



MERCURY AND TOXIC METAL EFFECTS ON KIDNEYS, URINARY SYSTEM AND FERTILITY

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I. Introduction

A large U.S. Centers for Disease Control epidemiological study, NHANES III, found that those with more amalgam fillings (more mercury exposure) have significantly higher levels of chronic health conditions (543). Among the conditions where incidence was significantly correlated with having more than the average number of amalgam surfaces were diseases of the male and female genital tracts, and Diseases of the genitourinary system (543).

A 2009 study found that inorganic mercury levels in people have been increasing rapidly in recent years (543b). It used data from the U.S. Centers for Disease Control and Prevention's National Health Nutrition Examination Survey (NHANES) finding that while inorganic mercury was detected in the blood of 2 percent of women aged 18 to 49 in the 1999-2000 NHANES survey, that level rose to 30 percent of women by 2005-2006. Surveys in all states using hair tests have found dangerous levels of mercury in an average of 22% of the population, with over 30% in some states like Florida and New York (543c).

II. Mercury Exposure And Mercury Levels In Kidneys And Genitourinary System

Dental amalgam has been documented by thousands of medical lab tests and Government agencies to be the largest source of mercury in most who have amalgam dental fillings, and to be the largest source of mercury in kidneys (14, 85), where it bioaccumulates (14, 85, 273). Studies have found the number of dental amalgam fillings, chewing on amalgam, and fish consumption were positively associated with Urinary-HgC (85).

The number of amalgam surfaces has a statistically significant correlation to the mercury level in the renal (kidney) cortex (14, 16, 19, 20, 85, 254, 273, 348, 366). One study found levels ranging from 21 to 810 ppb. A study of levels in kidney donors found an average of 3 times higher mercury level in those with amalgams versus those without (14c, 85d). Studies found the number of amalgam surfaces has a statistically significant correlation to urine mercury level (38, 49, 57, 76, 77, 79, 82, 83, 134, 138, 167, 176, 254, 303, 332, 335).

Mercury levels of dental personnel average at least 2 times that of controls for urine (25d, 57, 64, 69, 99, 123, 124, 138, 171, 173, 222, 249, 290, 362, 397, 398, 399). Sweden, which voted to phase-out use of mercury in fillings, is the country with the most exposure and health effects studies regarding amalgam, and urine levels in dental professionals from Swedish and European studies ranged from 0.8 to 30.1 µg/L with study averages from 3.7 to 6.2 µg/L (64, 68, 124, 172, 253). The Swedish safety guideline for mercury in urine is 5.6 nmol Hg/nmol (11.6 µg/L). Study averages for other countries ranged from 3.3 to 36 microgram/litre (µg/L) (69, 70, 171, 290, 397). A large survey of dentists at the Norwegian Dental Association meeting (171) found that the mean mercury level in 1986 was 7.8 µg/L with approximately 16% above 13.6µg/L, and for 1987 found an average of 8.6 µg/L with approximately 15% above 15.8 µg/L, with women having higher levels than men in general.

A U.S. national sample of dentists provided by the American Dental Association had an average of 5.2 µg/L (70, 290). In that large sample of dentists, 10% of dentists had urine mercury levels over 10.4 µg/L and 1% had levels over 33.4µg/L (25c, 290), indicating daily exposure levels of over 100 µg/day. Researchers from the University of Washington School of Dentistry and Department of Chemistry tested a sample of dentists at an annual ADA meeting (230). The study found that the dentists had a significant body burden of mercury and the group with higher levels of mercury had significantly more adverse health conditions than the group with lower exposure.

Another study of a group of 194 U.S. male dentists with mean urine mercury level of 3.3 µg/L and 233 female dental assistants with mean urine mercury level of 2.0 µg/L considered effects of polymorphism in brain-derived neurotrophic factor (BDNF) as well as mercury level (290b). The study found significant effects of mercury level on 9 measures of neurological deficits for the dentists and on 8 measures of neurological deficits for dental assistants (290b), as well as a significant difference relating to BDNF.

A group of dental students taking a course involving work with amalgam had their urine tested before and after the course was over. The average urine level increased by 500% during the course (63). But dental staff have been found to have mercury retention and kidney effects that tend to cause lower measured levels of mercury in urine tests (258).

III. Toxic Effects Of Mercury (& Toxic Metals) On Kidneys And Genitourinary System

Mercury has been found to be nephrotoxic (toxic to kidneys) (14, 20, 203, 209c, 223, 254, 260, 268, 334, 438).

