross sectional study involving women who never had dental amalgam

restorations placed, women who had amalgam restorations placed before pregnancy and women who had restorations placed during the index pregnancy. North of England Maternity Hospital. Fifty-three healthy women who delivered healthy babies at term. Maternal and fetal hair was collected in a standardized manner in the first few days following delivery. Maternal and neonatal hair mercury concentrations. When compared with women without restorations, there was a significant increase in the maternal hair mercury concentration in women who had dental amalgam placed outside of the index pregnancy and also in women who had dental amalgam placed during the index pregnancy. The fetal hair mercury concentration was significantly higher in babies when mothers had been exposed to dental amalgam either before pregnancy or during pregnancy compared with unexposed babies. There was no difference in the maternal or fetal hair mercury levels in the groups of patients who had dental amalgam placed before or during pregnancy. Maternal and fetal hair mercury levels were significantly higher in women who previously had dental amalgam restorations placed. There was no evidence that placement of dental amalgam restorations in pregnant women who had already similar restorations increased the maternal or fetal hair mercury level.

# Breast-milk mercury concentrations and amalgam surface in mothers from Brasília, Brazil

Sérgio L. da Costa, Olaf Malm, José G. Dóre

Biological Trace Element Research, August 2005, Volume 106, Issue 2, pp 145–151

#### Abstract:-

Human milk is the best source of nourishment for the newborn because of its incomparable balanced nutrition and psychological benefits to the infant's development. Dental fillings containing metallic Hg are the primary source of inorganic Hg contamination of humans. We studied Hg concentrations in the breast milk of mothers during the first month (7–30 d) postnatal in relation to the number of amalgam surfaces. The concentration of total Hg was determined in 23 samples of human milk collected from lactating mothers with a varied number of amalgam dental restorations. The average number of amalgam surfaces was 6.87 (5.81, SD) with a range of 0 to 20. The mean concentration of total Hg in breast milk was 5.73ng/g (range: 0–23.07). The Pearson correlation coefficient was significant (r=0.6087, p=0.0057) between breast-milk Hg and number of amalgam surfaces. In 56.5% of low-fish-eating mothers, the amount of Hg likely to be ingested by breastfed infants is above the World Health Organization.

Total and Inorganic Mercury in Breast Milk and Blood in Relation to Fish Consumption and Amalgam Fillings in Lactating Women Agneta Oskarsson, Andrejs Schütz, Staffan Skerfving, Ira Palminger Hallén, Birgit Ohlin & Birgitta Json Lagerkvist Archives of Environmental Health: An International Journal, Volume 51, 1996 - Issue 3, Pages 234-241

#### Abstract

Total mercury concentrations (mean  $\pm$  standard deviation) in breast milk, blood, and hair samples collected 6 wk after delivery from 30 women who lived in the north of Sweden were  $0.6 \pm 0.4$  mg/g  $(3.0 \pm 2.0 \text{ nmol/kg}), 2.3 \pm 1.0 \text{ ng/g} (11.5 \pm 5.0 \text{ nmol/kg}), \text{ and } 0.28 \pm 0.16 \text{ }\mu\text{g/g} (1.40 \pm 1.0 \text{ }\mu\text{g/g})$ 0.80µmol/kg), respectively. In milk, an average of 51% of total mercury was in the form of inorganic mercury, whereas in blood an average of only 26% was present in the inorganic form. Total and inorganic mercury levels in blood (r = .55, p = .003; and r = .46, p = .016; respectively) and milk (r = .47, p = .01; and r = .45, p = .018; respectively) were correlated with the number of amalgam fillings. The concentrations of total mercury and organic mercury (calculated by subtraction of inorganic mercury from total mercury) in blood (r = .59, p = .0006; and r = .56, p = .0006; and r = .56; p = .0006; p = .00006; p = .00006.001; respectively) and total mercury in hair (r = .52, p = .006) were correlated with the estimated recent exposure to methyl mercury via intake of fish. There was no significant between the milk levels of mercury in any chemical form and the estimated methyl mercury intake. A significant correlation was found between levels of total mercury in blood and in milk (r = .66, p = .0001), with milk levels being an average of 27% of the blood levels. There was an association between inorganic mercury in blood and milk (r = .96, p < .0001); the average level of inorganic mercury in milk was 55% of the level of inorganic mercury in blood. No significant correlations were found between the levels of any form of mercury in milk and the levels of organic mercury in blood. The results indicated that there was an efficient transfer of inorganic mercury from blood to milk and that, in this population, mercury from amalgam fillings was the main source of mercury in milk. Exposure of the infant to mercury from breast milk was calculated to range up to  $0.3 \,\mu g/kg \cdot d$ , of which approximately one-half was inorganic mercury. This exposure, however, corresponds to approximately one-half the tolerable daily intake for adults recommended by the World Health Organization. We concluded that efforts should be made to decrease mercury burden in fertile women.

