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Non-malignant respiratory disease mortality among dentists in the United States, 1979–2018

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Abstract

Background—Dentists can be exposed to dust and nanoparticles from teeth, dental composite, and metal alloys generated during dental procedures, and exposures to dusts can cause respiratory

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Contributions

EDF-L, RDL, and RJN contributed to study conceptualization and data acquisition. EDF-L, RDL, JMC-G, and SET contributed to methodology, analysis plan, and interpretation of results. EDF-L conducted the data analyses and led writing the report. All authors contributed to critical review, revision, and approval of the final manuscript.

Conflicts of Interest

Ethan D. Fechter-Leggett reports no conflicts of interest.

Ruth D. Lipman reports no conflicts of interest.

Suzanne E. Tomasi reports no conflicts of interest.

Randall J. Nett reports no conflict of interest.

Jean M. Cox-Ganser reports no conflict of interest.

Institutional Review Board

This activity was reviewed by CDC, deemed research not involving human subjects, and was conducted consistent with applicable federal law and CDC policy (see e.g., 45 C.F.R. part 46; 21 C.F.R. part 56; 42 U.S.C. §241(d), 5 U.S.C. §552a, 44 U.S.C. §3501 et seq.).

diseases, including pulmonary fibrosis. We described mortality from non-malignant respiratory diseases (NMRD) among dentists in the United States.

Methods—We submitted information on U.S. dentists who died during 1979–2018 to a centralized U.S. death records database to obtain underlying causes of death. Decedent data that met records-matching criteria were analyzed using the Life Table Analysis System software to calculate proportionate mortality ratios (PMRs), indirectly standardized for age, sex, race, and 5-year calendar period with 95% confidence intervals (CIs), for NMRD and a group of International Classification of Diseases Ninth and Tenth revision codes approximating idiopathic pulmonary fibrosis (PF group).

Results—Among 21,928 dentist decedents with complete race information, 1,583 deaths (7.2%) resulted from NMRD. Proportionate mortality for dentist decedents was significantly lower than the general population for NMRD overall (PMR, 0.66; 95% CI, 0.62 to 0.69), chronic obstructive pulmonary disease (PMR, 0.44; CI, 0.41 to 0.48), and pneumonia (PMR, 0.73; CI, 0.67 to 0.81) but significantly higher than the general population for the PF group (PMR, 1.57; CI, 1.37 to 1.80).

Conclusions—Dentists had decreased proportionate mortality for most NMRD and increased proportionate mortality for underlying causes of death associated with pulmonary fibrosis.

Practical Implications—Existing engineering controls that reduce inhalational exposures during dental procedures might be inadequate; improved characterization of these exposures could help inform more effective engineering controls.

Keywords

Dentists; Occupational Health; Pulmonary Fibrosis; Idiopathic Pulmonary Fibrosis; Occupational Exposure; Inhalation Exposure

Introduction

Dentists can be exposed to hazardous chemicals, airborne particulates, and bioaerosols known to be risk factors for respiratory disease. Vapors from solvents and acrylic resins, such as methyl methacrylate, can be released during procedures involving caries restorations, implants, and dental prosthetics as well as during environmental cleaning in dental settings.^{1,2} The dental dust generated during carious tissue removal and grinding/polishing dental materials can contain nanoparticles and respirable dusts from teeth, dental composite, glass ionomers, and metal alloys (containing nickel, chromium, cobalt, and molybdenum).^{3–7} Additionally, dental instruments such as ultrasonic scalers and high speed hand pieces can be sources of bioaerosols in the dental environment.^{8,9} Inhalational exposures are common among dentists; 55% of general dentists have reported their job required being exposed to contaminants (such as pollutants, gases, dust, or odors) every day, and another 19% reported these exposures occurred once a week or more but not every day.¹⁰

Studies among dental personnel have reported associations between materials used in dental settings and respiratory disease, including work-related upper and lower

respiratory symptoms, occupational asthma, and other respiratory hypersensitivities.^{11–15} Pneumoconiosis, a type of interstitial lung disease (ILD) caused by dust exposures and characterized by pulmonary fibrosis, has been documented among dental personnel.^{3,16} Idiopathic pulmonary fibrosis (IPF) is one of the most common ILDs and is a chronic, progressive disease with no cure, a median survival of 3–5 years, and lung transplantation is the only means of prolonging survival.^{17,18} Despite requirement for a specific set of clinical, radiologic, and histologic characteristics with a limited range of phenotypes for a diagnosis of IPF,¹⁹ patients continue to experience misdiagnosis.²⁰ This misdiagnosis may occur when these specific characteristics are absent, yet the diagnosis is applied based on some other pattern of pulmonary fibrosis on imaging or histology. Additionally, clinicians may inappropriately use this term when the correct patterns of pulmonary fibrosis are present on imaging or histology, but where a search for a cause is incomplete.¹⁹ A cluster of nine cases of IPF was identified among dental personnel treated at a tertiary care center during 2000–2017. The number of cases identified in that patient population was approximately 23-times higher than expected in the United States.²¹ Increased proportionate mortality ratios (PMRs) for dentists who died of “other interstitial pulmonary diseases with fibrosis,” which includes IPF, have also been previously described, indicating dentists might be occupationally exposed to hazards associated with pulmonary fibroses.²¹

