Background Information for the revision of the IADR Statement

Aim

The recent IADR policy statement and the position statement on safety of dental amalgam dated back to 2020 and the literature up to 2019 had been addressed. In the course of updating these IADR statements, the relevant literature from 2019 to 2024 has been evaluated. The general structure of the previous version of the statement was maintained while incorporating the recent literature to update the content.

Method

Here, PubMed/Medline data bank and Cochrane Database of Systematic Reviews has been searched for using the key words "amalgam" and toxicity" for the time period between January 1st 2019 and July 28, 2024. The search yielded 176 hits published in English language in total and a list is provided as appendix 1. The abstract of all 54 citations has been checked and the publications were categorized into the following groups:

- Narrative review
- Systematic review
- Association studies between Hg/amalgam exposure and systemic health effects
- Association studies between Hg/amalgam exposure and local health effects
- In vitro investigations on Hg/amalgam using different cell culture techniques
- Studies on mercury, but directly addressing dental amalgam in the study design
- Exposure studies
- Epidemiology: Frequency of use for amalgam
- Statements of professional organizations

Result

The distribution of the hits to these categories is shown in Table 1.

Table 1: Summary of references from 2019 to 2024 from PubMed/Medline, Cochrane Database, assessed July 28, 2024. Total: 176 references

	Narrative review	Syst. review	Association Study - systemic	Association Study - local	In vitro	Other materials, other mercury	Exposure studies	Epidemiology/ frequency of use	Statements
amount	26	7	27	8	7	24	20	11	3

Ref Number	4, 7, 9, 14, 16, 21, 27 (Cochrane), 28, 31, 33, 34, 40, 42, 45, 49, 52, 53, 56, 72, 76, 83, 87, 99, 109, 144,176	13, 18, 50, 60, 71, 113, 128	1, 5, 10, 12, 24, 26, 29, 37, 38, 41, 48, 51, 67, 106, 108, 122, 127, 132, 133, 134, 136, 138, 147, 156, 159, 163, 166	20, 70, 77, 84, 96, 119, 126 (pulp), 149	2, 30, 39, 44, 85, 148, 154	3, 17, 19, 32, 57, 59, 63, 68, 86, 89, 92, 97, 100, 101, 105, 107, 130, 146, 152, 155, 160, 162, 168, 174	6, 8, 43, 46, 65, 75, 94, 95, 102, 115, 150, 153, 170, 171 **Environment:** 25, 62, 66, 80, 129, 140	11, 15, 79, 118, 120, 135, 139, 142, 151, 158, 161	FDI: 22, 23 IADR: 112

50 references

Others (43 references):

35	Information on amalgam toxicity knowledge in Saudi Arabia **not included, not the topic**
36	case report: **not included, case report**
47	therapy detox study: amalgam and titanium implants **not included: not the topic**
54	Cytotoxicity study on amalgam alternatives **not included: not the topic**
55	Letter to the editor, not included
58	secondary caries, not included
61	Letter to the editor, not included
64	Periodontal Health, not included
69	Secondary Caries, not included
73	Letter to the editor, not included
74	Influence on beam diffraction, not included
78	Case Report, not included
81	Amalgam detection in environment, not included
82	Case Report, not included
88	Secondary Caries, not included
90	Amalgam detection in environment, not included

91	Amalgam detection in environment, not included
93	Letter to the editor, not included
98	Clinical success of bonded amalgam, not included
103	Amalgam detection in environment, not included
104	Amalgam detection in environment, not included
110	Influence on beam diffraction, not included
111	mechanical testing, not included
114	no investigation of amalgam, not included
116	secondary caries, not included
117	Case Report, not included
121	retrograde fillings, not included
123	Amalgam detection environment, not included
124	Bonding and microleakage, not the topic, not included
125	Case Report, not included
131	mechanical testing, not included
137	bonding, not included
141	Amalgam detection in environment, not included
143	Amalgam detection in environment, not included
145	Amalgam detection in environment, not included
157	Case Report, not included
164	Amalgam detection in environment, not included
165	Case Report, not included
167	Case Report, not included
169	Case Report, not included
172	Case Report, not included
173	Microleakage, out of scope, not included
175	Case Report, not included

Hand searches

- FDI Policy on amalgam alternatives **included**
- Longevity of resins composites **included**
- EU Legislation on amalgam ban from 2024: **included**
- EU/UK agreement to maintain dental amalgam In Northern Ireland through **2024: included**
- Yin et al 2021 Children "as well as a strong association between
- urinary mercury and the number of the amalgam fillings"… "maximum approximately 3.2 mg/L"… "In Urine, the geometric means of IHg were 0.23, 0.19, 0.18, 0.18, 0.20, and 0.19, mg/l in group 1 and 0.40, 0.31, 0.27, 0.25, 0.25, and 0.25 mg/l in group 2 for each age category, while values were 0.17, 0.17, 0.17, 0.17, 0.17, and 0.18 mg/l in group 0 among different age categories" **included**

Detailed analysis of the PubMed hits

For all references, except for narrative reviews, in vitro studies and studies covering mercury toxicity but not amalgam in the study design, further evaluations have been performed. Clinical evaluations with n<500 were excluded.

The narrative reviews # 27 (Cochrane report) and comparative evaluation between amalgam and composite resins may be considered for inclusion.

Systematic reviews

Seven systematic reviews were assessed.

1. Ref 13
   Maternal Mercury Exposure and Hypertensive Disorders of Pregnancy: A Systematic Review.
   Dantas AO, Castro TDSDS, Câmara VM, Santos ASE, Asmus CIRF, Vianna ADS. Rev Bras Ginecol Obstet. 2022 Dec;44(12):1126-1133. doi: 10.1055/s-0042-1760215. Epub 2022 Dec 29. PMID: 36580940 Free PMC article.
   Content
   Objective: The present review aimed to synthesize the evidence regarding mercury (Hg) exposure and hypertensive disorders of pregnancy (HDP).
   Two studies found a positive association between Hg and HDP in the group with more exposure, and the other four did not present it.
   The absence or no proper adjustment for negative confounding factor, such as fish consumption, was observed in five studies.
   Comment
   No firm evidence for an association with HDP of pregnancy was found. **CAN BE INCLUDED**

2. Ref 18
   How Do Different Physical Stressors' Affect the Mercury Release from Dental Amalgam Fillings and Microleakage? A Systematic Review.
   Keshavarz M, Eslami J, Abedi-Firouzjah R, Mortazavi SA, Abbasi S, Mortazavi G. J Biomed Phys Eng. 2022 Jun 1;12(3):227-236. doi: 10.31661/jbpe.v0i0.2009-1175. eCollection 2022 Jun. PMID: 35698539 Free PMC article.
   Content
   The data extracted from the 13 articles reviewed. 5 studies no or little effect, 8 studies increased corrosion, mainly in vitro. No information on the health effect
   Comment
   Mainly in vitro studies, no indication of related health effects **CANNOT BE INCLUDED**

3. Ref 50

Human exposure to mercury and its hematological effects: a systematic review. Vianna ADS, Matos EP, Jesus IM, Asmus CIRF, Câmara VM. Cad Saude Publica. 2019 Feb 11;35(2):e00091618. doi: 10.1590/0102-311X00091618. PMID: 30758455 Free article.

Content

The main goal of this study was to assess the available evidence on human exposure to mercury and its hematological effects in articles published from 1950 to February 2018.

Search strategy: mercury together with hematological terms

NOT AMALGAM

14 studies that aimed at hematological effect as the primary outcome…..

The main exposure pathway for children/teenagers was food consumption, mainly fish and shellfish, although rice may be another methylmercury source for Asians 58. Another concern regarding this group is the fact that this silver liquid metal - found at home, at school and at others sites where it is not adequately stored - is seen by them as an amusing substance to play with, which may cause health problems…..

Comment

Study not related to amalgam **CANNOT BE INCLUDED**

4. Ref 60

Jonidi Jafari A, Esrafili A, Moradi Y, Mahmoudi N. Mercury level in biological samples of dentists in Iran: a systematic review and meta-analysis. J Environ Health Sci Eng. 2020 Oct 8;18(2):1655-1669. doi: 10.1007/s40201-020-00558-w. PMID: 33312669; PMCID: PMC7721756.