# Effect of teeth amalgam on mercury levels in the colostrums human milk in Lenjan Elaheh Norouzi · Nader Bahramifar · Seyed Mahmoud Ghasempouri

Environ Monit Assess (2012) 184:375-380 DOI 10.1007/s10661-011-1974-1

#### Abstract:-

 $P_{age}7$ 

Human milk is usually the only source of food for infants during the first 4 to 5 months of their life. Maternal environmental mercury exposure is directly related to fish consumption or amalgam filling. In this research, 38 human milk samples were collected from mothers of Lenjan area who were not occupationally exposed with mercury. Mercury concentration in human milk was determined by AMA254 Mercury Analyzer. A level of mercury was examined in relation to somato metric,

demographic and dental amalgam parameters. Obtained results showed that only dental amalgam significantly increased the mercury level in human milk (p < 0.001). The mean mercury concentrations in milk of mothers without teeth fillings (n = 13), with one to three teeth fillings (n = 10), and four to eight teeth fillings (n = 15) were 2.87, 5.47, and 13.33 µg/l, respectively. The result of this study also showed a positive correlation of mercury milk levels with the number of teeth filling of the mother (p < 0.05, r = 0.755). The estimated weekly intake of mercury of a breastfed infant in this study was, in some cases, higher than provisional tolerance weekly intake recommended by FAO/WHO, which pose a threat to their health.

# <u>The Mercury Concentration in Breast Milk Resulting from Amalgam Fillings and</u> <u>Dietary Habits</u> HansDrexlerKarl-HeinzSchaller

Environmental Research, Volume 77, Issue 2, May 1998, Pages 124-129

#### Abstract:-

Health risks from amalgam fillings are a subject of controversy. In Germany it is not advised to use amalgam fillings during breast feeding. Objectives of this study were to examine the concentration of mercury in human breast milk and the confounders which may modify the mercury levels. Women who gave birth between August 1995 and May 1996 in a district hospital were asked to participate in the study. The examination included a standardized anamnesis and an inspection of the teeth by a dentist. Blood and urine samples of 147 women and breast milk samples of 118 women were collected in the first week after birth. After 2 months of breast feeding a second breast milk sample was collected from 85 of women. Mercury was measured by cold-vapor atomic absorption spectrometry. The concentration of mercury in the breast milk collected immediately after birth showed a significant association with the number of amalgam fillings as well as with the frequency of meals. Urine mercury concentrations correlated with the number of amalgam fillings and amalgam surfaces. In the breast milk after 2 months of lactation, the concentrations were lower (mean: < 0.25 $\mu$ g/L; range <0.25–11.7  $\mu$ g/L) compared with the first sample (mean: 0.90  $\mu$ g/L; range <0.25–20.3  $\mu g/L$ ) and were positively associated with the fish consumption but no longer with the number of the amalgam fillings. Accordingly, the additional exposure to mercury of breast-fed babies from maternal amalgam fillings is of minor importance compared to maternal fish consumption.

