

# Mercury Vapour in the Oral Cavity in Relation to Number of Amalgam Surfaces and the Classic Symptoms of Chronic Mercury Poisoning.

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## *Abstract*

*This study shows that individuals with dental amalgam fillings who exhibit symptoms typical of chronic mercury poisoning, all have mercury vapour concentrations in their oral cavity far higher than acceptable levels and on average, higher than the maximum permitted levels for the industrial environment. Results indicate that those patients with only amalgam fillings, high concentrations of mercury vapour in the oral cavity, and who have also many amalgam surfaces, exhibit on average more symptoms than those with lower concentrations of mercury vapour and few amalgam surfaces. The results indicate that the presence of symptoms is not solely dependent on the size of mercury dose.*

## **Introduction**

Ever since the 1920s, it has been known that "silver" amalgam fillings liberate mercury vapour in concentrations regarded as hazardous. Professor Alfred Stock demonstrated this with an impressive accuracy, especially for that era.<sup>1</sup>

Mercury is an unusual metal which is liquid at room temperature and which evaporates very easily. In the form of vapour, mercury is easily absorbed through the air passages and the mucosa into the blood which spreads it throughout the body at high speed.<sup>2,3</sup> Mercury emerges in all tissues and organs. Examinations have shown that it passes the brain barrier easily, and comparable concentrations have been found in brain and muscular tissues.<sup>4</sup> Many scientific studies show that mercury vapour accumulates easily and dramatically in the muscular tissue of the heart, and that mercury is the most probable cause

of many heart and vascular diseases.<sup>5</sup> In the case of pregnant women, mercury passes completely unhindered through the placenta to the embryo, and it has been shown that the concentration of mercury in the blood of an embryo can be up to 30 times higher than in the blood of the mother.<sup>6</sup> Gustav Drasch, the medical jurist and professor of toxicology at the University of Munich, has carried out new and impressive studies which show that the quantity of mercury in aborted embryos and dead infants corresponds to the number of amalgam fillings which the mother has.<sup>7</sup>

Many crafts and industries have, in the past, made use of the metal mercury or of easily vapourizing mercury combinations. Within medicine, mercury and mercury combinations were used as treatment, disinfectant and preservatives, for instance against syphilis, in mercurochrome and in vaccinations. Gradually, the use of mercury has been prohibited by law, as it is now realized that mercury is extremely injurious to living creatures even in extremely small quantities, and especially in its vapourized form.

In order to protect people against poisonous mercury vapours in the work place, maximum permitted levels have been set to control the amount of mercury which the air may contain before the authorities demand changes in working practices and special provisions using filters and exhaust mechanisms.

Here in Denmark, the maximum permitted level of mercury vapour has been set at 50 microgram mercury vapour per cubic metre air in an area where people work eight hours a day five days a week. In Russia and Switzerland, the maximum permitted level has been set at 10 microgram mercury vapour per cubic metre. In Germany and U.S.A. it is 100 microgram per cubic

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metre air in a given work area.

A Health Canada report entitled "Assessment of Mercury Exposure and Risk from Dental Amalgam" was published on 27 Nov. 1995 in conjunction with the first "Amalgam Stateholder Meeting" in Toronto. This Risk Assessment report recommends the establishment of a "Tolerable Daily Intake (TDI)" for mercury vapour and suggests the number of dental amalgam fillings for various age groups that will not exceed the TDI. A TDI of 0.014 mcg Hg/kg body weight/day was proposed for mercury vapour, the principal form of mercury to which bearers of amalgam fillings are exposed. The number of amalgam-filled teeth, for each age group, estimated to cause exposure equivalent to the TDI were: one filling in toddlers and children; three fillings in teenagers; and four fillings in adult and seniors.<sup>8</sup>

In its report on inorganic mercury, published in 1991, WHO states that, on the basis of many scientific studies, it is impossible to set a minimum risk level where no damages and symptoms of chronic mercury poisoning may occur.<sup>9</sup> In other words, we are officially advised to inhale as little mercury as possible, as some people exhibit symptoms from even very low concentrations of mercury in the inhaled air. According to WHO, the greatest source of mercury in the body is our amalgam fillings.<sup>9</sup>

Officially, the attitude still prevails that mercury is so strongly bound in amalgam fillings that leakage is very minimal, and that it is almost impossible to measure. However, studies have shown, especially within the last 10 years, that free mercury may be seen pearling on the surface of the amalgam fillings, and that high concentrations of mercury vapour can be measured in the oral cavity, especially after chewing food, and consuming hot or sour drinks.<sup>10,11</sup>

