Health effects of dental amalgam exposure: a retrospective cohort study

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Background Whether dental amalgam fillings (containing mercury) are hazardous is a long-standing issue, with few epidemiological investigations. Allegations have particularly involved nervous system disorders, such as multiple sclerosis, Alzheimer’s disease, and chronic fatigue syndrome. This retrospective cohort study, the largest of its kind, contained people in the New Zealand Defence Force (NZDF) between 1977 and 1997. The NZDF has its own dental service, providing all personnel with regular and consistent treatment. Comprehensive treatment records are maintained and archived.

Methods Yearly dental treatment histories, including amalgam filling placements, were compiled from individual records. To minimize amalgam exposure misclassification the cohort was restricted to people who, at NZDF entry, were aged <26 years and had all their posterior teeth. The cohort was linked with morbidity records. Data were analysed with a proportional hazards model, using a time-varying exposure unit of 100 amalgam surface-years.

Results The final cohort contained 20 000 people, 84% males. Associations with medical diagnostic categories, particularly disorders of the nervous system and kidney, were examined. Of conditions allegedly associated with amalgam, multiple sclerosis had an adjusted hazard ratio (HR) of 1.24 (95% CI: 0.99, 1.53, P = 0.06), but there was no association with chronic fatigue syndrome (HR = 0.98, 95% CI: 0.94, 1.03), or kidney diseases. There were insufficient cases for investigation of Alzheimer’s or Parkinson’s diseases.

Conclusions Results were generally reassuring, and provide only limited evidence of an association between amalgam and disease. Further follow-up of the cohort will permit investigation of diseases more common in the elderly.

Keywords Chronic fatigue syndrome, cohort studies, dental amalgam, kidney diseases, mercury, multiple sclerosis, New Zealand

Mercury, combined with other metals to form solid amalgams, has long been used in reconstructive dentistry. Dental amalgam currently contains about 50% mercury, with the remainder mainly silver. Although alternative dental materials are increasingly available for posterior fillings, amalgam has advantages that maintain its popularity as a filling material. These include relatively low cost, durability, and less sensitivity to clinical technique than other materials.

The use of mercury in dentistry has been controversial since at least the middle of the 19th century, as inorganic mercury can cause a wide variety of health effects, particularly to the neurological and renal systems.1,2 This controversy has intensified over...
the last 20 years or so, because highly sensitive analytical techniques have shown mercury to be continuously released from dental amalgam fillings and absorbed into the body. Reviews of the evidence have consistently stated that there is a deficiency of adequate epidemiological studies addressing this issue.

The New Zealand Defence Force (NZDF) is the only large organization in New Zealand that has its own dental service and maintains consistent and comprehensive adult dental records, which are centrally stored and archived. Free dental care has been provided to all members of the regular New Zealand military forces since 1918. Treatment is mandatory, regular, and consistent across ranks. This study is a retrospective cohort study of NZDF personnel, with an internal comparison. The cohort study design was selected because there is no particular disease which has been clearly identified as associated with dental amalgam use. However, various claims have been made, particularly about associations with autoimmune and neurological diseases, such as multiple sclerosis (MS), Alzheimer’s disease, Parkinson’s disease, and chronic fatigue syndrome (CFS).

This paper presents overall results, with additional focus on diseases of the nervous system and kidney, not including cancer.

**Methods**

The study design was approved by the Wellington Ethics Committee.

**Identification and definition of the cohort**

Potentially, the cohort comprised all members of the regular NZDF (army, navy, and air force) meeting the following criteria:

1. a member of the regular arm of the NZDF for at least one day between 1 January 1977 and 31 December 1997. These dates were selected for the availability of health outcome data;
2. NZDF dental records for the period of service were available. Individuals with incomplete records were excluded.

**Confirmation of vital status**

For cohort members not recorded by the New Zealand Health Information Service (NZHIS) as deceased, a variety of methods were used to confirm that they were alive at, or as close as possible to, the final date of follow-up (31 December 1997). These were similar to methods previously described and included NZDF service dates, records of the New Zealand Drivers’ License Register, dates of last contact with the New Zealand public hospital system, pension and retirement fund records, and electronic voter registration lists. Person-time contributions to the cohort terminated at death, end of the follow-up period, or the date closest to end of follow-up at which they could be confirmed as alive and living in New Zealand.