# Reduced Levels of Mercury in First Baby Haircuts of Autistic Children Amy S. Holmes, Mark F. Blaxill, Boyd E. Haley

International Journal of Toxicology, 1.504, Impact Factor, Journal Indexing & Metrics

#### Abstract:-

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Reported rates of autism have increased sharply in the United States and the United Kingdom. One possible factor underlying these increases is increased exposure to mercury through thimerosal-

containing vaccines, but vaccine exposures need to be evaluated in the context of cumulative exposures during gestation and early infancy. Differential rates of postnatal mercury elimination may explain why similar gestational and infant exposures produce variable neurological effects. First baby haircut samples were obtained from 94 children diagnosed with autism using Diagnostic and Statistical Manual of Mental Disorders, 4th edition (DSM IV) criteria and 45 age- and gender-matched controls. Information on diet, dental amalgam fillings, vaccine history, Rho D immunoglobulin administration, and autism symptom severity was collected through a maternal survey questionnaire and clinical observation. Hair mercury levels in the autistic group were 0.47ppm versus 3.63ppm in controls, a significant difference. The mothers in the autistic group had significantly higher levels of mercury exposure through Rho D immunoglobulin injections and amalgam fillings than control mothers. Within the autistic group, hair mercury levels varied significantly across mildly, moderately, and severely autistic children, with mean group levels of 0.79, 0.46, and 0.21ppm, respectively. Hair mercury levels among controls were significantly correlated with the number of the mothers' amalgam fillings and their fish consumption as well as exposure to mercury through childhood vaccines, correlations that were absent in the autistic group. Hair excretion patterns among autistic infants were significantly reduced relative to control. These data cast doubt on the efficacy of traditional hair analysis as a measure of total mercury exposure in a subset of the population. In light of the biological plausibility of mercury's role in neurodevelopment disorders, the present study provides further insight into one possible mechanism by which early mercury exposures could increase the risk of autism.

# Effect of amalgam fillings on the mercury concentration in human amniotic fluid

Pier Franca Luglie · Guglielmo Campus · Giannina Chessa · Giovanni Spano · Giampiero Capobianco · Giovanni Maria Fadda · Salvatore Dessole

#### Abstract: -

 $P_{age}$ 

Methyl mercury (MeHg) and metallic Hg is well known as neurotoxin agent. Dental amalgam contributes significantly to elemental Hg vapor exposure in the general population. There is little information about Hg concentration in human amniotic fluid (AF) of pregnant women and its potential toxic effect on the fetuses. **Objective**: Primary to assess the relationship between the presence of detectable mercury (Hg) concentration in human AF, number and surface areas of amalgam fillings of pregnant women; secondary to analyze their obstetric history and perinatal complications. **Methods**: Seventy-two pregnant women took part in this prospective study. One dentist recorded the dental status, presence, number and surface areas of amalgam fillings. Total Hg concentration in AF was determined in digested samples using automatic cold vapor atomic absorption equipment. The detection limit of Hg in AF, determined from blank readings, was0.08ng/ml. To estimate the dependence of the explanatory variables (such as number and surface areas of amalgam fillings, fish consumption, presence of liver or neurological diseases and smoking habits) on mercury concentration several linear regression models were built up. Stepwise logistic regression procedures were running on total sample and on patients with at least one

amalgam filling (Positive Filling group = PF). Principal component analysis (PCA) provided two factors, which explained for more the 60% of the variance among the variables. **Results:** The overall mean Hg concentration in AF among all patients was  $0.37 \notin 0.49$  ng/ml. nineteen (26.4%) women had Hg concentration.

# The effect of occupational exposure to mercury vapor on the fertility of female dental assistants

Andrew S Rowland, Donna Day Baird, Clarice R Weinberg, David L Shore, Carl M Shy, Allen J Wilcox Epidemiology Branch, National Institute of Environmental Health Sciences, Research Triangle Park, NC 27709, USA A S Rowland D D Baird A J Wilcox Statistics and Biomathematics Branch, National Institute of Environmental Health Sciences, Research Triangle Park, NC 27709, USA C R Weinberg West at Inc, Durham, NC, USA D L Shore Department of Epidemiology, University of North Carolina School of Public Health, Chapel Hill NC 27599-7400, USA C M Shy Requests for reprints to: Andrew S Rowland, PhD, Epidemiology Branch A3-05, NIEHS, PO Box 12233, Research Triangle Park, NC 27709, USA. Accepted 15 February 1993