Mercury exposure has been shown to adversely affect kidney function in occupational and animal studies (20, 203, 211, 223, 260, 438), and also in those with more than average number of amalgam fillings (223, 254). Richardson (Health Canada) has estimated that about 20% of the population suffers a subclinical impairment of kidney or CNS function related to amalgam mercury (209c).

Inorganic mercury exposure has been found to exert a dose-dependent cytotoxicity by generating extremely high levels of hydrogen peroxide, which is normally quenched by pyruvate and catalase (203). HgCl₂ also has been found to impair function of other organelles such as lysosomes that maintain transmembrane proton gradient, and to decrease glutathione peroxidase activity in the kidneys while upregulating heme oxidase function. The Government's toxic level for mercury in urine is 30 mcg/L (189), but adverse effects have been seen at lower levels and low levels in urine often mean high mercury retention and chronic toxicity problems (258). For this reason urine tests are not a reliable measure of mercury toxicity (11, 36, 57, 183, 216, 258, 260, 503).

A survey of over 60,000 U.S. dentists and dental assistants with chronic exposure to mercury vapour and anaesthetics found increased health problems compared to controls, including significantly higher liver, kidney, and neurological diseases

(99,193). A recent study in Scotland found similar results (531). Some studies have found increased risk of lung, kidney, brain, and CNS system cancers among dental workers (14, 34, 99, 143, 283).

Mercury causes interruption of the cytochrome C oxidase system/ATP energy function (35, 43, 84, 232, 338c) and blocks enzymes needed to convert porphyrins to adenosine tri phosphate (ATP) causing progressive porphyrinuria, resulting in low energy, digestive problems, and porphyrins in urine (34, 35, 69, 70, 73, 210, 212, 226, 232, 258, 260).

Mercury and toxic metals have been found to be common toxic exposures that have been found to cause increased permeability of the kidney epithelial and brush border cells (338, 592).

In men, including workers occupationally exposed to mercury, U-HgC was positively associated with the kidney markers, especially with NAG, but to some extent also with A1M and albumin.

The primary detoxification/excretion pathway for mercury absorbed by the body is as mercury-glutathione compounds through the liver/bile loop to faeces (111, 252, 538), but some mercury is also excreted though the kidneys in urine and in sweat. A high fibre diet has been shown to be helpful in mercury detoxification (538). The range of mercury excreted in urine per day by those with amalgams is usually less than 15 µg (6, 49, 83, 138, 174, 335, etc.), but some patients are much higher (93).

A large NIDH study of the U.S. military population (49) with an average of 19.9 amalgam surfaces and range of 0 to 60 surfaces found the average urine level was 3.1 µg/L, with 93% being inorganic mercury. The average in those with amalgam was 4.5 times that of controls and more than the U.S. EPA maximum limit for mercury in drinking water(218). The average level of those with over 49 surfaces was over 8 times that of controls. The same study found that the average blood level was 2.55 µg/L, with 79% being organic mercury. The total mercury level had a significant correlation to the number of amalgam fillings, with fillings appearing to be responsible for over 75% of total mercury. From the study results it was found that each 10 amalgam surfaces increased urine mercury by approx. 1 µg/L. A study of mercury species found blood mercury was 89% organic and urine mercury was 87% inorganic (349b).

In a population of women tested In the Middle East (223e, 254), the number of fillings was highly correlated with the mercury level in urine, mean= 7 µg/L. Amalgam

has also been found to be the largest source of organic mercury in most people (79, 220, 386, 506, etc.). Nutrient transport and renal function were also found to be adversely affected by higher levels of mercury in the urine.

Significant correlations between increasing urine mercury concentrations and prolonged motor and sensory distal latencies were established (119e, 285g). Chronic immune activation is common in CFS, with increase in activated CD8+ cytotoxic T-cells and decreased natural killer (NK) cells (518). Numbers of suppressor-inducer T cells and NK cells have been found to be inversely correlated with urine mercury levels (270a, 270d). CFS patients usually improve and immune reactivity is reduced when amalgam fillings are replaced (342, 383, 405). Neurological effects have been documented at very low levels of exposure (urine Hg<4 µg/L), levels commonly received by those with amalgam fillings (290).

Mercury has been documented to be a common cause of hypothyroidism and autoimmune thyroiditis.

Studies have also established a “clear association” between the presence of thyroid antibodies in pregnant women and spontaneous abortions (511), as well as a connection between maternal thyroid disease and babies born with heart, brain, and kidney defects (509c).