In 2022, there were approximately 202,500 dentists employed in the United States, and the number of dentists in the United States potentially exposed to respiratory hazards is expected to increase over time because of increased demand for dental treatments.^{22,23} Despite known occupational exposures to hazardous compounds, few mortality studies of United States dentists have been published; furthermore, of those studies that have been published, the vast majority were prior to 1980 and limited to specific states.²⁴ To further understand the relationship between occupation as a dentist and respiratory disease, our objective was to describe the patterns and causes of mortality, focusing on non-malignant respiratory diseases (NMRD) including pulmonary fibrosis, among dentists who died in the United States during 1979–2018.

Methods

Data Sources

The American Dental Association (ADA) has a database of dentists, both members and non-members, in the United States that indicates vital status (alive/deceased). ADA provided data on dentists who died during 1979–2018 to the Centers for Disease Control and Prevention (CDC), National Institute for Occupational Safety and Health (NIOSH) through a Data Use Agreement in 2020. When information was available, the ADA decedent records included first name (or initial), middle name (or initial), last name, sex, race, date of birth, birth state, date of death, last known state of residence, graduation year, and practice type.

The National Death Index (NDI), administered by CDC’s National Center for Health Statistics, is a database of all deaths in the United States, beginning in 1979, and the most complete source of cause-of-death information in the country.²⁵ We submitted dentist decedent information to the NDI to obtain information on decedents’ cause(s) of death.

Case Selection

We reviewed decedent records that met NDI's minimum data requirements of first name (or initial), last name, birth month, and birth year and used public resources, such as publicly available online obituaries and cemetery records, to clarify birth date, death date, or dental school graduation year. The decedent data set was prepared according to NDI specifications using SAS version 9.4 (SAS Institute, Cary, NC) and submitted to NDI. NDI returned a list of potential person matches, with their causes of death, and a probabilistic score that summarizes the agreement between user-submitted data and the NDI death record. This probabilistic score is a conservative estimate indicating which matches have the highest probability of being true matches. To select final decedent matches, we used the NDI's probabilistic score recommended cutoff points (37.5 for Class 3; 32.5 for Class 4) that are designed to maximize the proportion of records correctly classified and minimize the number of records incorrectly classified as true matches.²⁶ In the cases of tied probabilistic scores, we used death date information to select decedent matches.

We used Life Table Analysis System (LTAS) version 4.5 software developed by NIOSH²⁷ for analyses. LTAS requires underlying cause of death (UCOD) and exposure start date to calculate proportionate mortality ratios (PMRs) so we assumed exposure start to be dental school graduation year; therefore, decedent matches with dental school graduation year were eligible for PMR analyses in LTAS.

Statistical Analysis

We calculated PMRs with 95% confidence intervals (CIs) using LTAS, which indirectly standardizes for age, sex (male/female), race (White/all other races), and 5-year calendar period. PMRs are useful when only numerator information, such as deaths within a given occupational group, is available while denominator information, such as the entire population of that occupational group, is not available. Because information on the non-decedent dentist population during 1979–2018 (the entire population at risk) was unknown, we calculated PMRs instead of standardized mortality ratios (SMRs). PMRs are calculated as the observed number of deaths from a specific cause divided by the expected number of deaths from that specific cause, where the expected number of deaths is obtained by multiplying the total number of study decedents (dentists in the present study) by the proportion of deaths from that cause in the reference population (general U.S. population in the present study). PMRs can also be conceptualized as the proportion of deaths from a specific cause among the study decedents (dentists) divided by the proportion of deaths from that specific cause among a reference population (general U.S. population). A PMR > 1.00 indicates the proportion of deaths from that specific cause among dentists was larger than the proportion of deaths from that specific cause among the general U.S. population. LTAS calculates *P* values and 95% CIs based on the Poisson distribution,²⁷ and we considered *P* values < .05 significant. We examined PMRs over time using the 5-year calendar period PMRs.

We calculated PMRs using UCOD for the NMRDs defined in LTAS's NIOSH-119 mortality rate file²⁸ and an *a priori* defined group of International Classification of Diseases (ICD) Ninth revision (ICD-9) and Tenth revision (ICD-10) codes most closely approximating

pulmonary fibroses including IPF (PF group) (Supplemental Table 1). Because our cause-of-death data were at a higher hierarchy level than specific IPF ICD codes, this PF group was based on definitions used in prior publications^{29–32} and defined as ICD-9 515 (postinflammatory pulmonary fibrosis), ICD-9 516.3 (idiopathic interstitial pneumonia, which includes the specific ICD-9 IPF code 516.31), or ICD-10 J84.1 (other interstitial pulmonary diseases with fibrosis, which includes the specific ICD-10 IPF code J84.112). We limited main analyses to decedents with complete race information that matched race information from NDI death records, because LTAS requires race and these records did not require any assumptions about the decedents' race during analyses. Cell sizes < 10 were suppressed to comply with NDI data presentation requirements.