DOI: 10.1007/s40201-020-00558-w

Content

In order to prevent bias in this study and identify eligible studies, various steps of the study was performed independently by two researchers. Out of 13 studies in the meta-analysis process which included 1499 IDs, the mean of the mercury level in the urine, nail, and blood was estimated to be 6.29 (95% CI: 2.61–9.97, I-square: 62.7%, P: 0.006), 3.54 (95% CI: 2.81–4.28, I-square: 0.0%, P: 0.968), 11.20 (95% CI: 2.28–20.13, I-square: 59.9%, P: 0.082), respectively. The mean mercury level (MML) in the biological samples of IDs was higher than the standard of World Health Organization (WHO).

So, in accordance with Article 10 of the European Union Regulations (EUR), in the context of the Minamata Convention (MC) on Dental Amalgam (DA), in order to avoid the dangers of mercury exposure in dentists, **it is necessary for Iran and other countries to approve laws and to implement a national plan** to reduce mercury levels and replace the appropriate materials.

in some parts of the world have banned or reduced the use of this substance in dentistry. For example, the use of DA is banned in countries such as Norway [53] and Sweden [54] and, in other countries such as Japan and Switzerland [29], the use

of fillers is banned. However, DA use in other countries such as Denmark, Finland, Estonia, and Italy accounts for less than 5% of the total dental restoration [29]. According to WHO's guideline, the mercury levels of 5 μg/l, 4 μg/l, and 2 μg/g were considered as "reference values" in the blood, urine, hair, and nail of humans, respectively [12, 49].

Comment

Not to include

Ref 71

Mohammadi S, Shafiee M, Faraji SN, Rezaeian M, Ghaffarian-Bahraman A. Contamination of breast milk with lead, mercury, arsenic, and cadmium in Iran: a systematic review and meta-analysis. Biometals. 2022 Aug;35(4):711-728. doi: 10.1007/s10534-022-00395-4. Epub 2022 May 16. PMID: 35575819.

DOI: 10.1007/s10534-022-00395-4

Content

The Hg mean concentration in the breast milk of mothers with at least one amalgam-filled tooth was approximately three times that of mothers without amalgam-filled teeth. Risk assessment analysis indicated that the intake of Pb and Hg by infants through breastfeeding can be considered a health concern in Iran. It seems necessary to reduce the Pb exposure of pregnant and lactating women in Iran. However, more extensive studies are needed to clarify the toxic metals' exposure status of infants through breast milk in other parts of the country.

Comment

No information on dental amalgam, **Exclude**

6. Ref 113

Rahat S, Kashetsky N, Bagit A, Sachdeva M, Lytvyn Y, Mufti A, Maibach HI, Yeung J. Can We Separate Oral Lichen Planus from Allergic Contact Dermatitis and Should We Patch Test? A Systematic Review of Chronic Oral Lichenoid Lesions. Dermatitis. 2021 May-Jun 01;32(3):144-150. doi: 10.1097/DER.0000000000000703. PMID: 33273245.

DOI: 10.1097/DER.0000000000000703

Content

For patients with OLLs, 91.6% of the patients with positive patch tests and 82.9% with negative patch tests had improvement with removal of amalgam, whereas for patients with OLP, 89.2% of the patients with positive patch tests and 78.9% with negative patch tests had improvement with removal of amalgam.

Comment

Amalgam removal leads to improvement of OLLs. Not to include.

7. Ref 128

Gallusi G, Libonati A, Piro M, Di Taranto V, Montemurro E, Campanella V. Is Dental Amalgam a Higher Risk Factor rather than Resin-Based Restorations for Systemic Conditions? A Systematic Review. Materials (Basel). 2021 Apr 15;14(8):1980. doi: 10.3390/ma14081980. PMID: 33920968; PMCID: PMC8071234.
DOI: 10.3390/ma14081980

Content

…nine publications matched the inclusion criteria and were included in this systematic review.
On the basis of the available RCTs, amalgam restorations, if compared with resin-based fillings, do not show an increased risk for systemic diseases.
As for any systemic effects, there was no difference between amalgam and composite restoration. On the basis of the available RCTs, amalgam restorations, if compared with resin-based fillings, do not show an increased risk for systemic diseases. There is still insufficient evidence to exclude or demonstrate any direct influence on general health. The removal of old amalgam restorations and their substitution with more modern adhesive restorations should be performed only when clinically necessary and not just for material concerns.

Comment

Include

Twenty-seven Association studies with systemic effects were assessed

1. Ref 1

   Biomonitoring Study of Toxic Metal(loid)s: Levels in Lung Adenocarcinoma Patients. Milošević N, Milanović M, Sazdanić Velikić D, Sudji J, Jovičić-Bata J, Španović M, Ševo M, Lukić Šarkanović M, Torović L, Bijelović S, Milić N. Toxics. 2024 Jul 4;12(7):490. doi: 10.3390/toxics12070490. PMID: 39058142 Free PMC article.

   Content

   Sixty-three patients of both sexes with adenocarcinoma stage IIIB or IV were enrolled in this research. The heavy metal(loid) urine concentrations were measured using ICP-MS. Mercury was measured above the limit of quantification in 63.49% of the samples and was not associated with amalgam dental fillings

   Comment

   No Association of amalgam fillings with Lung Adenocarcinoma, only Hg and some serum parameters **INCLUSION QUESTIONABLE**

2. Ref 5

   Estimated mercury vapor exposure from amalgams among American pregnant women.
   Geier DA, Geier MR. Hum Exp Toxicol. 2024 Jan-Dec;43:9603271241231945. doi: 10.1177/09603271241231945. PMID: 38316638 Free article.

   Content

1,665,890 weighted-pregnant women (n = 37) was examined in the 2015-2020 National Health and Nutrition Examination Survey (NHANES). Median daily urinary Hg excretion was ~2.5-fold higher among pregnant women with amalgams as compared to pregnant women without amalgams. Among pregnant women with amalgams, it was estimated that the median daily Hg vapor dose from amalgams was 7.66 µg of Hg and 0.073 µg of Hg/Kg bodyweight. Urine data: with amalgam 0.99 [0.56 to 1.43], without amalgam 0.41 [0.28 to 0.55].

Comment

The dependency of urine mercury level from the number of amalgam fillings is known. Actual urine concentration data are below relevant limit values (10.1186/s40557-015-0086-8) (seealso Yin et al 2016 SUCHEN The calculations of the daily vapor dose from urinary data is based in model assumptions and not on measurements. Therefore, **no new information has been** provided and thus not included. **REF ON NHANES STUDY 2021 CAN BE INCLUDED (See above)**

3. Ref 10

   Mercurial risk from dental amalgam use in a population of Moroccan dentists: A latent class regression approach.

   Attiya N, Fattahi R, Amarouch MY, El-Haidani A, El Jaafari S, Filali-Zegzouti Y. Int J Risk Saf Med. 2023;34(4):313-323. doi: 10.3233/JRS-210052. PMID: 37355914

   Content

   Dentists using dental amalgam are chronically exposed to low doses of elemental mercury. The complex toxico-kinetics of this systemic toxicant results in polymorphic and variable clinical phenotypesThe final obtained model showed acceptable calibration and discrimination. Its interpretation revealed that the increase of the frequency of amalgam use was associated with significant higher odds of belonging to the high risk latent class.

   Comment

   Att dentists. Methodological study, no figures on e.g. urine concentrations in Abstract. Full text not freely accessible**. Not included**

4. Ref 12

   Associations between mercury exposure with blood pressure and lipid levels: A cross-sectional study of dental professionals.

   Xu W, Park SK, Gruninger SE, Charles S, Franzblau A, Basu N, Goodrich JM. Environ Res. 2023 Mar 1;220:115229. doi: 10.1016/j.envres.2023.115229. Epub 2023 Jan 5. PMID: 36610536 Free PMC article.

   Content

   In 2012, we recruited dental professionals attending the Health Screening Program at the American Dental Association (ADA) Annual Session in California. Total Hg levels in hair and blood samples were analyzed as indicators of methylmercury exposure

and in urine as an indicator of primarily elemental Hg exposure (n = 386; mean ± sd age 55 ± 11 years)
The geometric means (geometric standard deviations) for urine Hg were 1.30 (2.44) μg/L.
For every one μg/L increase in specific gravity-adjusted urine Hg, LDL increased by 2.31 mg/dL (95% CI = 0.09, 4.54), in linear regression

Comment

Dental professional. According to Wikipedia: adult ranges: 100 to 129 mg/dL. For special high risk group: 50 und 70 mg/dL. Borderline high: 130 to 159 mg/dL. In the light of these limit values, the clinical relevance a max of 1.30 (2.44) μg/L seems questionable. **Not included**

5. Ref 24

Analysis of dental amalgam fillings on primary Sjögren's syndrome: A population-based case-control study in Taiwan.
Chen KH, Yu HC, Chang YC. Medicine (Baltimore). 2021 Nov 24;100(47):e28031. doi: 10.1097/MD.0000000000028031. PMID: 34964800 Free PMC article.