**Outcome data**

Each person in New Zealand is allocated a unique National Health Index (NHI) number on first contact with the national health system. All public hospital records (hospital discharge records) and deaths are linked to NHI numbers. All mortality records since 1988 are identifiable through the associated NHI numbers. Earlier mortality linkage is by name and birth date. Hospital discharge information was not universally linked to an NHI number until the late 1980s.

Once an NHI number for a cohort member was obtained, linked hospital discharge and mortality data, by dates and disease codes, were obtained up to 1997. When there were duplicate hospital admissions for the same condition, only the first admission date was used in the analysis.

**Amalgam exposure data and exposure index**

Amalgam exposure data were obtained from NZDF Dental Service records. Treatments are recorded by tooth surface on dental record cards. Bite-wing X-rays are taken on entry and periodically thereafter.

Dental record charts for retirees from the NZDF before 1992 were stored in the NZDF personnel archives. Navy records for personnel retiring up to about 1989 were stored elsewhere and were unavailable. For the purposes of this study, the dental records, including X-rays, of all other NZDF personnel discharged during 1977 to 1991 were systematically examined by dental therapists who were part of the study team. A data entry template was used for consistent recording of amalgam placements by tooth, tooth surface, and year, for each year of military service. For each person for whom dental records were available, all amalgam placements and tooth extractions, from year of entering the NZDF until 1991, were recorded.

Dental treatment data for people in service 1992–1997 were available as an electronic database. This database was combined with the database created from the archive-based records to provide the final amalgam exposure database.

For each subject for whom we had dental records, a dental amalgam exposure index was created based on the cumulative weighted sum of times since placement of fillings in tooth surfaces. Because they are larger, amalgam-filled, pre-molar and molar occlusal (top) tooth surfaces were weighted more highly than other surfaces. Relative surface area weightings were based on the evaluation of Saxe et al. The highest weighting was 2.9— for amalgam-filled occlusal surfaces on molar teeth with at least two other amalgam-filled surfaces.

Exposure index assumptions were: (1) amalgam fillings existing on entry into the NZDF had been in place since age 15. The average period from age 15 to NZDF entry was 4.3 years; (2) amalgam filling burden at NZDF discharge remained constant until death or the end of the follow-up period; (3) contribution of an amalgam filling to exposure ceased if the amalgam was replaced with a filling of other material or when the tooth with the amalgam was extracted.

**Covariate data**

Available covariate data were date of birth, sex, calendar period of NZDF service, and military rank at either exit from the NZDF or end of follow-up. Since the three different services have corresponding ranks, a combined variable for ‘equivalent rank’ was used.

**Statistical analysis**

The primary method of analysis was the Cox proportional hazards model. The selected unit of amalgam exposure was 100 amalgam-filled surface-years. This arbitrary unit is equivalent to having 10 non-occlusal amalgam-filled surfaces for 10 years. This was entered into models as a time-varying cumulative exposure index. The model was stratified by sex, year of birth (five calendar-year blocks), and equivalent rank (four levels).
All models were tested for compliance with the proportionality assumption. The hazard ratios (HR) represent the risk associated with one unit of amalgam exposure, relative to the risk associated with having no amalgam exposure.

Results

Of the 40,366 individuals who potentially could have been in the cohort because of their period of service, 1716 had missing electronic dental records and 8970 either did not have available paper-based dental records or they were considered to be insufficiently complete. Individuals with missing and incomplete records appeared to be randomly distributed across the potential cohort. After excluding individuals with missing and incomplete records, we were left with 29,680 people with complete dental records (the ‘initial cohort’). However, particularly prior to 1970, a substantial proportion of the cohort had missing teeth, other than wisdom (third molar) teeth, at entry into the NZDF. Because we had no information on prior amalgam treatments for missing teeth, we minimized amalgam exposure misclassification by limiting the main analysis to people aged <25 years at entry to the NZDF and with no missing posterior teeth, except wisdom teeth. This resulting ‘final cohort’ contained exactly 20,000 people.

Table 1 shows the outcome of the follow-up for the initial and the final cohorts. Of the theoretical total person-years of follow-up, 92.5% was traced for the initial cohort, and 93.0% for the final cohort. The theoretical total person-years of follow-up assumes that all cohort members lost to follow-up were alive at the end of follow-up.

Table 2 shows demographic details for the initial and final cohorts. The final cohort tended to be younger and began service with the NZDF on average later than the initial cohort. However, the average length of follow-up was comparable for the initial and final cohorts (12.5 and 11.2 years, respectively).