#### Abstract:-

Exposure to mercury vapor or inorganic mercury compounds can impair fertility in laboratory animals. To study the effects of mercury vapor on fertility in women, eligibility questionnaires were sent to 7000 registered dental assistants in California. The final eligible sample of 418 women, who had-become pregnant during the previous four years, was interviewed by telephone. Detailed information was collected on mercury handling practices and the number of menstrual cycles without contraception it had taken them to become pregnant. Dental assistants not working with amalgam served as unexposed controls. Women with high occupational exposure to mercury were less fertile than unexposed controls. The fecund ability (probability of conception each menstrual cycle) -of women who prepared 30 or more amalgams per week and who had five or more poor mercury hygiene factors was only 63% of that for unexposed women (95% CI 42%/o-96%) after controlling for covariates. Women with low exposure were more fertile, however, than unexposed controls. Possible explanations for the U shaped dose response and limitations of the exposure measure are discussed. Further investigation is needed that uses biological measures of mercury exposure.

Longitudinal Study of Methyl mercury and Inorganic Mercury in Blood and Urine of Pregnant and Lactating Women, as Well as in Umbilical Cord Blood 🛣 MarieVahter<sup>a</sup>AgnetaÅkesson<sup>a</sup>BirgerLind<sup>a</sup>UllaBjörs<sup>a</sup>AndrejsSchütz<sup>b</sup>MarikaBerglund<sup>a</sup>

Environmental Research, Volume 84, Issue 2, October 2000, Pages 186-194

Abstract:-

Investigated exposure to methyl mercury (MeHg) and mercury vapor (Hg<sup>6</sup>) in pregnant women and their newborns in Stockholm. The women were followed for 15 months post delivery. MeHg, inorganic Hg (I-Hg), and total Hg (T-Hg) in maternal and cord blood were determined by automated alkaline solubilization/reduction and cold vapor atomic fluorescence spectrometry. T-Hg in urine was determined by inductively coupled plasma mass spectrometry. About 72% of the Hg in blood (*n*=148) in early pregnancy was MeHg (median 0.94 µg/L, maximum 6.8 µg/L). Blood MeHg decreased during pregnancy, partly due to decreased intake of fish in accordance with recommendations to not eat certain predatory fish during pregnancy. Cord blood MeHg (median1.4 µg/L,maximum 4.8 µg/L) was almost twice that in maternal blood in late pregnancy and was probably influenced by maternal MeHg exposure earlier and before pregnancy. Blood I-Hg (median0.37 µg/L, maximum4.2 µg/L) and urine T-Hg (median 1.6 µg/L, maximum 12 µg/L) in early pregnancy were highly correlated, and both were associated with the number of amalgam fillings. The concentrations decreased during lactation, probably due to excretion in milk. Cord blood I-Hg was correlated with that in maternal blood. The results show the importance of speciation of Hg in blood for evaluation of exposure and health risks.

Possible foetotoxic effects of mercury vapor: a case report MA PhD LDS DDPH DHMSAStanleyGelbier(Senior Lecturer/Specialist in Community Dental Health)BDS LDSJaneIngram(Research Assistant) Public Health, Volume 103, Issue 1, January 1989, Pages 35-40

A thirty-year-old dental surgeon who worked until the 35th week of pregnancy in a surgery, in which mercury vapor concentrations in excess of the threshold limit value (TLV) had been detected, gave birth at 42 weeks to a small-for-dates baby with severe brain damage. The possibility that this baby's development might have been harmed by mercury is discussed and the literature relevant to teratogenicity of mercury reviewed. Attention is drawn to the need for further research into the effects on health and pregnancy outcome of mercury vapor in dental surgeries.

**TO SUMMARIZE** - In the past years increasing attention has been paid to possible adverse health effects of mercury exposure from dental amalgam fillings, exposure to mercury may cause developmental deficits during fetal development, and attention deficit and developmental delays during childhood. Recent studies suggest that mercury may have no threshold below which some adverse effects do not occur. Among all the materials regularly handled in dental offices, mercury stands out as a notoriously harmful substance. Mercury exposure at high levels can harm the brain, heart, kidneys, <u>lungs</u>, and immune system. High levels of methyl mercury in the bloodstream of unborn <u>babies</u> and young children may harm the developing nervous system, making the child less able to think and learn.