Content

Taiwan Study
In this study, a nationwide population-based database was employed to investigate the association of amalgam filling (AMF) and the risk of primary Sjögren Syndrom. The results demonstrated no statistically significant differences between AMF and pSS (odds ratio [OR]: 0.974, 95% confidence interval [CI] = 0.904-1.049). In addition, pSS was also not associated with AMF for women (OR: 0.743, 95% CI = 0.552-1.000) and men (OR: 1.006, 95% CI = 0.670-1.509), respectively. Taken together, evidence demonstrated that the association of AMF and pSS was inconsistent from this robust register databank.

Comment

Good study, **to be included**

6. Ref 26

Reported asthma and dental amalgam exposure among adults in the United States: An assessment of the National Health and Nutrition Examination Survey.
Geier DA, Geier MR. SAGE Open Med. 2021 Oct 20;9:20503121211048677. doi: 10.1177/20503121211048677. eCollection 2021. PMID: 34691469 Free PMC article.

Content

Conclusion: Increased dental amalgam exposure was associated with an increased risk of reported asthma diagnoses in American adults, but future studies should further evaluate this relationship. Data based on NHANES study of 2020

Comment

Data of the NHANES study were statistically analyzed, but nor actual data on urine Hg concentrations in the different groups has been provided. Therefore, the evaluation of the study is difficult. **Not included**

7. Ref 29

   Validity and responsiveness of EQ-5D-5L and SF-6D in patients with health complaints attributed to their amalgam fillings: a prospective cohort study of patients undergoing amalgam removal.

   Lamu AN, Björkman L, Hamre HJ, Alræk T, Musial F, Robberstad B. Health Qual Life Outcomes. 2021 Apr 17;19(1):125. doi: 10.1186/s12955-021-01762-4. PMID: 33865400 Free PMC article.

   Content

   The purpose of this study was to estimate the validity and responsiveness of the EQ-5D-5L and SF-6D utilities following removal of dental amalgam fillings in patients with health complaints

   Comment

   Purely methodological study using different methods for analysis of health utility. **Not included – but the 2024 study was included**

8. Ref 37

   Dental Amalgam Fillings and Multiple Sclerosis: A Nationwide Population-Based Case-Control Study in Taiwan.

   Tseng CF, Chen KH, Yu HC, Huang FM, Chang YC. Int J Environ Res Public Health. 2020 Apr 12;17(8):2637. doi: 10.3390/ijerph17082637. PMID: 32290568 Free PMC article.

   Content

   Taiwan Study

   Differences between cases and controls was not statistically significant (OR: 0.82, 95% CI = 0.65-1.05). In subjects stratified by gender, MS was also not associated with AMF for women (OR: 0.743, 95% CI = 0.552-1.000) and men (OR: 1.006, 95% CI = 0.670-1.509), respectively.

   In summary, this Taiwanese nationwide population-based case-control study did not find an association between MS and AMF.

   Comment

   Important study **to be included**

9. Ref 38

   Association between Dental Amalgam Filling and Essential Tremor: A Nationwide Population-Based Case Control Study in Taiwan.

   Tseng CF, Chen KH, Yu HC, Chang YC. Int J Environ Res Public Health. 2020 Jan 27;17(3):780. doi: 10.3390/ijerph17030780. PMID: 32012693 Free PMC article.

   Content

Taiwan study

3008 cases and 3008 controls were included. The results from this nationwide population-based case-control study did not indicate any association between ET and AMF in Taiwan.

Comment

Important **to be included**

10. Ref 41

Exposure to Dental Filling Materials and the Risk of Dementia: A Population-Based Nested Case Control Study in Taiwan.

Mikhailichenko N, Yagami K, Chiou JY, Huang JY, Wang YH, Wei JC, Lai TJ. Int J Environ Res Public Health. 2019 Sep 6;16(18):3283. doi: 10.3390/ijerph16183283. PMID: 31500155 Free PMC article.

Content

In general, the research conducted did not reveal any direct relationship between the development of dementia and the volume of filling material containing amalgam. However, among the people with dementia, there were persons for whom its progression was accelerated in cases where a large volume of dental filling material containing amalgam was present.

Accelerated dementia may be associated with larger need of dental treatment and thus with more amalgam

Comment

Important, **to be included**

11. Ref 48

Evaluation of amalgam-related retinal neurotoxicity with optical coherence tomography findings.

Bilak Ş, Önderci M, Şimşek A. Hum Exp Toxicol. 2019 Jul;38(7):814-822. doi: 10.1177/0960327119842637. Epub 2019 Apr 12. PMID: 30977404

Content

In our study, we found higher blood Hg levels and a positive correlation between blood Hg levels and the number of amalgam fillings in the amalgam group.…

SD-OCT can be an objective method for evaluating amalgam-related neurotoxicity. The volume of GCL–IPL complex can be a useful parameter for evaluating amalgam related neurotoxicity.

Comment

Comment by ophthalmologist professor: study contains methodological flaws such as multiple t-test without Bonferoni adjustment. This, the results on the significance is questionable. **Not included**

12. Ref 51

The impact of the use of amalgam in dental treatment on the prevalence of restless legs syndrome in older people.

Szklarek M, Kostka T. Med Pr. 2019 Feb 28;70(1):9-16. doi: 10.13075/mp.5893.00749. Epub 2018 Dec 21. PMID: 30653198 Free article.

Content

The relationship between RLS and the presence of amalgam in the teeth of 104 people aged 60-97 years old was determined. Research was carried out in a Polish Housing Society in Penrhos, North West Wales, founded in 1949, providing accommodation and support to Polish ex-service men and women who remained in the UK following World War II.

Questionnaire study

The average age of respondents was 84±7.1 years old. Forty-one subjects had RLS, and 63 did not. In conclusion, older subjects with the presence of symptoms of RLS had a significantly higher number of amalgam dental fillings as compared to the subjects without RLS symptoms

…. Not all people with amalgam fillings exhibit RLS symptoms. Conversely, some people with RLS do not appear to have had amalgam fillings.

Comment

Small not representative cohort, data difficult to interpret, no blood or urine analyses. Inconclusive results. **Not included**

13. Ref 67

O'Donoghue JL, Watson GE, Brewer R, Zareba G, Eto K, Takahashi H, Marumoto M, Love T, Harrington D, Myers GJ. Neuropathology associated with exposure to different concentrations and species of mercury: A review of autopsy cases and the literature. Neurotoxicology. 2020 May;78:88-98. doi: 10.1016/j.neuro.2020.02.011. Epub 2020 Feb 22. PMID: 32092311; PMCID: PMC7217745.

DOI: 10.1016/j.neuro.2020.02.011

Content

This study brings together information on the neuropathological findings and deposition of Hg in the central nervous system of people exposed to different species of Hg at varying concentrations. Mean total mercury in the cerebrum of people with no known exposure was 16 ppb. Mean total mercury in the cerebrum of Seychellois consuming fish was 129–182 ppb.Histologically, cerebral and cerebellar cortices from Rochester and Seychelles specimens were indistinguishable

Comment

Interesting study but not related to amalgam filling**s – not included**

14. Ref 106

Lamu AN, Robberstad B, Hamre HJ, Alræk T, Musial F, Björkman L. Validity and responsiveness of GHC-index in patients with amalgam-attributed health complaints.

Acta Odontol Scand. 2022 Apr;80(3):226-233. doi: 10.1080/00016357.2021.1989032. Epub 2021 Oct 15. PMID: 34651557.
DOI: 10.1080/00016357.2021.1989032

Content

Three outcome measures - GHC-index, GBB-24, and Munich Amalgam Scale (MAS) - were administered at baseline and 12 months after removal of all dental amalgam restorations

Comment

Methodological study **– not included**

15. Ref 108

Björkman L, Musial F, Alræk T, Werner EL, Hamre HJ. Mercury, silver and selenium in serum before and after removal of amalgam restorations: results from a prospective cohort study in Norway. Acta Odontol Scand. 2023 May;81(4):298-310. doi: 10.1080/00016357.2022.2143422. Epub 2022 Nov 16. PMID: 36383213.
DOI: 10.1080/00016357.2022.2143422

Content

Patients (n = 32) with medically unexplained physical symptoms (MUPS), which were attributed to dental amalgam restorations had all their amalgam restorations removed and replaced with other dental restorative materials. Concentration of I-Hg and Ag in serum decreased significantly after removal of all amalgam restorations. Concentration of MeHg and Se in serum were not changed. Intensity of health complaints was significantly reduced after amalgam removal, but there were no statistically significant correlations between exposure indicators and health complaints.