## Methods and Result

All new patients suspected of chronic mercury poisoning caused by their amalgam fillings and who came to the clinic

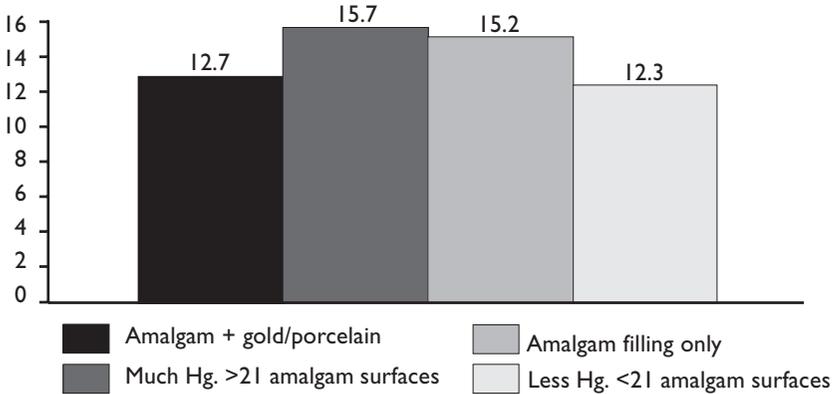
over a period of time, received (as usual) a thorough odontologic examination and anamnesis. In addition, they were all measured for mercury vapour concentrations in the oral cavity in microgram per cubic metre air (mcg Hg/m<sup>3</sup>).

The measuring instrument is a Jerome 413X from Texas Instruments which measures mercury vapour with the accuracy of 1 microgram per cubic metre air. All patients filled out a questionnaire containing questions on 38 chosen typical chronic poisoning symptoms and complains.

Figure 1 (page 89) relates the number of symptoms for all participants to the average number of amalgam surfaces, as well as whether the amalgams were also associated with gold and/or porcelain fillings.

One-hundred-three individuals took part in the study of whom 72 were women and 31 men, aged from 26 to 79 years, with an average age of 47 years. The 103 individuals of the study had on average 14 symptoms each. The highest mercury vapour concentration in the oral cavity was measured at 329 mcg Hg/m<sup>3</sup> air, and lowest measurement was 3 mcg Hg/m<sup>3</sup> air. The average concentration of mercury vapour in the group was 54.6 mcg Hg/m<sup>3</sup> air. Fifty-eight of the participants had between 25 and 75 mcg Hg/m<sup>3</sup> air. Those individuals who had only amalgam fillings and those who had high mercury vapour and many amalgam surfaces had, on average, more symptoms than those who had also gold/porcelain/metal and those with lower mercury vapour and few amalgam surfaces.

Those individuals with more than 50 mcg Hg/m<sup>3</sup> air had on average 26.8 amalgam surfaces and 1.2 gold surfaces per person, and those with less than 50 mcg Hg/m<sup>3</sup> air had only 19.8 amalgam surfaces, but 1.8 gold surfaces per person. The largest number of amalgam surfaces per person was 63 and the lowest was 2. The average number of amalgam surfaces per person was 22.5. Apart from their amalgam fillings, 24 individuals also had gold fillings,



**Figure 1.** Average Number of Symptoms in Relation to Amount of Different Metals + Hg. Vapour

two had steel crowns and 24 had metal/porcelain crowns.

**Figure 2** (page 90) shows the specific symptoms for those with only amalgam fillings; amalgam and gold/porcelain fillings; those with more than 50 mcg Hg/m<sup>3</sup>; those with less than 50 mcg Hg/m<sup>3</sup>; those who had more than 21 amalgam surfaces; those with less than 21 amalgam surfaces. The most frequent symptoms experienced by more than 50 percent of the participants were: fatigue, poor concentration, poor memory, bloating, joint pain, muscle fatigue, cold hands and feet, irritability and headache. Those individuals with higher mercury vapour concentration than average suffered more frequently from intestinal cramps, irritability, dizziness and leg cramps. It seems that individuals with a lower concentration of mercury vapour than average more often get symptoms such as sore throat, depression and chest pain.

**Figure 3** (page 91) shows that there is a small difference in the average number of symptoms (14.9 and 14.4) depending on the number of amalgam surfaces. Those with many amalgam surfaces have on average, higher mercury vapour concentrations in the oral cavity than those with few amalgam surfaces.