Sensitivity Analyses

We conducted sensitivity analyses that, in addition to decedents with complete race information matching race information from NDI death records, also included additional decedents with uncertain race information. Uncertainty in race information could have been because (1) race information was unavailable from ADA, (2) ADA race information did not match the NDI race information, or (3) no race information was available from NDI. Because LTAS requires race (coded as White or “all other races”) for PMR analyses, we coded decedents with uncertain race information in various combinations of White or “all other races” for sensitivity analyses and started with the broadest inclusion criteria (Group 1) and progressively narrowed the inclusion criteria (Groups 2–5) until we reached the strictest inclusion criteria that formed the main analyses (Supplemental Table 2).

Institutional Review Board

This activity was reviewed by CDC, deemed research not involving human subjects, and was conducted consistent with applicable federal law and CDC policy.

Results

Case Selection

A total of 48,585 dentist decedent records met inclusion criteria to be submitted to NDI (Figure 1) to obtain cause(s) of death. After records-matching criteria were applied, 39,282 dentist decedents were matched to a single NDI record. Of 38,719 dentist decedent records with sufficient data for LTAS analysis, 21,928 (56.6%) had complete race information that matched NDI's race information. These 21,928 dentist decedents were included in our main analyses. The remaining 16,791 dentist decedents with uncertain race data were additionally included in sensitivity analyses: race data were unavailable from ADA for 16,096 (95.9%), the ADA race information did not match NDI race information for 596 (3.5%), and race data were unavailable from NDI for 99 (0.6%).

Demographics

Among the 21,928 dentist decedents included in main analyses, 21,587 (98.4%) were male, 20,977 (95.7%) were White, mean age at death was 78.6 years, and mean time between dental school graduation and death was 51.5 years (Table 1). A total of 1,583 (7.2%)

decedents had a NMRD as their UCOD, and 212 of these decedents (13.4% of decedents who died from NMRD; 1.0% overall) died from a PF group UCOD.

NMRD Overall and Specific Respiratory Diseases

Proportionate mortality for dentist decedents was significantly lower than the general U.S. population for NMRD overall, chronic obstructive pulmonary disease (COPD), pneumonia, and asbestosis (Table 2). Proportionate mortality for dentists was not significantly different from the general U.S. population for acute respiratory infections (excluding influenza/pneumonia), influenza, and asthma. No decedents had an UCOD of silicosis or other pneumoconioses. Proportionate mortality for dentist decedents was significantly higher than the general U.S. population for the NMRD “other respiratory diseases” category.

Over time, the PMRs for NMRD overall, COPD, and pneumonia were significantly less than one during all calendar periods 1995–2018 (Figure 2). While NMRD “other respiratory diseases” category had a PMR > 1.0 during all calendar periods 1995–2018, only calendar period 2010–2014 reached statistical significance (PMR, 1.27; 95% CI, 1.08 to 1.48; $P = .004$). For calendar periods before 1995, the number of deaths from each of these causes among decedents included in our main analyses was less than 20 during each 5-year calendar period, and none of these PMRs significantly different from one, except for COPD during 1990–1994 (PMR, 0.38; 95% CI, 0.12 to 0.88; $P = .019$).

The most common UCODs among the 537 decedents in the NMRD “other respiratory diseases” category were PF group diseases (includes IPF), which accounted for 39.5% of this category across all calendar periods, and pneumonitis due to food and vomit, which accounted for 35.8% of this category across all calendar periods (Table 3); these respective percentages remained stable across each calendar period of the study since first appearing as UCOD during 1990–1994 (Figure 3).

PF Group

When the pulmonary fibrosis-related deaths were analyzed separately from the broader “other respiratory diseases” category, proportionate mortality for dentist decedents was significantly higher than the general U.S. population for this PF group (Table 2). The earliest death from a PF group UCOD was during 1990–1994 among decedents in our main analyses; during this calendar period, the PMR did not reach statistical significance, though there were few decedents in this group. The PMRs for PF group deaths were significantly elevated during 1995–2014; the PMR during 2015–2018 was also > 1.0 but did not reach statistical significance (Figure 4).

Sensitivity Analyses

Characteristics of dentists in sensitivity analysis groups (Supplemental Table 3) were not substantially different from those included in main analyses. Sensitivity analyses results are reported in supplemental materials.