Even though intensity of health complaints decreased after removal of all amalgam restorations there was no clear evidence of a direct relationship between exposure and health complaints.

Comment

Interesting study **to be included with other Björkman study**

16. Ref 122

Geier DA, Geier MR. Dental Amalgams and the Incidence Rate of Arthritis among American Adults. Clin Med Insights Arthritis Musculoskelet Disord. 2021 May 19;14:11795441211016261. doi: 10.1177/11795441211016261. PMID: 34045912; PMCID: PMC8138300.
DOI: 10.1177/11795441211016261

Content

This hypothesis-testing study evaluated the relationship between mercury (Hg)-based dental amalgams and arthritis diagnoses among adults in the United States (US). Based on NHANES data

Comment

Same design as above: folds but no urine data**. Not included**

17. Ref 127

Perng WT, Ma KS, Hung HY, Tsai YC, Huang JY, Liao PL, Hung YM, Wei JC. Dental caries and risk of newly-onset systemic lupus erythematosus: a nationwide population-based cohort study. Curr Med Res Opin. 2023 Feb;39(2):307-317. doi: 10.1080/03007995.2022.2159146. Epub 2022 Dec 28. PMID: 36533392.
DOI: 10.1080/03007995.2022.2159146

Content

Taiwan; This study investigated whether patients with history of dental caries are associated with an increased risk of newly-onset systemic lupus erythematosus (SLE) A total of 501,461 carious patients and 258,918 controls without carious teeth were enrolled between 1997 and 2013 from the National Health Insurance Research Database. Subgroup analyses were conducted based on restorative materials including amalgam, composite resins, or both.
The risk of SLE for dental caries management among different restorative materials, including amalgam, composite resins, or both, was not statistically different.

Comment

Interesting study – **to be included**

18. Ref 132

Björkman L, Musial F, Alraek T, Werner EL, Weidenhammer W, Hamre HJ. Removal of dental amalgam restorations in patients with health complaints attributed to amalgam: A prospective cohort study. J Oral Rehabil. 2020 Nov;47(11):1422-1434. doi: 10.1111/joor.13080. Epub 2020 Aug 30. PMID: 32810306.
DOI: 10.1111/joor.13080

Content

In a group of patients with medically unexplained physical symptoms, which they attributed to dental amalgam restorations, removal of amalgam restorations was followed by a significant reduction of health complaints.

Comment

The same patient group as above (10.1080/00016357.2022.2143422) with the same results, **therefore not included**

19. Ref 133

Louopou RC, Trottier H, Arbuckle TE, Fraser WD. Dental amalgams and risk of gestational hypertension in the MIREC study. Pregnancy Hypertens. 2020 Jul;21:84-89. doi: 10.1016/j.preghy.2020.04.015. Epub 2020 Apr 28. PMID: 32447273.
DOI: 10.1016/j.preghy.2020.04.015

Content

However, the presence of dental amalgams or their replacement was not associated with GH but with decreased SBP for the replacement. Further studies are required.

Comment

To be included together with 10.1055/s-0042-1760215 from PubMed search

20. Ref 134

Attiya N, Filali A, Fattahi R, Moujane S, Mazouz H, Amarouch MY, Filali-Zegzouti Y. Modeling Subjective Symptoms Related to Micro-Hydrargyrism in a Population of Moroccan Dentists. Ethiop J Health Sci. 2021 Jan;31(1):147-158. doi: 10.4314/ejhs.v31i1.17. PMID: 34158762; PMCID: PMC8188101.
DOI: 10.4314/ejhs.v31i1.17

Content

In order to study the health impact of the occupational mercury exposure in a population of liberal dentists practicing in two Moroccan regions, a list of eighteen subjective symptoms commonly associated with micro-hydrargyrism was drawn up. Interpretation of the selected model allowed us to conclude that the reduction of dental amalgam use allows the reduction of subjective symptoms related to mercury exposure

Comment

Questionnaire study See also above: 10.3233/JRS-210052. No data on ways of use by dentists **Not included**

21. Ref 136

Movassagh H, Halchenko Y, Sampath V, Nygaard UC, Jackson B, Robbins D, Li Z, Nadeau KC, Karagas MR. Maternal gestational mercury exposure in relation to cord blood T cell alterations and placental gene expression signatures. Environ Res. 2021 Oct;201:111385. doi: 10.1016/j.envres.2021.111385. Epub 2021 Jun 12. PMID: 34129869; PMCID: PMC8478717.
DOI: 10.1016/j.envres.2021.111385

Content

We investigated the associations between gestational mercury exposure and frequency of cord blood T cells as well as placental gene expression. 13 immun tox markers were correlated with number of amalgam of the mother and in 2 an association was found. Other studies found this with other substances

Comment

Clinical relevance of only two indicators is unclear, fish consumption. Why not urine samples? **Not included**

22. Ref 138

Björkman L. Adverse reactions to dental biomaterials: Experiences from a specialty clinic. Dent Mater. 2024 Mar;40(3):563-572. doi: 10.1016/j.dental.2024.01.004. Epub 2024 Feb 9. PMID: 38336526.

DOI: 10.1016/j.dental.2024.01.004

Content

Producer independent adverse reaction reporting can provide valuable information about the safety of these materials and could serve as a complement to the mandatory reporting system described in the European medical device regulations (MDR).

Comment

General comments not specifically to amalgam **not included**

23. Ref 147

Laamech J, El Hangouche AJ, Amekran Y, Najdi A, Ben Driss A, Ben Driss EK, Louajri A, Lyoussi B. Risk factors and early renal effects of environmental exposure to the trace elements in Moroccan adolescents. Minerva Pediatr (Torino). 2021 May 31. doi: 10.23736/S2724-5276.21.06211-X. Epub ahead of print. PMID: 34056889.
DOI: 10.23736/S2724-5276.21.06211-X

Content

There is an urgent need for the limitation of trace elements' sources, particularly the strict application of the laws concerning leaded-petrol prohibition.

Comment

Not directly related to amalgam **not included**

24. Ref 156

Dobson ML, Cousins M. Can removal of amalgam restorations reduce health complaints in patients with medically unexplained physical symptoms? Evid Based Dent. 2021 Jan;22(3):118-119. doi: 10.1038/s41432-021-0190-2. PMID: 34561668.
DOI: 10.1038/s41432-021-0190-2

Content

Three groups of non-equivalent patients using a prospective cohort study design. Patients who credited their medically unexplained symptoms (MUPS) to their dental amalgam restorations (amalgam cohort) were compared to two other groups: patients with MUPS who did not credit their symptoms to amalgam (MUPS cohort) and those who recognised themselves as healthy (healthy cohortConclusions General health complaints in patients with MUPS, that attributed their symptoms to their dental amalgams, reduced after removal of dental amalgam restorations.

Comment

A number of methodological flaws. The present study may actually reflect more on the power of meeting patient expectations. We do not feel that transferable conclusions can be drawn. (comment Björkman) **Not included**

25. Ref 159

Sinha N, Hamre HJ, Musial F, L Werner E, Björkman L. Health complaints before and at one and five years after removal of dental amalgam restorations - data from a

prospective cohort study in Norway. Acta Odontol Scand. 2024 May 3;83:219-229. doi: 10.2340/aos.v83.40260. PMID: 38699922; PMCID: PMC11302653.
DOI: 10.2340/aos.v83.40260

Content

Conclusion: After removal of all amalgam restorations, both local and general health complaints were reduced. Since blinding of the treatment was not possible, specific and non-specific treatment effects cannot be separated.

Comment

Long term study of recent studies. **To include**

26. Ref 163

Emeny RT, Korrick SA, Li Z, Nadeau K, Madan J, Jackson B, Baker E, Karagas MR. Prenatal exposure to mercury in relation to infant infections and respiratory symptoms in the New Hampshire Birth Cohort Study. Environ Res. 2019 Apr;171:523-529. doi: 10.1016/j.envres.2019.01.026. Epub 2019 Jan 11. PMID: 30743244; PMCID: PMC6561090.
DOI: 10.1016/j.envres.2019.01.026

Content

Among infants of mothers who did not consume fish, we found an elevated risk of upper respiratory infections requiring a doctor visit in relation to having dental amalgams during pregnancy (RR = 1.5 (95% CI: 1.1, 2.1)).
Conclusions: Our analyses of a US birth cohort, along with prior mechanistic work, raise the possibility that gestational Hg exposure through fish/seafood consumption and dental amalgams may alter respiratory infections and respiratory symptoms in infants.