It would seem that the number of individual symptoms varies depending on

the number of amalgam surfaces present. The frequency in occurrence of different symptoms varies widely, depending on whether the patients have amalgams as well as gold/porcelain fillings, or whether they have only amalgams.

Individuals with only amalgam fillings have on average a much higher frequency of the following symptoms: Tender teeth, bad breath, metallic taste, facial tension, nasal congestion, bloating, intestinal cramps, headache, migraine, fatigue, poor concentration, poor memory, irrational fear, irritability, depression, dizziness, muscle fatigue, leg cramps and frequent infections.

Individuals with amalgam fillings and gold/porcelain and other metal in their mouths have, on average, a higher frequency of the following symptoms: bleeding gums, diarrhea, constipation, sciatic pain, heart problems and urinary disorders.

### Mercury Vapour Measurement

All those who took part in this study had four measurements taken of the mercury vapour concentration at various places in the oral cavity. Each person had further measurements taken after ten minutes of chewing gum. The measurement showed that if they chewed on the fillings, the release of mercury vapour

**Figure 2.** Symptoms: The 103 participants in this study had on average the following symptoms expressed as a percentage

Symptoms / complaints.	Symptoms for those with amalgam fillings only						
	Symptoms for those with amalgams and porcelain/gold fillings		Symptoms for those with less than 21 amalgam surfaces		Symptoms for those with more than 21 amalgam surfaces		Symptoms for those with less than 50 mcg. Hg/m <sup>3</sup>
	Symptoms for those with more than 50 mcg. Hg/m <sup>3</sup>		Symptoms for those with less than 50 mcg. Hg/m <sup>3</sup>		Symptoms for those with more than 50 mcg. Hg/m <sup>3</sup>		Symptoms for all participants in the group
Allergy	36	34	37	38	34	35	35
Skin reaction	33	34	32	36	30	24	38
Bleeding gums	24	24	24	34	16	24	23
Tender teeth	37	34	40	36	39	30	43
Bad breath	29	37	32	28	30	19	35
Metallic taste	43	39	47	45	43	30	51
Blisters & sores	30	27	32	32	29	24	32
Watery eyes	29	27	31	28	30	24	31
Sore throat	35	29	39	36	34	32	37
Facial tension	50	49	50	53	46	27	62
Nasal congestion	33	37	31	30	36	21	40
Nasal discharge	30	32	29	34	37	30	31
Bloating	60	51	66	55	64	58	43
Hunger pain	46	49	44	43	48	46	43
Poor appetite	12	15	11	11	14	14	8
Diarrhea	25	27	32	23	27	22	30
Constipation	33	39	31	34	34	31	41
Intestinal cramps	38	49	32	38	39	46	24
Headache	53	54	53	53	54	43	58
Migraine	12	12	13	21	5	8	14
Fatigue	76	78	76	81	73	70	80
Poor concentration	69	71	68	70	68	54	77
Poor memory	65	61	68	66	64	51	72
Irrational fear	36	37	35	21	39	30	40
Irritability	52	63	45	55	50	41	58
Depression	33	24	39	36	30	24	38
Insomnia	46	41	50	43	50	46	48
Dizziness	49	61	42	51	48	41	54
Muscle fatigue	58	54	61	62	55	51	62
Muscle tremor	33	37	32	34	34	30	35
Sciatic pain	38	39	37	34	41	43	35
Chest pain	22	20	32	21	23	21	23
Legs cramps	27	37	21	30	25	21	29
Joint pain	60	59	61	62	59	62	58
Cold hands/feet	53	54	53	57	50	51	54
Heart problems	14	10	18	11	18	19	12
Urinary syst.disorders	19	20	19	23	16	27	14
Frequent infections	19	17	21	21	18	16	22