Table 3 shows the weighted mean annual number of amalgam fillings across approximate quartiles of the follow-up period, and numbers of person-years of exposure for each of the age-censual period categories. Generally, the number of fillings increases with age, then declines in the older groups, probably because of extractions. There is a progressive decline in person-years contributed after age 25 years. The average cumulative exposure summed over the years of follow-up for the final cohort was 628 amalgam-filled surface-years.

The morbidity data analysis was undertaken on any occurrence of an International Classification of Diseases, Ninth Revision (ICD) code, or group of codes, within up to 15 codes that could be recorded for every hospital discharge, after eliminating any readmission for the same condition (ICD code).

Table 4 shows HR for broad disease categories, based on target organs or types of illness, in the final cohort. Most HR were around 1.00. The only category that had an HR that was statistically significant (i.e. P ≤ 0.05) was endocrine, nutritional, and metabolic diseases, and immunity disorders (ICD-9: 240–279). However, this was in the direction of reduced risk. We carried out a similar across-the-board analysis of mortality in the final cohort. There were 189 deaths (HR = 1.01, 95% CI: 0.97, 1.05), of which 131 were from injuries and poisonings (ICD-9: 800–999) and 28 from neoplastic diseases (ICD-9: 140–239). No causes of death showed evidence of an association with amalgam exposure, although numbers were small.

We then examined individual three-digit ICD-9 codes for hospital admissions for the two main target organs of inorganic mercury toxicity—the nervous system and the kidney. Table 5 shows results for psychiatric and neurological disorders. Two models that did not satisfy the proportionality assumption were excluded. These were acute reaction to stress (ICD-9: 308.13 cases) and conduct disturbance not elsewhere identified (ICD-9: 312.7 cases). Four conditions had CI excluding the null value: other paralytic syndromes (ICD-9: 344) and mononeuritis of the upper limb and mononeuritis multiplex (ICD-9: 354) had elevated HR; adjustment reaction (ICD-9: 309) and inflammatory and toxic neuropathy (ICD-9: 357) had reduced HR.

Of the conditions that have been alleged to be associated with dental amalgam, MS (ICD-9: 340) had an elevated relative risk estimate (HR = 1.24, 95% CI: 0.99, 1.53, P = 0.06), but there was no evidence of any association between amalgam exposure and CFS (ICD-9: 780) (HR = 0.98, 95% CI: 0.94, 1.03). There were no cases of Parkinson’s disease (ICD-9: 332) in the cohort, one of motor neuron disease (ICD-9: 335.2), and two of Alzheimer’s disease (ICD-9: 331). These were considered insufficient for useful calculation of HR.

There were no elevated HR for kidney diseases (Table 6). There were HR less than unity for several of the conditions, particularly nephritis not otherwise specified (ICD-9: 583) and chronic renal failure (ICD-9: 585).

In the models shown in Tables 4–6, tooth surfaces were weighted to reflect the greater surface areas of occlusal fillings, and therefore their greater potential for mercury release. We investigated the effect of eliminating the differential weighting so that all tooth surfaces were considered to contribute equally to exposure. The results (not shown) were consistent. Removing the weighting in almost all cases resulted in HR that were further away from the null value than the corresponding weighted value, although usually only by a few per cent.

Discussion

The debate about possible health effects induced by dental amalgam is marked by an absence of adequate epidemiological studies. Previous studies have mostly been small, had limited exposure data, been particularly subject to selection bias in terms
of dental treatment access, and focused on a narrow range of outcomes. By contrast, our study had a large sample size, detailed exposure data, a consistent level of dental treatment across the cohort, and investigation of a wide range of possible health outcomes. The success of the follow-up process, accounting for 93% of the theoretically possible maximum person-time, suggests that selection bias from loss to follow-up is not likely to be a problem. Also, as noted in the Results, there were 8920 incomplete and 1716 missing records for people potentially in the cohort. We think it highly unlikely that the distribution of
A strength of the present study was the detailed, tooth surface-specific amalgam exposure data, by year of treatment, for the entire cohort across the period of military service. It is particularly unusual to have longitudinal amalgam placement data, and unique to have it in a cohort of this size. A recent cross-sectional study of neuropsychological function in relation to amalgam exposure highlighted this as a particular limitation. 