Comment

Very weak correlation, no control, questionnaire study, outcome of doctor visit? **Not included**

27. Ref 166

Lamu AN, Björkman L, Hamre HJ, Alræk T, Musial F, Robberstad B. Is amalgam removal in patients with medically unexplained physical symptoms cost-effective? A prospective cohort and decision modelling study in Norway. PLoS One. 2022 Apr 29;17(4):e0267236. doi: 10.1371/journal.pone.0267236. PMID: 35486640; PMCID: PMC9053791.
DOI: 10.1371/journal.pone.0267236

Content

Costs of removal in MUPS patients

Comment

Not valid for all patients, only for MUPS. **Not included**

Eight Association study with local health effects

1. Ref 20

   Low Prevalence of Amalgam-Associated Lichenoid Lesions in the Oral Cavity: A Prospective Study.
   Gupta P, Mallishery S, Bajaj N, Banga K, Mehra A, Desai R. Cureus. 2022 Feb 28;14(2):e22696. doi: 10.7759/cureus.22696. eCollection 2022 Feb. PMID: 35386156 Free PMC article.

   Content

   Two thousand patients having at least one amalgam restoration were examined for signs of lichenoid lesions when visiting the OPD of Conservative Dentistry and Endodontics at the Nair Hospital Dental College in Mumbai
   Three (0.15%) out of 2000 patients were clinically diagnosed as suffering from a lichenoid lesion caused by amalgam restoration
   (all)…. showed complete resolution of lesions after the replacement of the restorations.

   Comment

   Important **to be included**

2. Ref 70

   Ma KS, Thota E, Huang JY, Huang YF, Wei JC. Onset of oral lichen planus following dental treatments: A nested case-control study. Oral Dis. 2023 Apr;29(3):1269-1281. doi: 10.1111/odi.14115. Epub 2022 Feb 1. PMID: 34953110.
   DOI: 10.1111/odi.14115

   Content

   In this population-based nested case-control study, 421 cases of OLP and 1,684 controls were included after propensity score matching. Logistic regression was used to estimate the adjusted odds ratio (aOR) of OLP in individuals who had received amalgam and composite resin restorations, root canal therapy, and tooth extraction over a follow-up duration of five years.
   Conclusions: We reported no significant association between dental restorations and consequent OLP, and significantly lower odds of OLP following both root canal therapy and tooth extraction.

   Comment

   Interesting study: **to be included**

3. Ref 77

   Rupel K, Biasotto M, Gobbo M, Poropat A, Bogdan Preda MT, Borruso G, Torelli L, Di Lenarda R, Ottaviani G. Knowledge and awareness of oral cancer: A cross-sectional survey in Trieste, Italy. Front Oral Health. 2023 Jan 30;4:1056900. doi: 10.3389/froh.2023.1056900. PMID: 36794079; PMCID: PMC9922703.
   DOI: 10.3389/froh.2023.1056900

   Content

The aim of the study was to verify the knowledge on oral cancer and to assess possible differences in awareness and information basing on different demographic and subject-related factors.

Comment

Only awareness of oral cancer, no relation to the topic. **Not included**

4. Ref 84

   Noronha MS, Souto GR, Felix FA, Abreu LG, Aguiar MCF, Mendonça EF, Mesquita RA. Mast cells in oral lichen planus and oral lichenoid lesions related to dental amalgam contact. Braz Oral Res. 2024 Jan 5;38:e005. doi: 10.1590/1807-3107bor-2024.vol38.0005. PMID: 38198305.

   DOI: 10.1590/1807-3107bor-2024.vol38.0005

   Content

   The aim of this study was to analyze the expression of mast cell markers toluidine blue, c-kit, and tryptase and presence of mononuclear inflammatory cells in oral lichen planus (OLP) and oral lichenoid lesions related to dental amalgam.

   Comment

   Only comparison between OLLC and OLP, not related to topic. **Not included**

5. Ref 96

   Forkel S, Schubert S, Corvin L, Heine G, Lang CCV, Oppel E, Pföhler C, Treudler R, Bauer A, Sulk M, Kränke B, Schäkel K, Heratizadeh A, Worm M, Witte J, Geier J, Buhl T. Contact allergies to dental materials in patients. Br J Dermatol. 2024 May 17;190(6):895-903. doi: 10.1093/bjd/ljad525. PMID: 38123140.

   DOI: 10.1093/bjd/ljad525

   Content

   To analyse current sensitization patterns to dental materials in patients with suspected contact allergy.

   Allergic contact stomatitis to dental materials is rare. Patch testing should not only focus on metals such as nickel, palladium, amalgam and gold, but also (meth)acrylates and the natural substances propolis and 'balsam of Peru'.

   Comment

   Interesting study, but not directly related to the topic. Maybe included in the med problem with alternatives. **Was not included: Already well known, already mentioned, nothing new**

6. Ref 119

   Ting S, Nguyen J, Palmer A, Rosemary Nixon AM. Contact sensitisation in oral lichen planus: An Australian perspective. Contact Dermatitis. 2023 Nov;89(5):335-344. doi: 10.1111/cod.14366. Epub 2023 Jun 13. PMID: 37311568.

   DOI: 10.1111/cod.14366

   Content

We aimed to evaluate relevant contact sensitisers in OLP.
A retrospective study was conducted on OLP patients who underwent patch testing from 1 January 2006 to 31 December 2020 at an Australian tertiary dermatology institution, compared to cheilitis patients patch tested over the same time period. Forty-three (44.8%), 22 (22.9%), 21 (21.9%) and 17 (17.7%) OLP patients had relevant reactions to mercury-related chemicals, amalgam, spearmint and carvone, respectively,

Comment

This means that in the group of OLP patients, 23 were positive teste to amalgam, the rest to other chemicals. **already mentioned, nothing new, not included**

7. Ref 126 (Pulp)
   Estrada LA, Martínez-Cuazitl A, Mata-Miranda MM, González-Díaz CA, Vázquez-Zapién GJ, Saldaña-Rivera E, Sánchez-Monroy V. Evaluation of the effect of heat damage on DNA extracted from the dental pulp of restored teeth. Leg Med (Tokyo). 2019 Mar;37:54-59. doi: 10.1016/j.legalmed.2019.01.006. Epub 2019 Jan 14. PMID: 30660659.
   DOI: 10.1016/j.legalmed.2019.01.006

   Content

   We evaluate structural damage effects of heat on DNA obtained from the dental pulp of restored premolars. We studied three groups (A, B and C) each group comprised twenty premolars extracted from five patients.

   Comment

   Study related to forensic dentistry **Not Included**

8. Ref 149
   Kindler S, Seebauer C, Mksoud M, Samietz S, Kocher T, Holtfreter B, Lucas C, Völzke H, Metelmann HR, Rau A, Ittermann T. Impact of dental restorations and removable prostheses on potentially malignant oral mucosal disorders in the general population. J Prosthet Dent. 2023 Jan;129(1):89-95. doi: 10.1016/j.prosdent.2022.05.017. Epub 2022 Jun 24. PMID: 35753826.
   DOI: 10.1016/j.prosdent.2022.05.017

   Content

   The data of 6041 participants in the population-based Studies of Health in Pomerania (SHIP) were accessed.
   Conclusions: Participants with removable prostheses have a higher risk of potentially malignant disorders. Composite resin restorations are associated with a higher risk of mucosal lesions, whereas no significant association was found between amalgam restorations and mucosal lesions.

   Comment

   Interesting large scale study. **To be included**

Twenty exposure studies, 6 out of them regarding environmental exposure

1. Ref 6

   Mercury air, urine monitoring and health effects on occupationally exposed dental healthcare workers in Delhi, India.

   Mawari G, Kumar N, Sarkar S, Joshi TK, Frank AL, Daga MK, Singh MM. Work. 2024 Jan 17. doi: 10.3233/WOR-230109. Online ahead of print. PMID: 38251084

   Content

   Hg vapour concentration ranged from 0.96µg/m3 to 15µg/m3, the highest concentration was recorded in the amalgam room (15µg/m3). Urine Hg levels in healthcare workers (0.51±0.17µg/L) were higher than the control (0.29±0.05µg/L) …. Urinary Hg measurements did not reveal an excess of body burden except in one case.