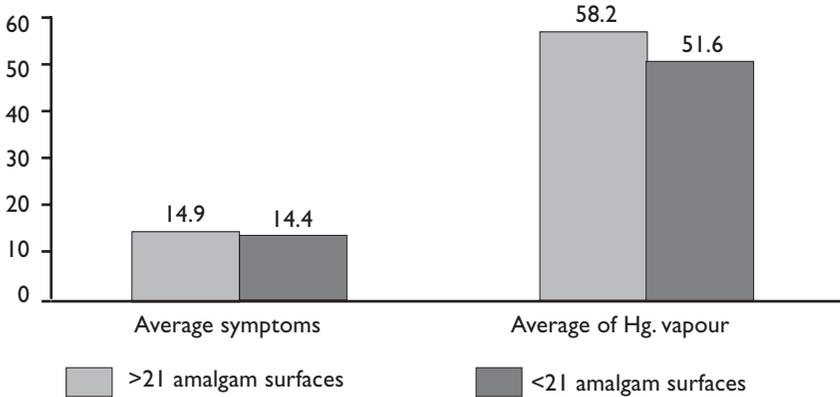


Figure 3. Average Number of Symptoms and Mercury Vapour with Few and Many Amalgam Surfaces

increased in most cases. This was expected, as this effect has been demonstrated in many studies. This study was designed to find the approximate average mercury vapour concentration for each individual. I therefore chose to use the highest of the four first measurements that was made before chewing as an acceptable measure for the average concentration of mercury vapour in the oral cavity.

### Description of Symptoms

All of the 103 individuals who participated in the study filled in a questionnaire with 38 typical mercury poisoning symptoms. They were asked whether they often suffer from the listed symptoms and complaints. The participants of the study had 1445 symptoms in all, or an average of 14 symptoms per individual. Individuals with more than the average of 21 amalgam surfaces and more than 55 mcg Hg/m<sup>3</sup> air, which is the average measured on the 103 participants, had, on average, 15.2 symptoms. Those with only amalgam fillings had almost the same average number of symptoms, namely 15.7 per person. For those who had gold/porcelain too, the average number of symptoms was 12.7.

Individuals with less than 21 amalgam surfaces, and less than 55 mcg

Hg/m<sup>3</sup> air, had an average of only 12.3 symptoms. Apparently, the number of amalgam surfaces and the amount of mercury vapour concentration seem to have a distinct influence on the number of symptoms. (Figure 1.)

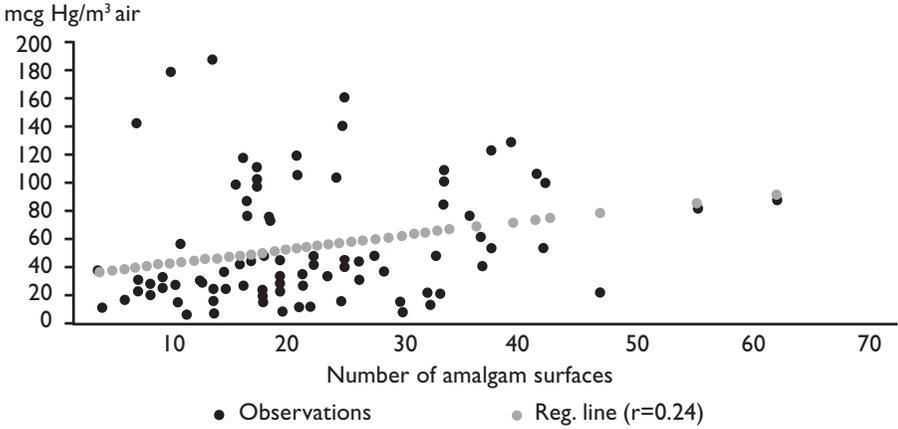
There is a clear connection between the mercury vapour concentration and the number of amalgam surfaces, as can be seen from the reference line. the correlation coefficient  $r = 0.24$ . If you subtract the 10 percent of the measured result that varies most from the reference line, the correlation is stronger ( $r = 0.47$ ). (Figure 4, page 92)

### Discussion

When the correlation between the mercury vapour concentration and the number of amalgam surfaces is not very clear, it may be due to the following circumstances:

1) that for more than 20 years an amalgam with 10 percent more copper has been used (High Copper Amalgam). It is known from scientific studies that this type of amalgam releases up to 50 times as much mercury and copper as types of amalgam used in the past.<sup>12</sup> Many individuals have had this type of amalgam, and it is impossible to see the difference between the two types of fillings.