Discussion

During 1979–2018, dentists had lower proportionate mortality than the general U.S. population for all NMRDs, except the non-specific “other respiratory diseases” category. Dentists had higher proportionate mortality than the general U.S. population for this “other respiratory diseases” category, which was primarily composed of underlying causes of death of pulmonary diseases with fibrosis (PF group), a particular interest in this study as potentially being occupationally related, and pneumonitis due to food and vomit, which we would not expect to be occupationally related. Because we could not separate deaths from pulmonary fibrosis from deaths due to other causes in the “other respiratory diseases” category using standard LTAS rate files, we *a priori* designed a PF group of ICD codes to most closely approximate IPF as possible. These more specific analyses on pulmonary fibrosis, in both our main and sensitivity analyses, revealed dentists had higher proportionate mortality than the general U.S. population for pulmonary diseases with fibrosis, both overall and during each calendar period with at least one death from a PF group UCOD, with most reaching statistical significance.

Our study is the first mortality study of its size among dentists in the United States in almost 50 years. A previous study commissioned by NIOSH published in the 1970s included over 102,000 dentists and examined causes of death among the 8,945 dentists who died during the study period 1960–1965. That study revealed significantly reduced mortality among dentists from NMRD overall, compared to the general U.S. population.³³ Our results are also similar to smaller studies in Taiwan, Japan, Europe, and the United States that found reduced mortality among dentists, compared with the general population, for COPD, pneumonia, influenza, bronchitis, and asthma.^{34–37} The authors of these other studies suggest the findings of reduced mortality from respiratory diseases might be because of dentists’ high socioeconomic status and access to healthcare. In the United States, a low smoking prevalence of approximately 6% among dentists, compared with 19.6% among all U.S. working adults and 15.9% among U.S. adults working in the healthcare and social assistance industry, might also contribute to these findings in our study.^{38,39}

Our study is also the first to specifically examine mortality from NMRD with a focus on fibrotic pulmonary diseases, following a cluster of IPF cases identified among dental personnel.²¹ Although historically dental practices have not been considered settings where potentially harmful exposures that could contribute to ILDs occur, occupational pneumoconiosis linked to dental dust has been documented among dental professionals, particularly dental technicians, across multiple studies in various countries.³ Additionally, a case report from the United States described a 79-year-old retired dentist with severe interstitial pulmonary fibrosis of unknown cause who died from respiratory failure, and a necropsy with scanning electron microscopy of his lung tissue revealed inclusions consistent with alginate impression powders the dentist used during his career.⁴⁰ If we made assumptions about state and year of death from this case report, we could conclude this dentist was included in our study in the PF group.

In our study of dentists, no decedent had silicosis or other pneumoconiosis as the UCOD. Still, given dentists’ known occupational exposures to dental dust and previous case

reports/series of ILDs including IPF among dental personnel, our pulmonary fibroses (PF group) results corroborate concerns about a potential relationship between occupational exposures and pulmonary fibrosis among dentists. Our PF group results are also consistent with elevated PMRs previously reported by NIOSH using surveillance data for “other interstitial pulmonary disease with fibrosis” (which included IPF), both among those with the occupation of dentist (PMR, 1.78; 95% CI, 1.45 to 2.20) and those who worked in the offices of dentists (PMR, 1.44; 95% CI, 1.22 to 1.69).²¹ Future studies examining pulmonary fibrosis in dentists is warranted to investigate if the decreased PMR for the most recent calendar period represents an overall decreasing trend of pulmonary fibrosis among dentists, especially given the increasing proportion of female dentists over time (16.0% in 2001 to 31.8% in 2018) and binary sex differences in IPF survival.^{23,41} We also acknowledge other dental personnel could also be exposed to similar occupational hazards warranting future investigation.

Our study’s strengths include its sample size of over 38,000 dentist decedents, 40 years of included data, national scope, and specific analyses on pulmonary fibroses that is a topic of recent concern to the occupation. Although the proportion of dentist deaths captured by ADA is uncertain, this proportion is estimated to be greater than 50%; while we do not anticipate the captured deaths to be systematically different from non-captured deaths, the number of dentist deaths during the study period may be an undercount, and we cannot make conclusions about the representativeness of the included decedents.

Our study is also subject to at least four limitations. First, for some decedents, NDI returned multiple potential death record matches. Although the NDI-recommended probability score cutoffs and date of death were used to select a single death record, we acknowledge misclassification is possible. Second, misclassification of cause(s) of death on death certificates is possible, and some decedents could have had pulmonary fibrosis not indicated by the UCOD ICD code;⁴² this limitation would result in an undercount of decedents with any pulmonary fibrosis in our study. We also did not exclude decedents with contributing causes of death associated with known causes of pulmonary fibrosis, as has been done in previous studies attempting to examine IPF specifically.^{30,32,43} These types of multiple-cause-of-death analyses were beyond the scope of the current study, and furthermore, the UCOD is the recommended unit of primary tabulation to examine opportunities for public health intervention for the precipitating cause of death.⁴⁴ Third, while we defined the PF group ICD codes *a priori*, based on previous IPF studies,³¹ to most closely approximate IPF as possible for the UCOD, the PF group likely includes decedents whose UCOD was pulmonary fibrosis, but not specifically IPF. This limitation was acceptable in our current study, because decedents with IPF are often either coded to one of these more general pulmonary fibrosis ICD codes and additional ICD codes on death certificates are inadequately sensitive to determine pulmonary fibrosis etiology.^{29,30,32} Finally, a general limitation of PMRs is that cause-specific PMRs are mutually dependent, meaning an elevated PMR for one cause could result in a decreased PMR for another cause. If dentists’ mortality overall is lower than the general U.S. population, for example because of the healthy worker effect, then PMRs might differ from SMRs, which are more reliable estimates of mortality but require data on the entire at-risk population.⁴⁵ Future analyses