The only other published study with exposure data of comparable quality to our own was a small study by Saxe et al.10

Another strength was consistency of dental treatment across the cohort. All NZDF personnel have received compulsory and equivalent treatment, irrespective of rank. However, among civilians, dental treatment is not equally accessible. People of higher socioeconomic status (SES) are more likely to obtain dental treatment, and hence to have more amalgam fillings. Since higher SES is associated with better health status, there is

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Table 3  Weighted-average annual numbers of tooth surfaces with amalgam and corresponding numbers of person-years in the final cohort during the period of follow-up, 1977–1997, New Zealand Defence Force dental amalgam study

<table>
<thead>
<tr>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Age-groups (years)</td>
<td>Amalgam surfaces</td>
<td>Person-years</td>
<td>Amalgam surfaces</td>
<td>Person-years</td>
<td>Amalgam surfaces</td>
</tr>
<tr>
<td>16–20</td>
<td>41.0</td>
<td>7945</td>
<td>28.4</td>
<td>6656</td>
<td>18.6</td>
</tr>
<tr>
<td>21–25</td>
<td>50.9</td>
<td>10 894</td>
<td>40.7</td>
<td>14 133</td>
<td>27.4</td>
</tr>
<tr>
<td>26–30</td>
<td>59.1</td>
<td>4243</td>
<td>52.0</td>
<td>10 888</td>
<td>41.2</td>
</tr>
<tr>
<td>31–35</td>
<td>62.5</td>
<td>1922</td>
<td>60.0</td>
<td>4144</td>
<td>52.5</td>
</tr>
<tr>
<td>36–40</td>
<td>62.5</td>
<td>908</td>
<td>63.4</td>
<td>1934</td>
<td>60.5</td>
</tr>
<tr>
<td>41–45</td>
<td>61.7</td>
<td>298</td>
<td>62.9</td>
<td>913</td>
<td>63.7</td>
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<tr>
<td>46–50</td>
<td>54.7</td>
<td>142</td>
<td>62.8</td>
<td>295</td>
<td>63.0</td>
</tr>
<tr>
<td>51–55</td>
<td>48.2</td>
<td>28</td>
<td>55.0</td>
<td>137</td>
<td>63.0</td>
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<tr>
<td>56–60</td>
<td>39.7</td>
<td>5</td>
<td>48.3</td>
<td>28</td>
<td>54.8</td>
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<tr>
<td>61–65</td>
<td>39.7</td>
<td>5</td>
<td>48.3</td>
<td>28</td>
<td>56.7</td>
</tr>
<tr>
<td>66–70</td>
<td>39.7</td>
<td>5</td>
<td>48.3</td>
<td>28</td>
<td>56.7</td>
</tr>
<tr>
<td>71–75</td>
<td>43.9</td>
<td>9</td>
<td>43.9</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>50.6</td>
<td>26 385</td>
<td>45.7</td>
<td>39 133</td>
<td>38.8</td>
</tr>
</tbody>
</table>

Table 4  Hazard ratios (HR) for broad disease categories in the final cohort, New Zealand Defence Force amalgam study