2) that one third, 37 of the participants of the study, besides having amalgam



**Figure 4.** Concentration of Mercury Vapour (mcg Hg/m³ air) in Relation to Number of Amalgam Surfaces

also have gold fillings/crowns or metal/porcelain crowns. This mixing of various metals in the mouth is known to give added corrosion of the amalgam fillings, which means that more mercury is released from the fillings, but mainly as a product of corrosion and not as mercury vapour.<sup>13</sup>

3) that some of the patients had activated their amalgam fillings just before we performed the measurement, for instance by having brushed their teeth, or had a warm drink or by chewing gum, which may have influenced the result of the measurement.<sup>14</sup> Using only individual symptoms yields a greater variance in the number of symptoms depending on the concentration of mercury vapour in the participants of the study, and on the number and kind of metals they have in the teeth. This study shows that individuals with high mercury vapour concentrations in the oral cavity also have the most symptoms including intestinal cramps, irritability, dizziness and leg cramps.

It also appears that those with amalgam fillings only have far more tender teeth, bad breath, skin reactions, blisters and sores, metallic taste, facial tension and nasal congestion, bloating and intestinal cramps compared with those who have also gold/porcelain/metal. Also, symptoms such as headache, migraine, fatigue, poor concentration,

poor memory, irrational fears, irritability, depression and dizziness, muscle fatigue, leg cramps and frequent infections were more prevalent with the participants who have only amalgam fillings.

Those who, besides their amalgam fillings, also have gold/porcelain/metal in their teeth, seem to have on average a higher frequency of bleeding gums, diarrhea, constipation, sciatic pain, heart problems and urinary disorders.

Many studies have shown that metals in the oral cavity corrode one another, and that these corrosion products are harmful to some individuals.<sup>15</sup> Scientific studies show that if an individual is exposed to mercury vapour from amalgam fillings through each breath 17,000 times daily, this may result in many different symptoms, complaints and illness. The mercury is quickly received through the lungs and travels through the bloodstream to all organs of the body.

For example, the heart musculature is especially exposed as mercury quickly and dramatically accumulates in this important muscle. This may lead to destruction of areas of the heart muscle which may again lead to symptoms such as pain in the heart region, fatigue and other heart symptoms.<sup>16,17,18,19</sup> Some participants of this study have experienced these symptoms. In many earlier published studies it has been

shown that removal of all amalgam fillings results in a remarkable decrease in the number of symptoms, as 8-9 out of 10 symptoms get better or disappear. Or to put it another way, individual symptoms are reduced from 60-100 % after one year or more from the time of change.<sup>20,21</sup>

It is important to point out that though an individual may inhale relatively large quantities of mercury, this does not necessarily translate directly into injury. There is an enormous difference in the resistance levels of different individuals, but inhaling mercury vapour will always be a hazard to one's health.<sup>22,23,24</sup>

Attempts have been made to set a safe minimum risk level for mercury vapour. The Agency for Toxic Substances and Disease Registry (ATSDR) of the U.S.A. Public Health Service has recently published a list of 275 of the most dangerous substances that represent of potential threat to the health. Mercury is one of these substances.

ATSDR has recently reduced the maximum recommended level daily chronic inhalation of metallic mercury vapour from 0.028 to 0.014 mcg Hg/m<sup>3</sup> air per kilogram body weight.<sup>25</sup>

## Conclusion

This study shows that the mercury vapour concentration in individuals with symptoms of chronic mercury poisoning is on average 54.6 mcg Hg/m<sup>3</sup> air and consequently above the maximum permitted limit for the working environment of 50 mcg Hg/m<sup>3</sup> air, 5 days a week, 8 hours a day, and far above the set maximum permitted level of 0.014 mcg Hg/m<sup>3</sup> air per kilogram body weight, comparable to one microgram for a person of 70 kilograms.

Furthermore, the study shows that on average there is a difference in the number of single symptoms in individuals with many amalgam fillings and high mercury vapour concentrations compared with individuals with few amalgam fillings and lower vapour concentration.

Certain symptoms, including bleeding gums, blister and sores, skin reactions, facial tension, metallic taste and some others seem to be more frequent than those who have many fillings, or only amalgam fillings.

Those who, besides the amalgam fillings, have also gold/porcelain or other metal in their teeth, more often experience diarrhea or constipation

The results of the study indicate that the dosage of mercury acquired is not the only decisive factor determining whether symptoms are experienced.

Other important factors include the presence of metals apart from amalgam, which type of amalgam is present, length of time exposed to mercury, as well individual tolerance levels. Additionally, symptoms which are promoted by these factors seem to differ widely. This study demonstrates that metals, and particularly the amalgam used in dentistry today, are an important cause of increased mercury levels in the human body.

Results indicate that mercury poisoning from the amalgam fillings is widespread throughout the population.

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