   Comment

   Dental Personnel. Lots of information missing, questionnaire part without control, higher urine Hg concentration for dental personnel is not new, Data under limit values. **Not included**

2. Ref 8

   Mercury Concentration in Saliva and the Impact of Chewing: An Inductively Coupled Plasma Mass Spectrometry Study.

   Tercanli H, Yavuz E, Yilmaz SG, Yardimci S. Biol Trace Elem Res. 2024 May;202(5):1965-1971. doi: 10.1007/s12011-023-03825-7. Epub 2023 Aug 26. PMID: 37632686

   Content

   As the number of amalgam restorations and the number of amalgam restoration surfaces increased, the mercury concentration in the saliva increased (p= 0.015 and p= 0.021, respectively). There was no statistically significant difference between mercury levels in the unstimulated saliva and the stimulated saliva (p=0.316). Chewing presented an insignificant difference in mercury concentration.

   Comment

   Interesting data, **may be included**

3. Ref 43

   Levels of Mercury in Fish-Eating Children, With and Without Amalgam Restoration.

   Padmakumar V, Premkala Raveendran K, Abdulla AM, Ganapathy S, Sainudeen S, Nasim VS, Vedam V. J Pharm Bioallied Sci. 2019 May;11(Suppl 2):S397-S401. doi: 10.4103/JPBS.JPBS_44_19. PMID: 31198376 Free PMC article.

   Content

   Seventy-five subjects, 42 males (56%) and 35 females (44%) of age group ranging 7-13 years, living in South Canara district of Karnataka, India, were selected as a part of

the study. Hair and urine samples were collected for estimation of organic and inorganic levels of mercury, respectively.
In coastal regions of Karnataka where the present study was conducted, the level of organic mercury from fish was higher than inorganic mercury from dental amalgam. Thus, stating the risk could probably be more of an organic form than an inorganic one. Thus amalgam is relatively safe to be practiced and the controversy against it should be reevaluated.

Comment

Important **to be included**

4. Ref 46

   Concentration of mercury, cadmium, and lead in breast milk from Norwegian mothers: Association with dietary habits, amalgam and other factors.
   Vollset M, Iszatt N, Enger Ø, Gjengedal ELF, Eggesbø M. Sci Total Environ. 2019 Aug 10;677:466-473. doi: 10.1016/j.scitotenv.2019.04.252. Epub 2019 Apr 19. PMID: 31063889 Free article.

   Content

   We detected a significant association ($p < 0.01$) between Hg in breast milk and maternal consumption of Atlantic halibut, lean fish, mussels and scallops and lifetime consumption of crab. Seafood intake alone explained 10% of variance, while together with amalgam explained 46% of variance in Hg concentration in breast milk.

   Comment

   Interesting study **maybe included**

5. Ref 65

   Sekovanić A, Piasek M, Orct T, Sulimanec Grgec A, Matek Sarić M, Stasenko S, Jurasović J. Mercury Exposure Assessment in Mother-Infant Pairs from Continental and Coastal Croatia. Biomolecules. 2020 May 27;10(6):821. doi: 10.3390/biom10060821. PMID: 32471193; PMCID: PMC7355586.
   DOI: 10.3390/biom10060821

   Content

   The results confirmed higher fish consumption in coastal vs. continental Croatia and increases of both Hg and Se related to fish consumption in all analyzed samples. Increased blood Hg reflected the predominant MeHg share from seafood, while increased serum Hg matched exposure from dental amalgams.

   Comment

   Not to include, no tendency of decline.

6. Ref 75

   Bartel-Steinbach M, Lermen D, Gwinner F, Schäfer M, Göen T, Conrad A, Weber T, von Briesen H, Kolossa-Gehring M. Long-term monitoring of mercury in young German adults: Time trend analyses from the German Environmental Specimen Bank,

1995-2018. Environ Res. 2022 May 1;207:112592. doi: 10.1016/j.envres.2021.112592. Epub 2021 Dec 31. PMID: 34973943.
DOI: 10.1016/j.envres.2021.112592

Content

Results show a clear decrease in both, about 86% in urine total daily Hg excretion from 1995 (0.76 µg/L) to 2018 (0.11 µg/L) (n = 10,069) and about 57% in blood concentrations of Hg from 2001 (1.76 µg/L) to 2010 (0.77 µg/L) (n = 4085).
The factors mostly influencing Hg excretion identified in this study are dental amalgam as well as fish and seafood consumption.

Comment

To be included

7. Ref 94

Park SB, Kim EK, Sakong J, Park EY. Association between dental amalgam restoration and urine mercury concentrations among young women: a cross-sectional study. J Yeungnam Med Sci. 2023 Oct;40(4):373-380. doi: 10.12701/jyms.2022.00955. Epub 2023 Mar 21. PMID: 36941777; PMCID: PMC10626308.
DOI: 10.12701/jyms.2022.00955

Content

The urine mercury concentration significantly increased with an increase in the number of teeth filled with amalgam, cavity surfaces involved, and number of defective amalgam fillings, and according to the latest exposure time (p<0.001).

Comment

Not to include (n=99)

8. Ref 95

Tuček M, Bušová M, Čejchanová M, Schlenker A, Kapitán M. Exposure to mercury from dental amalgam: actual contribution for risk assessment. Cent Eur J Public Health. 2020 Mar;28(1):40-43. doi: 10.21101/cejph.a5965. PMID: 32228815.
DOI: 10.21101/cejph.a5965

Content

Authors support opinion that amalgam fillings in the oral cavity are a permanent source of mercury for the body itself.

Comment

Not to include (n=50)

9. Ref 102

Yin L, Lin S, Summers AO, Roper V, Campen MJ, Yu X. Children with Amalgam Dental Restorations Have Significantly Elevated Blood and Urine Mercury Levels. Toxicol Sci. 2021 Oct 27;184(1):104-126. doi: 10.1093/toxsci/kfab108. Erratum in: Toxicol Sci. 2022 Feb 28;186(1):174. doi: 10.1093/toxsci/kfab156. PMID: 34453845.
DOI: 10.1093/toxsci/kfab108

Content

Here, we examined data from the two most recent National Health and Nutrition Examination Surveys (NHANES) on 14 181 subjects to assess the contributions of seafood consumption versus AMG to blood total mercury (THg), inorganic mercury (IHg), and methyl mercury (MeHg) and to urine creatinine corrected mercury (UTHg).

Using stratified covariate (ANOVA) and multivariate (GLM) analyses revealed a strong correlation of blood (THg and IHg) and urine (UTHg) levels with the number of AMGs

Comment

To be included (NHANES + große Sample size)?

10. Ref 115

Choudhary S, Bach T, Wallace MA, Stoeckel DC, Thornhill MH, Lockhart PB, Kwon JH, Liang SY, Burnham CD, Biswas P, Steinkamp HM, Durkin MJ. Assessment of Infectious Diseases Risks From Dental Aerosols in Real-World Settings. Open Forum Infect Dis. 2022 Nov 11;9(11):ofac617. doi: 10.1093/ofid/ofac617. PMID: 36447607; PMCID: PMC9697589.

DOI: 10.1093/ofid/ofac617

Content

Out of scope. Infections from aerosols.

Comment

Not to include (out of scope, no dental amalgam).

11. Ref 150

Attiya N, Filali A, Fattahi R, Moujane S, Mazouz H, Amarouch MY, Filaly-Zegzouti Y. Preventive planning against mercury over-exposure among Moroccan dentists using multidimensional statistical methods. Work. 2022;72(3):1065-1076. doi: 10.3233/WOR-205115. PMID: 35599522.

DOI: 10.3233/WOR-205115

Content

Rather low quality study

Comment

Not to include (method questionable)

12. Ref 153

Hrubá F, Černá M, Chen C, Harari F, Horvat M, Koppová K, Krsková A, Laamech J, Li YF, Löfmark L, Lundh T, Lyoussi B, Mazej D, Osredkar J, Pawlas K, Pawlas N, Prokopowicz A, Rentschler G, Snoj Tratnik J, Sommar J, Spěváčková V, Špirić Z, Skerfving S, Bergdahl IA. A regional comparison of children's blood cadmium, lead, and mercury in rural, urban and industrial areas of six European countries, and China, Ecuador, and Morocco. Int J Occup Med Environ Health. 2023 Sep 7;36(3):349-364.

doi: 10.13075/ijomeh.1896.02139. Epub 2023 Aug 28. PMID: 37681424; PMCID: PMC10663995.
DOI: 10.13075/ijomeh.1896.02139
Content
Not relation to dental amalgam.
Comment
Not to include.