<table>
<thead>
<tr>
<th>Disease category (ICD-9 codes)</th>
<th>No. of cases</th>
<th>HR&lt;sup&gt;b&lt;/sup&gt;</th>
<th>95% CI</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infectious and parasitic diseases (001–139)</td>
<td>439</td>
<td>1.00</td>
<td>0.97, 1.04</td>
<td>0.83</td>
</tr>
<tr>
<td>Neoplastic diseases (140–239)</td>
<td>264</td>
<td>1.00</td>
<td>0.97, 1.03</td>
<td>0.83</td>
</tr>
<tr>
<td>Endocrine, nutritional, and metabolic diseases, and immunity disorders (240–279)</td>
<td>126</td>
<td>0.96</td>
<td>0.92, 0.99</td>
<td>0.02</td>
</tr>
<tr>
<td>Diseases of the blood (280–289)</td>
<td>82</td>
<td>0.97</td>
<td>0.91, 1.04</td>
<td>0.37</td>
</tr>
<tr>
<td>Psychiatric disorders (290–319)</td>
<td>572</td>
<td>0.98</td>
<td>0.95, 1.02</td>
<td>0.31</td>
</tr>
<tr>
<td>Nervous system diseases (320–389)</td>
<td>341</td>
<td>1.02</td>
<td>0.98, 1.05</td>
<td>0.34</td>
</tr>
<tr>
<td>Circulatory system diseases (390–459)</td>
<td>359</td>
<td>1.02</td>
<td>0.99, 1.05</td>
<td>0.34</td>
</tr>
<tr>
<td>Respiratory system diseases (460–519)</td>
<td>659</td>
<td>0.99</td>
<td>0.97, 1.02</td>
<td>0.56</td>
</tr>
<tr>
<td>Digestive system diseases (520–579)</td>
<td>1142</td>
<td>1.00</td>
<td>0.98, 1.02</td>
<td>0.73</td>
</tr>
<tr>
<td>Genitourinary system diseases (580–629)</td>
<td>599</td>
<td>1.00</td>
<td>0.97, 1.03</td>
<td>0.98</td>
</tr>
<tr>
<td>Complications of pregnancy and childbirth (630–677)</td>
<td>1062</td>
<td>0.99</td>
<td>0.97, 1.02</td>
<td>0.66</td>
</tr>
<tr>
<td>Skin and subcutaneous tissue diseases (680–709)</td>
<td>331</td>
<td>1.02</td>
<td>0.98, 1.06</td>
<td>0.24</td>
</tr>
<tr>
<td>Musculoskeletal and connective tissue diseases (710–739)</td>
<td>696</td>
<td>1.00</td>
<td>0.98, 1.03</td>
<td>0.95</td>
</tr>
<tr>
<td>Symptoms, signs, and ill-defined conditions (780–799)</td>
<td>859</td>
<td>1.01</td>
<td>0.99, 1.03</td>
<td>0.59</td>
</tr>
<tr>
<td>Injuries and poisonings (800–999)</td>
<td>2628</td>
<td>1.01</td>
<td>1.00, 1.03</td>
<td>0.10</td>
</tr>
</tbody>
</table>

<sup>a</sup>  International Classification of Diseases, Ninth Revision.  
<sup>b</sup>  Hazard ratio for 100 amalgam surface-years relative to no amalgam exposure. All HR stratified by sex, year of birth (5-calendar year blocks), and equivalent rank (four levels) at either discharge, death, or the end of follow-up.
potential for confounding by SES. This may be why the only other cohort study to examine this issue, found apparent protective associations with amalgam across a wide range of outcomes. 16, 17

As a measure of SES we had data on military rank at end of follow-up, death, or discharge from the NZDF. We investigated changes in amalgam associations with this variable in and out of the models. Its inclusion had some small effects on some associations, but these were always <5% of the HR and not in a consistent direction.

The possibility remains of differential dental treatment access in periods before joining and after discharge from the NZDF. However, by restricting our cohort to subjects <26 years at entry.
to the NZDF, we would have substantially reduced that problem, as most amalgam fillings are put in place before age 26.

Despite this study's strength, it had some potential limitations. Firstly, characteristic of retrospective cohort studies, is the absence of data on potential confounding factors, such as smoking and diet, both of which affect dental caries (and, therefore, amalgam placement) and other disease rates.

Another possible limitation was the reliance on routinely collected outcome data. Linkage of hospital discharge records to NHI numbers was incomplete in the earlier part of our follow-up period. But to bias the results of our study, linkage to NHI numbers would have had to have been differential by amalgam exposure status. We know of no reason why this would have been likely. Reporting of hospital discharge data by private hospitals in New Zealand may be less complete. If patients with higher amalgam exposure are more likely to have been treated in private hospitals and these data were not reported, then that would likely lead to underestimation of the relative risk estimates for any diseases truly associated with amalgam exposure. However, private hospitals account for only a small proportion of non-surgical admissions in New Zealand.

Some of the cases of conditions of interest in this study may not have involved hospital admission. For such conditions there would have been undercounts of the actual numbers of cases occurring in the cohort. However, again, provided that this undercounting was not differential by amalgam exposure it should not bias the results. The main impact would be a loss of statistical power and wider CI. Also, the cohort is relatively young and, therefore, has limited statistical power to investigate diseases of old age (such as Parkinson's disease and Alzheimer's disease) and causes of death.

Another area of uncertainty is dental treatment in the period following discharge from the military. A constant amalgam burden has been assumed from that point, although some people will have had additional tooth surfaces filled and some teeth will have been removed. The impact may not be great, as most people receive the bulk of their amalgam fillings in their younger years. Nonetheless it introduces some uncertainty into risk estimates, particularly for diseases predominating at older ages, and the direction of any bias that might result is unclear.