Metals tend to cause cellular acidic conditions which lead to disease and measuring urine acidity is useful in this regard. Normal acidity is pH of about 6.8 (228a).

IV. Mercury And Reproductive System And Fertility

Mercury accumulates in the ovaries, testes, and prostate gland (9, 19, 20, 25, 35, 85, 99, 273, 543b). In addition to having oestrogenic effects, mercury has other documented hormonal effects including effects on the reproductive system resulting in lowered sperm counts, defective sperm cells, damaged DNA, aberrant chromosome numbers rather than the normal 46, chromosome breaks, and lowered testosterone levels in males and menstrual disturbances and infertility in women (4, 9, 10, 23, 27, 31, 35, 37, 38, 105, 146, 159, 395, 433). Nickel has also been found to accumulate in the prostate and be related to prostate cancer (581).

Mercury has been found to cause decreased sperm volume and motility, increased sperm abnormalities and spontaneous abortions, increased uterine fibroids/endometritis, and decreased fertility in animals (4, 104, 105, 162) and in humans (9, 10, 23, 27, 31, 35, 37, 58, 105, 146, 159, 395, 433). In studies of women having miscarriages or birth defects, husbands were found to typically have low

sperm counts and significantly more visually abnormal sperm (393). It's now estimated that up to 85 per cent of the sperm produced by a healthy male is DNA-damaged (433).

Abnormal sperm is also being blamed for a global increase in testicular cancer, birth defects, and other reproductive conditions. Studies indicate an increase in the rate of spontaneous abortions with an increasing concentration of mercury in the fathers' urine before pregnancy (37). Studies have found that mercury accumulates in the ovaries and testes, inhibits enzymes necessary for sperm production, affects DNA in sperm, causes aberrant numbers of chromosomes in cells, causes chromosome breaks, etc.- all of which can cause infertility, spontaneous abortions, or birth defects (10, 31, 35, 296).

Sub-fertile males in Hong Kong were found to have 40% more mercury in their hair than fertile controls. 'Infertile males with abnormal semen' and 'infertile females with unexplained infertility' also had higher blood mercury concentrations than their fertile counterparts (55). The number of amalgam fillings was found to be an important factor in success of treating male infertility (55c). From clinical experience some of the symptoms of mercury sensitivity/mercury poisoning include frequent urination.

Studies in monkeys have found decreased sperm motility, abnormal sperm, increased infertility and abortions at low levels of methyl mercury (162, 365). Mercury causes infertility (4, 9, 10, 24, 38, 55, 121, 146, 162, 357, 365, 367, 511, 512, 513, 514). A study by a neuroscience researcher found a connection between the levels of pituitary hormone lutropin and chronic mercury exposure (543b). The authors indicated that inorganic mercury binding to luteinising hormone can impair gonadotrophin regulation affecting fertility and reproductive function. The normalisation of pituitary function also often normalises menstrual cycle problems, endometriosis, and increases fertility (9, 35).

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V. Tests For Mercury Level Or Toxicity And Treatment

1. Faeces is the major path of excretion of mercury from the body, having a higher correlation to systemic body burden than urine or blood, which tend to correlate with recent exposure level (6b, 21a, 21b, 21d, 35, 36, 79, 80, 183, 278). For this reason many researchers consider faeces to be the most reliable indicator of daily exposure level to mercury or other toxics. The average level of mercury in faeces of populations with amalgam fillings is as much as 1 ppm and approximately 10 times that of a similar group without fillings (25, 79, 80, 83, 335, 386, 528), with significant numbers of those with several filings having over 10 ppm and 170 times those without fillings (80). For those with several fillings daily faecal mercury excretion levels range between 20 to 200 µg/day.

2. The saliva test is another good test for daily mercury exposure, done commonly in Europe and representing one of the largest sources of mercury exposure. There is only a weak correlation between blood or urine mercury levels and body burden or level in a target organ (6b, 11, 21a, 21b, 21d, 36, 157, 183, 258, 278). Mercury vapour passes through the blood rapidly [half-life in blood is 10 seconds(370)] and accumulates in other parts of the body such as the brain, kidneys, liver, thyroid gland, pituitary gland, etc. Thus blood test measures mostly recent exposure.

3. Kidneys have a lot of hydroxyl(SH) groups which mercury binds to causing accumulation in the kidneys, and inhibiting excretion (503). As damage occurs to kidneys over time, mercury is less efficiently eliminated (11, 36, 57, 183, 216, 258, 260, 503), so urine tests are not reliable for body burden after long term exposure. Some researchers suggest hair offers a better indicator of mercury body burden than blood or urine (21a, 21b, 279), though still not totally reliable and may be a better indicator for organic mercury than inorganic.