could benefit from identifying sources of denominator data for dentists and calculating SMRs to confirm these findings.

Conclusion

Given the known occupational risks for interstitial lung disease among dental personnel, possible inadequate ascertainment of occupational history from patients, and potential for misdiagnosis of IPF,^{19,46–48} our mortality results might indicate IPF among dentists may not truly be idiopathic and instead may be related to a common underlying occupational exposure. Measuring actual dust and bioaerosol exposures in dental practice settings would provide information on specific respiratory hazards in these workplaces that could guide design and implementation of effective engineering controls.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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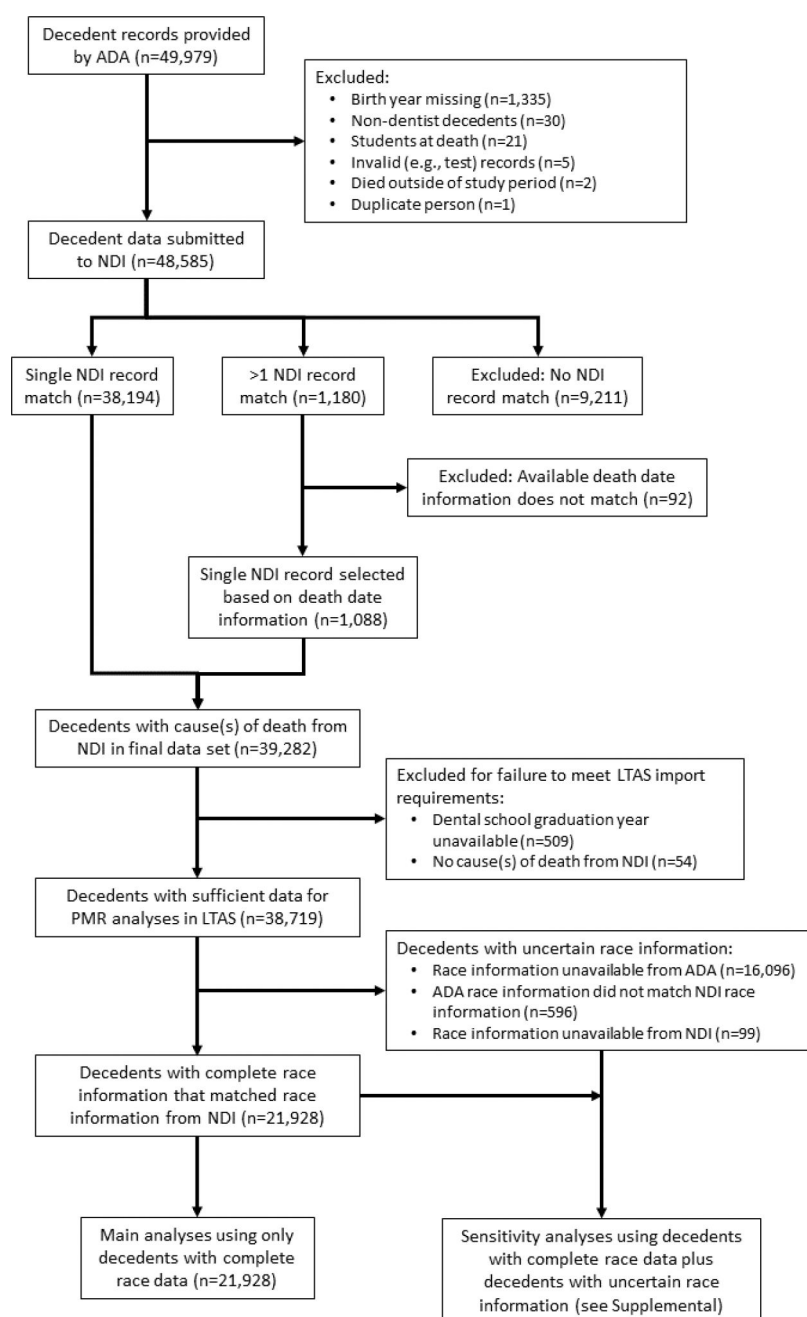
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**Figure 1.**

Flow diagram illustrating selection, inclusion, and exclusion of death records for proportionate mortality analyses from non-malignant respiratory diseases among dentists in the United States during 1979–2018. ADA: American Dental Association. NDI: National Death Index. LTAS: Life Table Analysis System. PMR: proportionate mortality ratio.