This study was mainly useful for investigating medical conditions with clearly defined diagnoses. It had limited ability to investigate symptom complexes not specifically diagnosed. We examined individual ICD codes within the subcategory of symptoms and signs (ICD-9: 780–789). There were no individual three-digit ICD-9 codes associated with amalgam exposure. There is, in fact, little evidence that ill-defined symptom complexes are associated with amalgam fillings. Epidemiological studies have examined people holding the belief that their symptoms were associated with amalgam, and have generally found no association, or, in some cases, a negative association with amalgam exposure.18–24

One poorly understood condition, involving symptoms but no objective medical changes, that we could investigate was CFS (ICD-9: 780). This condition has been alleged to be associated with dental amalgam, although there is only limited scientific literature on this.12 We had a sufficient number of cases CFS in our cohort to investigate this hypothesis. Our HR of 0.98 (95% CI: 0.94, 1.03) provides no evidence of any association between amalgam exposure and CFS (Table 5). A small number of other cases (n = 20) fell into the category ‘other ill-defined and unknown causes of morbidity and mortality’ (ICD-9: 799) (not shown in Tables), which had an elevated relative risk estimate (HR = 1.18, 95% CI: 1.03, 1.36, p = 0.02). There is the hypothetical possibility of diagnostic misclassification of CFS cases into this category. However, it seems implausible that people with CFS caused by amalgam would be differentially allocated to code 799, rather than the code for CFS. Therefore, we think it unlikely that this affects the validity of the null association for CFS.

Two neurological conditions with elevated risk estimates were other paralytic syndromes (ICD-9: 344) and mononeuropathy of the upper limb and mononeuropathy multiplex (ICD-9: 354) (Table 5). We know of no other data bearing on the plausibility of these results. Therefore, in the absence of supporting evidence, we regard these results as hypothesis-generating. It is likely they have arisen as a result of the number of statistical tests that were carried out—the well-known ‘multiple comparisons’ issue.23 This is also likely to be the case for the apparently protective associations shown in Tables 5 and 6.

We found no positive association between kidney disorders and amalgam exposure (Table 6)—an important result, as the kidney is a primary target of inorganic mercury toxicity.1,2

An interesting result was the suggestion of an association between amalgam exposure and MS (Table 5). While the number of cases was small, the HR of 1.24 (95% CI: 0.99, 1.53) for one unit of amalgam exposure was relatively strong in this study. A link between MS and dental amalgam was first suggested by Craelius, who noted a strong correlation in the geographical distributions of MS and dental caries.9 Later, Ingalls suggested that this was confounded by the prevalence of dental amalgam fillings in high caries areas.26 MS prevalence increases with latitude, and recent studies have examined a possible role of ultraviolet light.27–29

Three MS case-control studies have investigated an association with amalgam exposure.30–32 However, these studies had various limitations, such as prevalent cases, limited exposure measures (including lack of dental treatment records), and small numbers of subjects. The one study that used incident cases and actual dental records found higher relative risk estimates for a larger number of amalgam fillings.30 The odds ratio for having more than 15 fillings (relative to having none) was 2.6 (95% CI: 0.8, 8.5).

For reasons in large part to do with our exclusion criteria and the high prevalence in NZDF entrants of prior tooth extractions, the cohort is relatively young. This can be presumed to account for the small numbers of cases of diseases that are predominant in the elderly, such as Alzheimer's disease and Parkinson's disease, which have been hypothesized to be caused by amalgam.10,11 Also, for some outcomes the number of cases occurring in the cohort was low relative to the number of variables, with the possibility of some resulting bias in the effect estimates.33 Despite these limitations, this study is the most comprehensive so far to investigate the amalgam safety issue, and generally provides reassurance. In particular, the study has shown no association between dental amalgam exposure and either kidney diseases or CFS. Some important questions remain, however. Therefore, given the uniqueness of the cohort, it is essential that it be followed into the future. Continuing follow-up would collect updated data on dental treatments and health outcomes, would establish whether there were any associations with rarer diseases...
and diseases more common in the elderly, and confirm whether associations found in the cohort continue to be present.

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KEY MESSAGES
• There is a need for epidemiological studies using longitudinal dental treatment records to investigate whether amalgam fillings are associated with adverse health events.
• In this cohort study there was no evidence of an association between amalgam exposure and adverse kidney effects.
• There was no evidence that chronic fatigue syndrome is associated with dental amalgams.
• The possibility that multiple sclerosis could be associated with dental amalgams deserves further investigation.
• Further follow-up of this cohort will permit investigation of disease outcomes more prevalent in the elderly.

References