# 2. Global Bans on Mercury Amalgam use for Vulnerable Populations

#### **European Union**

#### (Provisional agreement)

The European Union (EU) has banned the use of Dental Amalgam for the vulnerable population,

Regulation (EU) 2017/852 of the European Parliament and of the Council of 17<sup>th</sup> May 2017 on mercury, and repealing Regulation (EC) NO 1102/2008.

Article 10: Dental Amalgam

"From 1 July 2018, dental amalgam shall not be used for dental treatment of deciduous teeth, of children under 15 years and of pregnant or breastfeeding women, except when deemed strictly necessary by the dental practitioner based on the specific medical needs of the patient."<sup>1</sup>

The EU Regulation requires Member States to set out a national plan, by 1 July 2019, outlining intended measures to reduce dental amalgam use. Countries within EU have already brought in country regulations based on this. Several European countries had already phased-down or completely phased-out the use of dental amalgam prior to the Minamata Convention and EU regulations.

#### a) United Kingdom

"Restricting the Use of Dental Amalgam in Specific Patient Groups has been developed to facilitate the implementation of Article 10(2) of Regulation (EU) 2017/852 on Mercury. *The new* environmental restrictions on dental amalgam use are applicable in UK law from 1 July 2018. After this date, the use of dental amalgam for treatment in patients under 15 years old, in pregnant or breastfeeding patients or for primary teeth in any patient will only be allowed where deemed strictly necessary by the dental practitioner. The restrictions specified in the EU regulation have been introduced to fulfill the requirements of the global Minamata Convention which aims to phase-down the use of mercury and mercury containing products, including dental amalgam, on environmental grounds."<sup>2</sup>

#### b) Sweden

Since 2009, Sweden has had a comprehensive ban on mercury. The ban means that the use of dental amalgam in fillings is not permitted and products containing mercury may no longer be

<sup>&</sup>lt;sup>1</sup>https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32017R0852&rid=2 <sup>2</sup>http://www.sdcep.org.uk/published-guidance/dental-amalgam/

released on the Swedish market.3 The ban means, among other things, those amalgam fillings will only be permitted in exceptional circumstances.4

In 1995, the state and county councils signed an agreement to phase out the use of dental amalgam from children's dentistry, and since 1999 there has been no financial support for amalgam fillings from the Swedish dental insurance. The use of amalgam reduced successively during the 1990s and the phase-out of dental amalgam was nearly complete before the general ban on mercury was in place 2009.5

Dental amalgam has been replaced by mercury-free alternatives. Today, the most common filling materials used in Sweden are composites. Other materials used are ceramics, glass ionomer cement and cast metal (mainly cobalt-chromium alloys, titanium and gold alloys).

## c) Denmark

- Ban on the use of dental amalgam for children's milk teeth and all front teeth.6
- "With the aim of significantly reducing both mercury use and releases, Denmark only permits amalgam in molar teeth where there are fillings already in place. Denmark is ready to ban the remaining use of dental amalgam, as soon as the Danish National Board of Health is satisfied that the non-mercury alternatives have full substitution capabilities."7
- In curricula, Danish dental schools actively collaborate in amalgam phase-down efforts; whilst Dutch dental schools stopped teaching the placement of amalgam between 1995 and 2005, on a voluntary basis.8

# d) Finland

After consultation with an expert group in 1993, Finland issued recommendations, including:(1) the use of dental amalgam should be reduced for environmental reasons; and (2)dental amalgam should be used only when other dental filling materials cannot be used. Since 1994, Finland's national guidelines stipulated that amalgam should not be used in restorations. The use of amalgam has declined significantly, recently accounting for no more than 3% of dental restorations.