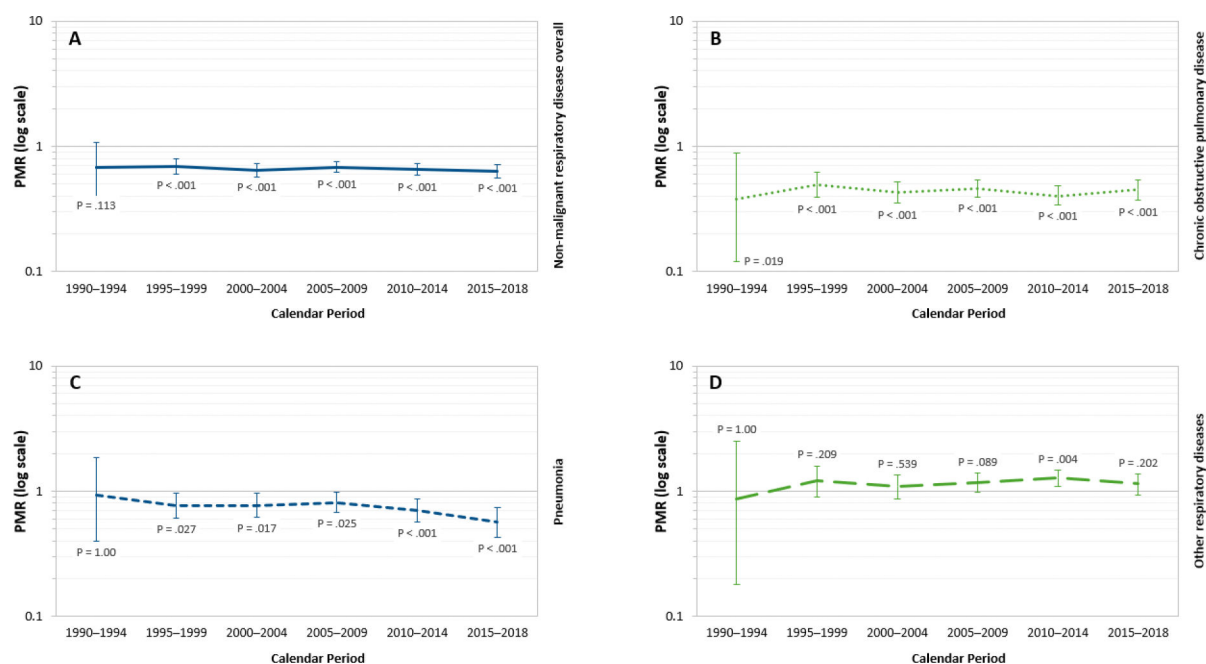


Figure 2.

Proportionate mortality from non-malignant respiratory disease overall (A), chronic obstructive pulmonary disease (B), pneumonia (C), and other respiratory diseases (D) among dentist decedents included in main analyses, by calendar period, with 95% confidence intervals (CIs). Proportionate mortality ratios (PMRs) were calculated using Life Table Analysis System software, indirectly standardized for age, sex, and race, with 95% CIs and 2-sided P values based on the Poisson distribution.