13. Ref 170
    Al-Saleh I. Reference values for heavy metals in the urine and blood of Saudi women derived from two human biomonitoring studies. Int J Hyg Environ Health. 2020 Apr;225:113473. doi: 10.1016/j.ijheh.2020.113473. Epub 2020 Feb 7. PMID: 32044536.
    DOI: 10.1016/j.ijheh.2020.113473
    Content
    Not related to dental amalgam
    Comment
    Not to include

14. Ref 171
    Snoj Tratnik J, Falnoga I, Mazej D, Kocman D, Fajon V, Jagodic M, Stajnko A, Trdin A, Šlejkovec Z, Jeran Z, Osredkar J, Sešek-Briški A, Krsnik M, Kobal AB, Kononenko L, Horvat M. Results of the first national human biomonitoring in Slovenia: Trace elements in men and lactating women, predictors of exposure and reference values. Int J Hyg Environ Health. 2019 Apr;222(3):563-582. doi: 10.1016/j.ijheh.2019.02.008. Epub 2019 Mar 14. PMID: 30878540.
    DOI: 10.1016/j.ijheh.2019.02.008
    Content
    Toxic elements' levels were mainly below the levels considered to present increased health risk. Lifestyle and nutritional habits appeared as significant determinants of exposure to Cd (smoking and game meat consumption), Hg (seafood and amalgam fillings), As (seafood) and Pb (alcohol consumption, smoking, game meat consumption and type of water supply).
    Comment
    No trends, just reference values. **Not to include**.

Exposure (Environment)

15. Ref 25
    Characteristics of wastewater originating from dental practices using predominantly mercury-free dental materials.

Binner H, Kamali N, Harding M, Sullivan T. Sci Total Environ. 2022 Mar 25;814:152632. doi: 10.1016/j.scitotenv.2021.152632. Epub 2021 Dec 25. PMID: 34963598

Content

With a concerted effort to reduce the use of Hg-based materials in dentistry, there is now a question as to how effective, or suitable, amalgamseparation technologies are, when DFMs contain an increasing fraction of engineered nanocomposite materials and/or plasticisers such as Bisphenol In this work, we analyse dental wastewater streams from three dental facilities in Ireland with differing amalgam separators in place. The potential overall toxicity, particulate load and physicochemical properties are analysed. The overall risk posed by these new materials is also discussed.

We have found

that dental wastewater from three dental facilities in Ireland that utilise alternatives to dental amalgamcontain a high proportion ofmicroscale particles,

but that larger particulate matter is effectively separated. Results also

indicate that the physicochemical characteristics of dental wastewater is

highly variable both within and between facilities, and reaches extremes

of pH, contains many dissolved substances, and has a relatively potent toxicological profile when tested against Daphniamagna.

Comment

Important **to be included**

16. Ref 62

Orlando MS, Love T, Harrington D, Dziorny AC, Shamlaye CF, Watson GE, van Wijngaarden E, Davidson PW, Myers GJ. The association of auditory function measures with low-level methylmercury from oceanic fish consumption and mercury vapor from amalgam: The Seychelles Child Development Study Nutrition 1 Cohort. Neurotoxicology. 2023 Mar;95:46-55. doi: 10.1016/j.neuro.2022.12.010. Epub 2023 Jan 5. PMID: 36621469; PMCID: PMC9998349.

DOI: 10.1016/j.neuro.2022.12.010

Content

210 evaluable participants. Overall, these data do not present a clear and consistent pattern to suggest that the auditory system is negatively affected by low-level methylmercuryexposure due to dietary consumption of oceanic fish or mercury vapor exposure from dental amalgams.

Comment

Not to include.

17. Ref 66

Piagno H, Afshari R. Mercury from crematoriums: human health risk assessment and estimate of total emissions in British Columbia. Can J Public Health. 2020

Dec;111(6):1011-1019. doi: 10.17269/s41997-020-00327-0. Epub 2020 Jun 10. PMID: 32524506; PMCID: PMC7728964.
DOI: 10.17269/s41997-020-00327-0

Content

Mercury from crematoriums accounts for more than 7% of total mercury emissions to the atmosphere in BC, but risk assessment found no indication that ground-level exposures to elemental mercury vapour from crematoriums poses a significant risk to human health. If the number of cremations increases, it might reach considerable levels, highlighting the need for developing a national plan similar to other countries.

Comment

No detailed information on dental amalgam. Not to include.

18. Ref 80

Rafiee A, Delgado-Saborit JM, Aquilina NJ, Amiri H, Hoseini M. Assessing oxidative stress resulting from environmental exposure to metals (Oids) in a middle Eastern population. Environ Geochem Health. 2022 Aug;44(8):2649-2668. doi: 10.1007/s10653-021-01065-z. Epub 2021 Aug 14. PMID: 34390449.
DOI: 10.1007/s10653-021-01065-z

Content

No clear relation to amalgam

Comment

Not to include.

19. Ref 129

Vogel N, Murawski A, Schmied-Tobies MIH, Rucic E, Doyle U, Kämpfe A, Höra C, Hildebrand J, Schäfer M, Drexler H, Göen T, Kolossa-Gehring M. Lead, cadmium, mercury, and chromium in urine and blood of children and adolescents in Germany - Human biomonitoring results of the German Environmental Survey 2014-2017 (GerES V). Int J Hyg Environ Health. 2021 Aug;237:113822. doi: 10.1016/j.ijheh.2021.113822. Epub 2021 Aug 25. PMID: 34454255.
DOI: 10.1016/j.ijheh.2021.113822

Content

higher levels of cadmium were associated with smoking and vegetarian diet and higher levels of mercury with the consumption of seafood and amalgam teeth fillings. No specific exposure determinants emerged for chromium. The health based guidance value HBM-I was not exceeded for mercury and for cadmium in urine it was exceeded by 0.6% of the study population. None of the exceedances was related to substantial tobacco smoke exposure. Comparisons to previous GerES cycles (GerES II, 1990–1992; GerES IV, 2003–2006) indicate continuously lower levels.
With respect to previously reported mercury-specific determinants, results indicate that participants with at least one amalgam dental filling (n = 50; 2% of participants)

had GM mercury concentrations more than twice as high as those without such tooth fillings.

Comment

No detailed information on dental amalgam. **Not to include**.

20. Ref 140

    Rafiee A, Delgado-Saborit JM, Sly PD, Quémerais B, Hashemi F, Akbari S, Hoseini M. Environmental chronic exposure to metals and effects on attention and executive function in the general population. Sci Total Environ. 2020 Feb 25;705:135911. doi: 10.1016/j.scitotenv.2019.135911. Epub 2019 Dec 6. PMID: 31838411.
    DOI: 10.1016/j.scitotenv.2019.135911

    Content

    N=200, not to include

    Age, gender, cigarette smoking, water-pipe smoking, traffic density in the area of residence, and dental amalgam filling were significant factors affecting the TMT test scores. The results suggest that chronic exposure to metals has detrimental effects on attention, executive function, mental flexibility and cognitive efficiency.

    Comment

    Not to include.

Eleven studies on Epidemiology/ frequency of use

1. Ref 11

    Decreased trends of using dental amalgam filling for decayed teeth in Taiwan from 1997 to 2013.
    Yang LC, Liu FH, Su NY, Wang YH, Yang PY, Chang YC. J Dent Sci. 2023 Jan;18(1):400-406. doi: 10.1016/j.jds.2022.11.001. Epub 2022 Nov 14. PMID: 36643251 Free PMC article.

    Content

    Conclusion: Form the results of this nationwide population-based database, a significant decrease of AMF in Taiwan was observed during past 17 years.

    Comment

    Important **to be included, maybe with EU data**

2. Ref 15

    Community social responsibility of continued and appropriate use of silver amalgam as dental restorative material in southern India: A cross-sectional study.
    Vasthare R, Ballal NV, Nayak PP, Kamath P, Singla N, Hegde T. F1000Res. 2022 Oct 26;11:1061. doi: 10.12688/f1000research.122690.2. eCollection 2022. PMID: 38868173 Free PMC article.