The median daily exposure through saliva for those with 10 or more fillings was over 10 times that of those with no fillings (199, 292, 315, 318). Mercury level in saliva has been found to give much better indication of body levels than blood or urine levels (36). Most people with fillings have daily exposure levels exceeding the U.S. ATSDR and EPA health guideline levels (2, 36, 83, 89, 93, 183, 199, 209, 217, 261, 292, 335). Note that the WHO standard assumes exposure for a 40 hour week with no other exposure, which gives large differences with standards or guidelines based on assuming continuous exposure.

4. A new test approved by the FDA for diagnosing damage that has been caused by toxic metals like mercury is the fractionated porphyrin test (35, 260), that measures

amount of damage as well as likely source. Mercury blocks enzymes needed to convert some types of porphyrins to haemoglobin and adenosine tri phosphate(ATP). The pattern of which porphyrins are high gives an indication of likely toxic exposure, with high precoproporphyrin almost always high with mercury toxicity and often coproporphyrin.

5. Provocation challenge tests after use of chemical chelators such as DMPS or DMSA also are effective at measuring body burden (57, 58), but high levels of DMPS can be dangerous to some people – especially those still having amalgam fillings or those allergic to sulphur drugs or sulphites.

The interruption of the ATP energy chemistry results in high levels of porphyrins in the urine (260).

Mercury, lead, and other toxics have different patterns of high levels for the 5 types of porphyrins, with pattern indicating likely source and the level extent of damage. The average for those with amalgams is over 3 time that of those without, and is over 20 times normal for some severely poisoned people (232, 260). The FDA has approved a test measuring porphyrins as a test for mercury poisoning. However some other dental problems such as nickel crowns, cavitations, and root canals also can cause high porphyrins.

Cavitations are diseased areas in bone under teeth or extracted teeth usually caused by lack of adequate blood supply to the area. Tests by special equipment (Cavitat) found cavitations in over 80% of areas under root canals or extracted wisdom teeth that have been tested, and toxins such as anaerobic bacteria and other toxics which significantly inhibit body enzymatic processes in virtually all cavitations (200, 437a, 437b). These toxins have been found to have serious systemic health effects in many cases, and significant health problems to be related such as arthritis, MCS, and CFS. These have been found to be factors along with amalgam in serious chronic conditions such as MS, ALS, Alzheimer's, MCS and CFS (35, 200, 204, 222, 292, 437). The problem occurs in extractions that are not cleaned out properly after extraction.

Also high mercury exposures with low hair mercury or urine mercury level usually indicates body is retaining mercury and likely toxicity problem (35). In such cases where (calcium > 1100 or < 300 ppm) and low test mercury, manganese, zinc, potassium; mercury toxicity likely and hard to treat since retaining mercury.

Use of urine test:

A group of German children with amalgam fillings had urine mercury level 4 times that of a control group without amalgams (76), while a Canadian study found 3.2 times as much exposure in those with amalgam with adverse health effects (low weight and height) (76c), and in a Norwegian group with average age 12 there was a significant correlation between urine mercury level and number of amalgam fillings (167).

A study (169) found blood and urine mercury levels to be very strongly related to Parkinson's with odds ratios of approximately 20 at high levels of Hg exposure.

Occupational studies have found that the number of suppressor-inducer immune cells and natural killer cells are significantly negatively correlated with urine mercury level (270a, 270d).

VI. Treatment Of Mercury Toxicity

Most patients with chronic health conditions related to mercury toxicity from amalgam recover or significantly improve after amalgam replacement (please refer to Results of removal of amalgam fillings).

After replacement of amalgam fillings, levels of mercury in the blood, urine, and faeces typically temporarily are increased for a few days, but levels usually decline in blood and urine within 6 months to from 60 to 85% of the original levels (57, 79, 82, 89, 196, 303). Removal of amalgam fillings resulted in a significant reduction in body burden and body waste product load of mercury (75, 82, 88, 89, 93, 95, 115). Total reduction in mercury levels in blood and urine is often over 80% within a few months (57, 79, 82, 89, 93, 115). On average those with 29 amalgam surfaces excreted over 3 times more mercury in urine after DMPS challenge than those with 3 amalgam surfaces, and those with 45 amalgam surfaces more than 6 times as much mercury (12b).

Recovery after amalgam replacement: infertility (9, 35, 38, 229, 367), endometriosis (9, 35, 38, 229)

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