<sup>8</sup>https://noharm-europe.org/sites/default/files/documents-

<sup>&</sup>lt;sup>3</sup>https://www.government.se/press-releases/2017/09/minister-for-the-environment-participates-in-internationalmeeting-on-mercury/

<sup>&</sup>lt;sup>4</sup>https://www.government.se/contentassets/12c4d85c2ca64d05827fc131f1a47ab9/sweden-will-ban-the-use-ofmercury

<sup>&</sup>lt;sup>5</sup>https://www.kemi.se/global/pm/2019/pm-3-19-national-plan-of-dental-amalgam-phase-

out.pdf?\_t\_id=1B2M2Y8AsgTpgAmY7PhCfg%3d%3d&\_t\_q=dental+amalgam&\_t\_tags=language%3aen%2csiteid%3 a007c9c4c-b88f-48f7-bbdc-

<sup>5</sup>e78eb262090&\_t\_ip=122.176.75.129&\_t\_hit.id=KemI\_Web\_Models\_Media\_DocumentFile/\_d702819f-15a3-4efc-9647-59e95726c3e7&\_t\_hit.pos=1

 <sup>&</sup>lt;sup>6</sup> Study on the potential for reducing mercury pollution from dental amalgam and batteries, European Commission
<sup>7</sup> UNEP Global Mercury Assessment Appendix Overview of Existing and Future National Actions, Including

Legislation, Relevant to Mercury as of 1 November 2002

files/5703/2018\_12\_18\_Dental\_amalgam\_recommendations\_FINAL.pdf

#### e) France

AFFSAPS (French Agency in charge of health products) recommended in 2005 to avoid dental amalgam use in pregnant and breastfeeding women (because of mercury vapors during placement). A similar recommendations had already been issued in 1998 by the French National Superior Hygiene Council9

#### f) Italy

A regulation entitled DecretoMinisterialesull'Amalgama issued by the Ministry of Health in 2001 limits the use of Amalgam in children under the age of 6, in pregnant and feeding woman, in people with allergy/sensitivity to one element of amalgam10

#### g) Germany

The Federal Public Health Office of Germany stated in 1992 that:

As already recommended in 1987 by the Federal Public Health Office, no major dental procedures involving amalgam should be done during pregnancy.

The Office continued to add to the list of contraindications. In 1995, the recommendations advised against using amalgam:

In pregnant women;

In patients with specific forms of kidney disease;

In patients with proven amalgam allergy;

In children under the age of six; and

For specific types of restorative procedures in all patients

# h) Catalonia, Spain

Since the end of 2007, there is a recommendation (by the Environment and Health Catalan Department) of not placing dental amalgam in pregnant women and children under 14 years old. In 2010, it was officially recommended (letter sent by Dr. Antonio Plasència, General Director of Public Health in the Catalonia Health Department, to the firms that buy/distribute medical

<sup>&</sup>lt;sup>9</sup>Study on the potential for reducing mercury pollution from dental amalgam and batteries: Final report, European Commission-DG ENV, 11 July 2012, bio Intelligence Service

<sup>&</sup>lt;sup>10</sup>Study on the potential for reducing mercury pollution from dental amalgam and batteries: Final report, European Commission-DG ENV, 11 July 2012, bio Intelligence Service

products) not to buy or distribute dental amalgams because of health and environment reasons"1112

# Norway

- The Norwegian health authorities have been urging dentists to use alternative products since 1991. Consumption of dental amalgam was reduced by about 95% in the period 1990–2007, and has been eliminated with the general ban on mercury in products from 2008.13
- As of 1 January 2008, the use of amalgam as a dental restorative material has been banned in Norway. The ban states that "Special and substantial reasons must exist for the use of amalgam in children and adolescents."14

# Pakistan

Mercury based dental fillings for children were banned in Khyber Pakhtunkhwa Province (Pakistan)15.

# Mongolia

In January 2011, the Ministry of Health and the National Emergency Management Agency of Mongolia issued a Joint Order to ban further procurement of the mercury containing thermometers, sphygmomanometers and dental amalgam."16

# Canada

Page 1.

Non-mercury filling materials should be considered for restoring the primary teeth of children where the mechanical properties of the material are suitable.