    Content

This cross-sectional study was conducted among fifty-two private and public dental practitioners of Udupi district in Southern India …… A self-administered questionnaire was distributed, that involved assessment of their preferences, continuation of use and concerns of using DA as a restorative material.
The majority of dentists were satisfied (87%) with the results of the DA, found minimal failures (96%) and found DA more economical (89%). More than half (54%) of the participants reported that they would not continue the use of DA owing to mercury toxicity and environmental concerns. Dentists with higher age and longer clinical experience preferred continuation of DA.

Comment

Not directly related to the topic, **not included**

3. Ref 79

Cumerlato CBDF, Demarco FF, Barros AJD, Peres MA, Peres KG, Morales Cascaes A, de Camargo MBJ, da Silva Dos Santos I, Matijasevich A, Corrêa MB. Reasons for direct restoration failure from childhood to adolescence: A birth cohort study. J Dent. 2019 Oct;89:103183. doi: 10.1016/j.jdent.2019.103183. Epub 2019 Aug 23. PMID: 31449840.
DOI: 10.1016/j.jdent.2019.103183

Content

Objectives: The aim of this study was to assess the prevalence of direct restorations in posterior teeth in children aged 12, from a birth cohort, and to test the association between the quality of the restorations and individual variables experienced in the life cycle.

Comment

Not directly related to topic. Same content as FDI/Alternative paper. **Not included**

4. Ref 118

Bailey O, Vernazza CR, Stone S, Ternent L, Roche AG, Lynch C. Amalgam Phase-Down Part 1: UK-Based Posterior Restorative Material and Technique Use. JDR Clin Trans Res. 2022 Jan;7(1):41-49. doi: 10.1177/2380084420978653. Epub 2020 Dec 10. PMID: 33300416; PMCID: PMC8674792.
DOI: 10.1177/2380084420978653

Content

Amalgam use is currently high in the publicly funded sector of UK primary care. Composite is the most used alternative, but it takes longer to place and is more costly. Composite also has a higher reported incidence of postoperative complications than amalgam

Comment

Alternatives: takes longer and costly. **to be included**

5. Ref 120

Beltrán-Aguilar ED, Thornton-Evans G, Wei L, Bernal J. Prevalence and mean number of teeth with amalgam and nonamalgam restorations, United States, 2015 through 2018. J Am Dent Assoc. 2023 May;154(5):417-426. doi: 10.1016/j.adaj.2023.02.016. PMID: 37105669; PMCID: PMC10985832.
DOI: 10.1016/j.adaj.2023.02.016

Content

Conclusions: Nonamalgam restorations were the most common in the primary teeth of children older than 5 years and in the permanent teeth of adults younger than 40 years. Amalgam restorations were more common in older adults. Amalgam and nonamalgam restorations were equally common in children younger than 5 years.

Comment

Interesting data. **finally not included, other data are given**

6. Ref 135

Erçin Ö, Berkmen B, Durukan E, Arhun N. Awareness about dental amalgam among Turkish dentists and patients: a questionnaire and search engine based cross-sectional study. Int Dent J. 2020 Sep 29;71(2):113–21. doi: 10.1111/idj.12610. Epub ahead of print. PMID: 32996144; PMCID: PMC9275304.
DOI: 10.1111/idj.12610

Content

Conclusion: Awareness about dental amalgam is low among patients studied. Although dentists do not use dental amalgam frequently, they disagree on banning dental amalgam.

Comment

Awareness study using questionnaires, not riectly related to the topic **not included**

7. Ref 139

Khan S, Khalid N, Bajwa O, Qamar T, Kazmi A, Tariq A. Amalgam phase-out, an environmental safety concern: a cross-sectional study among general dental practitioners in Pakistan. East Mediterr Health J. 2022 Jan 31;28(1):69-73. doi: 10.26719/emhj.21.068. PMID: 35165880.
DOI: 10.26719/emhj.21.068

Content

Aims: To identify and assess the use of amalgam and its waste management by dentists in Pakistan post-Minamata Convention guidelines.

Methods: A cross-sectional study was conducted in Lahore among 520 general dental practitioners in 2019.

Comment

No comparison between the use some time ago and today. **Not included**

8. Ref 142

Reher V, Reher P, Peres KG, Peres MA. Fall of amalgam restoration: a 10-year analysis of an Australian university dental clinic. Aust Dent J. 2021 Mar;66(1):61-66. doi: 10.1111/adj.12807. Epub 2020 Dec 5. PMID: 33197295.
DOI: 10.1111/adj.12807

Content

Conclusions: A significant decrease in the use of amalgam was observed over time for both students and professionals.

Comment

Australia: **to be included**

9. Ref 151

Al-Asmar AA, Al-Khatib KM, Al-Amad TZ, Sawair FA. Has the implementation of the Minamata convention had an impact on the practice of operative dentistry in Jordan? J Int Med Res. 2019 Jan;47(1):361-369. doi: 10.1177/0300060518802523. Epub 2018 Oct 3. PMID: 30282511; PMCID: PMC6384461.
DOI: 10.1177/0300060518802523

Content

Methods: The cross-sectional study was conducted through structured questionnaires distributed to dentists in Amman, Jordan from June 2017 to February 2018.

Conclusion: The findings of this survey suggest that a 'phase-down' of dental amalgam is being implemented in Jordan's dental clinics

Comment

Jordan: **to be included**

10. Ref 158

Estrich CG, Eldridge LA, Lipman RD, Araujo MWB. Posterior dental restoration material choices in privately insured people in the United States, 2017 through 2019. J Am Dent Assoc. 2023 May;154(5):393-402. doi: 10.1016/j.adaj.2023.02.005. Epub 2023 Mar 30. PMID: 37003957.
DOI: 10.1016/j.adaj.2023.02.005

Content

Numbers of amalgam and composite posterior restorations from 2017 through 2019 were calculated using retrospective dental claims analysis of privately insured patients.

The rate of amalgam restorations declined over time from a mean of 6.29 per 100 patients in 2017 to 4.78 per 100 patients in 2019, whereas the composite restoration rate increased from 27.6 per 100 patients in 2017 to 28.8 per 100 in 2019.

Comment

US: decline of amalgams: **to be included**

11. Ref 161

Bakhurji E, Scott T, Sohn W. Factors Associated with Pediatric Dentists' Choice of Amalgam: Choice-Based Conjoint Analysis Approach. JDR Clin Trans Res. 2019 Jul;4(3):246-254. doi: 10.1177/2380084418822977. Epub 2019 Feb 19. PMID: 30931719.
DOI: 10.1177/2380084418822977

Content

Objectives: To establish strategic approaches to reduce amalgam use, the aim of this study is to use a marketing research analysis to determine which patient-related factors influence pediatric dentists' choice of amalgam.
Conjoint analysis revealed that, while both caries risk and type of insurance affected respondents' decision about amalgam use, caries risk was the driving factor in decision-making for using amalgam.

Comment

Interesting, but not directly related to the topic. **Not included**

Four Policy Statements

1. Ref 22
   Amalgam (Part 2): Safe Use and Phase Down of Dental Amalgam: Adopted by the FDI General Assembly: 27-29 September 2021, Sydney, Australia.
   [No authors listed] Int Dent J. 2022 Feb;72(1):12-13. doi: 10.1016/j.identj.2021.11.007. PMID: 35074199 Free PMC article. No abstract available.

   Content

   FDI Policy Statement 2021 on safety

   Comment

   To be included on safety

2. Ref 23
   Amalgam (Part 1): Safe Management of Waste and Mercury: Adopted by the FDI General Assembly: 27-29 September 2021, Sydney, Australia.
   [No authors listed] Int Dent J. 2022 Feb;72(1):10-11. doi: 10.1016/j.identj.2021.11.008. PMID: 35074198 Free PMC article. No abstract available.

   Content

   FDI Policy Statement 2021 on waste and environment

   Comment

   To be included

3. Ref 72
   Sanderson S. The great dental amalgam debate. Br Dent J. 2022 Nov;233(10):874. doi: 10.1038/s41415-022-5217-3. Epub 2022 Nov 25. PMID: 36434231; PMCID: PMC9702695.

DOI: 10.1038/s41415-022-5217-3

Content

Narrative statement

Comment

Not to include.

4. Ref 112

   Ajiboye AS, Mossey PA; IADR Science Information Committee; Fox CH. International Association for Dental Research Policy and Position Statements on the Safety of Dental Amalgam. J Dent Res. 2020 Jul;99(7):763-768. doi: 10.1177/0022034520915878. Epub 2020 Apr 21. PMID: 32315245.

   DOI: 10.1177/0022034520915878

   Content

   Preceding IADR Amalgam Statement

   Comment

   Not to include.