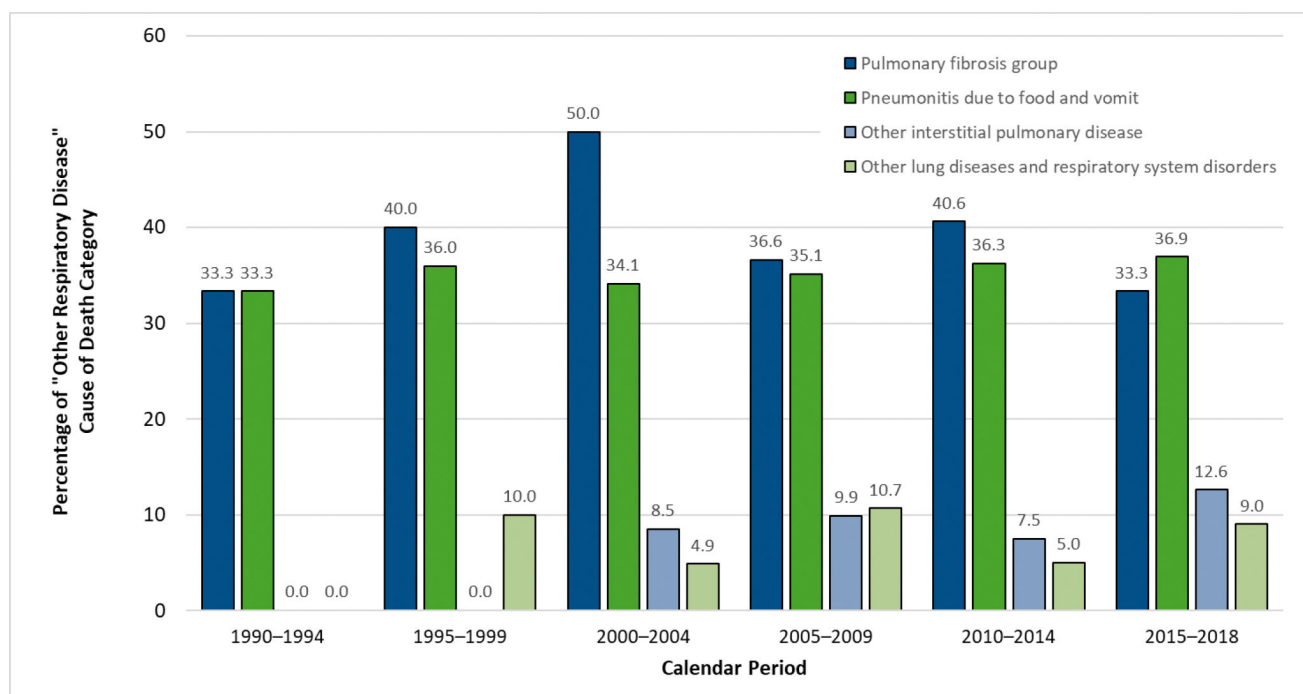


Figure 3. Percentage of “other respiratory diseases” category deaths from a specified cause or group of causes for dentist decedents included in main analyses, by calendar period.

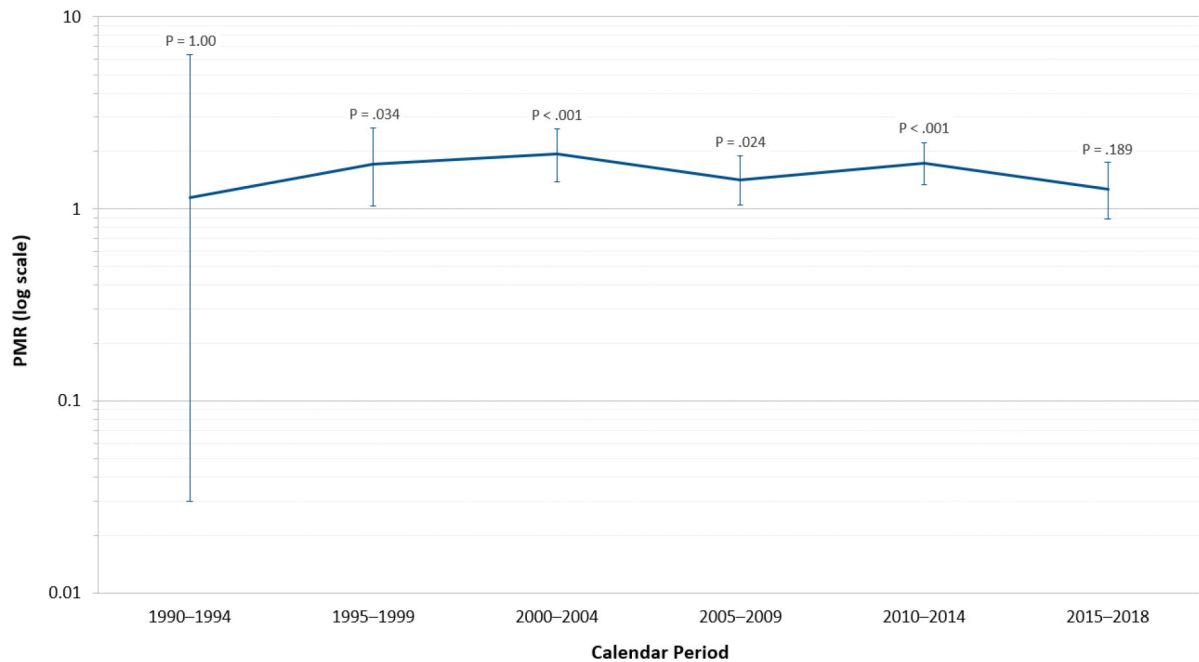


Figure 4.

Proportionate mortality from pulmonary fibrosis group causes of death among dentist decedents included in main analyses, by calendar period, with 95% confidence intervals (CIs). Pulmonary fibrosis group was defined as International Classification of Diseases (ICD), Ninth Revision (ICD-9) and Tenth Revision (ICD-10) codes that most closely approximated idiopathic pulmonary fibrosis: ICD-9 515 (postinflammatory pulmonary fibrosis), ICD-9 516.3 (idiopathic interstitial pneumonia), or ICD-10 J84.1 (other interstitial pulmonary diseases with fibrosis). Proportionate mortality ratios (PMRs) were calculated using Life Table Analysis System software, indirectly standardized for age, sex, and race, with 95% CIs and 2-sided *P* values based on the Poisson distribution.