Whenever possible, amalgam fillings should not be placed in or removed from the teeth of pregnant women. Health Canada suggests that alternatives should be considered for patients with impaired kidney function.17

<sup>&</sup>lt;sup>11</sup>Study on the potential for reducing mercury pollution from dental amalgam and batteries: Final report, European Commission-DG ENV, 11 July 2012, bio Intelligence Service

<sup>&</sup>lt;sup>12</sup>http://www.quimics.cat/wp-content/uploads/2012/02/NPQ-454.pdf

<sup>&</sup>lt;sup>13</sup>http://www.mercury.org.cn/zcfg/gj/201109/P020121211402569065991.pdf

<sup>&</sup>lt;sup>14</sup>http://www.keytoxins.com/hgbiblio-files/Norwegian%20dental%20guidelines%20July%201%202003.pdf

<sup>&</sup>lt;sup>15</sup>https://www.pakistantoday.com.pk/2018/07/14/mercury-based-dental-fillings-for-children-banned-in-kp/

<sup>&</sup>lt;sup>16</sup> https://www.paho.org/hq/dmdocuments/2016/marsha-palmer-thermometers-sphygmomanometers-replacement-jamaica.pdf

<sup>&</sup>lt;sup>17</sup>https://www.cda-adc.ca/en/oral\_health/faqs/dental\_amalgam\_faqs.asp

## Australia

Australian Dental Association under -Policy Statement 6.18 – Safety of Dental Amalgam (last amended on April 6/7 2017) has mentioned

3.3 Dentists should minimize the use of dental amalgam in children, pregnant or breastfeeding women and in individuals with kidney disease.

3.4 Only capsulated dental amalgam complying with ISO 24234:2015 'Dentistry - Dental amalgam' should be used in dental clinics.

3.5 Dental clinics should practice mercury hygiene and correctly dispose of dental amalgam waste.18

# Philippines <sup>19</sup>

During Sixteenth Congress of the REPUBLIC of the Philippines' on14 JUL 23, Senator M iriall1 Defensor Santiago in Congress introduced

An Act PROHIBITING THE USE OF MERCURY IN DENTAL AMALGAM FILLINGS

SECTION 1 Short Title. - This Act shall be known as the "Mercury in Dental Fillings

Prohibition Act"

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SECTION 2 Declaration of Policy - It $\cdot$  is the policy of the State to promote the general welfare of the people and protect the environment.

SECTION 3 Prohibitions on the Use of Mercury in Dental Amalgam Fillings. - Effective 1 January 2016, the use of mercury in dental amalgam fillings is hereby prohibited. Any person, corporation, partnership, association, or any such entity found to have used 10 mercury in the manufacture or production of dental Amalgam fillings, or to have sold, distributed, transported, or used in any dental or medical procedures dental amalgam fillings containing mercury shall be fined not less than Twenty Thousand Pesos (P20, 000.00) but not more than One Hundred Thousand Pesos (P I 00,000.00) for each violation.

SECTION 4 Implementing Rules and Regulations. - Within ninety (90) days from the 15 effectivity of this Act, the Secretary of Health shall promulgate the implementing rules and regulations necessary to carry out the provisions of this Act.



<sup>&</sup>lt;sup>19</sup> http://www.senate.gov.ph/lisdata/1954116659!.pdf

#### Japan

The Minamata Convention on Mercury held in Japan is a global treaty to protect human health and the environment from the negative effects of mercury. It was adopted in October 2013 and entered into force in August 2017

Annex A, Part II, of Article 4 on mercury-added products and dental amalgam outlines nine provisions for the phase-down of dental amalgam."20

Since the 1980s Japan has moved almost completely away from amalgam for aesthetic and environmental reasons. Amalgam has been replaced by composite resin, glass ionomer and gold/silver/palladium alloy.21

# Israel<sup>22</sup>

Under Circular No: \_32 / 2202\_ Jerusalem, 16 Av, 5763 2/32, July 22,2013 addressed to Directors of General Hospitals It was stated that mercury-containing medical equipment are a significant source of mercury, which flows into the environment and may harm public health, medical teams, and patients.