Table 1.

Demographics of dentists who died during 1979–2018, with complete race information, for which cause(s) of death were obtained (N=21,928).

Characteristic	n	(%)
Sex		
Male	21,587	(98.4)
Female	341	(1.6)
Race		
White	20,977	(95.7)
All Other Races	951	(4.3)
Age at death (years)		
Mean (range)	78.6 (26.3–108.8)	
25–34	85	(0.4)
35–44	285	(1.3)
45–54	819	(3.7)
55–64	1,990	(9.1)
65–74	3,926	(17.9)
75–84	7,099	(32.4)
85–94	6,756	(30.8)
≥95	968	(4.4)
Time between dental school graduation and death (years)		
Mean (range)	51.5 (<1–83.8)	
Less than 5	38	(0.2)
5–9	110	(0.5)
10–19	396	(1.8)
20–34	2,042	(9.3)
35–49	6,045	(27.6)
50–64	10,297	(47.0)
≥65	3,000	(13.7)
Practice Type		
Owner	16,080	(73.3)
Non-Owner	574	(2.6)
Associate	608	(2.8)
Independent Contractor	482	(2.2)
Unknown	4,184	(19.1)

Table 2.

Proportionate mortality ratios for non-malignant respiratory disease and pulmonary fibrosis group causes of death among dentist decedents included in main analyses (N=21,928).

Underlying Cause of Death	No. Observed	No. Expected	Standardized PMR (95% CI)*	P value
Non-malignant respiratory disease	1,583	2,409.7	0.66 (0.62–0.69)	< .001
Chronic obstructive pulmonary disease	583	1,320.7	0.44 (0.41–0.48)	< .001
Pneumonia	424	578.2	0.73 (0.67–0.81)	< .001
Influenza	16	13.3	1.21 (0.69–1.96)	.518
Asthma	16	16.6	0.96 (0.55–1.56)	1.00
Asbestosis	< 10	< 15	0.09 (0.00–0.50)	< .001
Acute respiratory infections (excluding influenza and pneumonia)	< 10	< 10	2.05 (0.75–4.47)	.153
Silicosis	0	1.3	0.00 (0.00–2.74)	.520
Other pneumoconioses	0	7.8	0.00 (0.00–0.47)	< .001
Other respiratory diseases	537	457.8	1.17 (1.08–1.28)	< .001
Pulmonary fibrosis group†	212	134.6	1.57 (1.37–1.80)	< .001

* PMRs were calculated using Life Table Analysis System software, indirectly standardized for age, sex, race, and 5-year calendar period, with 95% CIs and 2-sided *P* values based on the Poisson distribution.

† Pulmonary fibrosis group was defined as International Classification of Diseases (ICD), Ninth Revision (ICD-9) and Tenth Revision (ICD-10) codes that most closely approximated idiopathic pulmonary fibrosis: ICD-9 515 (postinflammatory pulmonary fibrosis), ICD-9 516.3 (idiopathic interstitial pneumonia), or ICD-10 J84.1 (other interstitial pulmonary diseases with fibrosis).

Table 3.

Underlying cause of death among dentist decedents included in main analyses in “other respiratory diseases” cause of death category and corresponding International Classification of Diseases (ICD) Ninth revision (ICD-9) and Tenth revision (ICD-10) codes (n=537).

Underlying Cause of Death	ICD-9 Codes	ICD-10 Codes	n (%)
Pulmonary fibrosis group	515, 516.3	J84.1	212 (39.5)
Pneumonitis due to food and vomit	507.0	J69.0	192 (35.8)
Other interstitial pulmonary disease	N/A *	J84.8, J84.9	46 (8.6)
Other lung diseases and respiratory system disorders	518.8, 519.8	J80, J98.4, J98.8, J98.9	41 (7.6)
Pleural effusion, hemothorax, and hydrothorax	N/A	J90, J94.2, J94.8	13 (2.4)
Bronchiectasis	494	J47	< 10 (< 2.0)
Infection, pus, or other abscess	510.9, 513.0, 513.1	J85.0, J85.1, J85.2, J86.9	< 10 (< 1.0)
Pulmonary edema	514, 518.4	J81	< 10 (< 1.0)
Upper respiratory diseases	473.9, 478.2, 519.1	J30.4, J38.0, J39.2, J39.8	< 10 (< 1.0)
Alveolar and parietoalveolar conditions	516.8	J84.0	< 10 (< 1.0)
Mediastinal emphysema and other diseases and diaphragm disorders	N/A	J98.2, J98.5, J98.6	< 10 (< 1.0)
Pneumothorax	512	J93.1, J93.9	< 10 (< 1.0)
Pulmonary insufficiency following trauma and surgery	518.5	N/A	< 10 (< 1.0)
Pulmonary collapse	518.0	N/A	< 10 (< 1.0)
Pulmonary eosinophilia	518.3	J82	< 10 (< 1.0)

* N/A: No decedents in this category.