Purpose: Provision of an order to stop the use of medical usable containing mercury in Israel.

Liability: Responsibility for implementing this circular applies to the directors of the medical institutions.

The validity of this Circular- from the date of its publication. July 22, 2013

#### **Nepal**

Nepal Dental Association (NDA)—the umbrella organization of dental surgeons in the country—has made a declaration to pursue mercury-free dentistry to protect public from its harmful effects during Nepal's Mid-year Dental Conference in March 2019.

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<sup>&</sup>lt;sup>20</sup> Study on the potential for reducing mercury pollution from dental amalgam and batteries: Final report, European Commission-DG ENV, 11 July 2012, bio Intelligence Service

<sup>&</sup>lt;sup>21</sup> Lessons from Countries phasing down dental amalgam use, UNEP, March 2016.

<sup>&</sup>lt;sup>22</sup> https://www.health.gov.il/hozer/MR23\_2013.pdf

As per the declaration made, the mercury dental amalgam should not be used for dental treatment of deciduous teeth of children under 15 years and of pregnant or breastfeeding women. "

Dr Surendra Kumar Yadav, state minister for health and population, stated "The government is committed to making health care services and dentistry mercury-free in its National Health Policy"<sup>23</sup>

# East Africa - Kenya, Uganda, and Tanzania 24

The East Africa Dental Amalgam Phase-Down Project (EADAP) was implemented in Kenya, Uganda, and Tanzania in December 2013 with collaborative efforts of UNEP and WHO.

It engaged the Ministries of Environment and Health in Kenya, Tanzania and Uganda, as well as the iLima (an African NGO), the World Dental Federation (FDI), the International Association of Dental Manufacturers (IDM) and National Dental Associations.

The project examined supply and trade patterns, raised awareness of preventive dental care, encouraged alternatives and promoted environmentally sound waste management practices. The findings are useful for other countries aiming to phase down the use of dental amalgam.

Additionally, in Uganda the National Environmental Management Authority (NEMA) has proposed a total ban on the production, importation and exportation of products containing mercury, by 2020.

Although the Products which contain mercury like Mekako soap, skin lightening creams, pesticides, energy saving bulbs, thermometers, blood pressure devices and dental fillings mercury amalgam are to be banned from the country by 2020, Government will allow its use in certain critical areas, specifically healthcare, for the next four years.

# Vietnam

# Directive No: 261/KCB - QLCL&CĐT]

Health Service Administration Department requests all odonto-stomatological examination and treatment facilities nationwide perform the following tasks:

1. Stop using dental Amalgam for children under 15, pregnant and lactating women by April 1st, 2019;

2. Develop a roadmap to stop using dental Amalgam in dentistry from January 1st, 2021

 $<sup>{}^{\</sup>rm Page}18$ 

<sup>&</sup>lt;sup>23</sup> <u>https://kathmandupost.ekantipur.com/news/2019-03-04/dentists-commit-to-stopping-mercury-use-in-dental-fillings.html</u>

<sup>&</sup>lt;sup>24</sup>https://www.who.int/oral health/publications/2014 dental mercury phase down project brochure 19nov.pd f?ua=1

#### To summarize:-

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In the recent years, the risk benefit of the use of amalgam in dentistry has been censured. In the dental amalgam is increasingly seen as a potential menace to health and environment. Researchers are calling out policy makers in the health and environmental sectors to pay attention to the extent of the risk. At the moment, we see that countries indeed are phasing down the use of amalgam. Norway banned dental amalgam in 2008,<sup>[155]</sup> Sweden banned the use of dental amalgam for almost all purposes in 2009,<sup>[156]</sup> and Denmark, Estonia, Finland, and Italy use it for less than 5% of tooth restorations.<sup>[157]</sup> Japan and Switzerland have also restricted or almost banned dental amalgam.<sup>[158]</sup> France has recommended that alternative mercury-free dental materials be used for pregnant women, and Austria, Canada, Finland, and Germany have purposely reduced the use of dental amalgam fillings for pregnant women, children, and/or in patients with kidney problems.<sup>[159]</sup>