

行政院國家科學委員會專題研究計畫 成果報告

台灣牙醫師的職業暴露與健康狀況之流行病學研究 研究成果報告(精簡版)

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行政院國家科學委員會補助專題研究計畫 成果報告
 期中進度報告

台灣牙醫師的職業暴露與健康狀況之流行病學研究

計畫類別： 個別型計畫 整合型計畫

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張琇雯、呂若勳、廖浩宇、黃舒暘、龔愛雲、彭俊瑋

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中華民國 99 年 10 月 28 日

中文摘要

研究指出牙醫師有高的職業相關健康問題，牙醫師在工作場所暴露於被細菌或病毒所污染的生物氣膠、汞及丙烯酸甲酯，這些物質對牙醫師的健康可能有不良影響，然台灣牙醫師的職業暴露與健康狀況尚未被充分了解，本研究的主要目的為：(1)進行全國性調查，探討牙醫師的疾病/症狀盛行率與職業暴露之關係；(2)建立全國牙醫師的研究世代，以追蹤調查其疾病的發生情況。本研究郵寄問卷和邀請函給 11125 位牙醫師，調查其工作內容、工作環境之暴露、工作時使用之防護設備或措施、疾病史、自覺症狀、與生活習慣等資料。並徵詢有意願參加世代研究者，規劃在未來持續追蹤調查其各疾病的發生情形。本研究運用 SAS 軟體作資料分析，包括敘述性統計、雙因子分析、logistic regression 等。共有 1493 位牙醫師參加本研究，參加率為 13.42%，其中 357 位同意參加未來的世代追蹤調查研究。參加者的平均年齡(標準差)和牙科臨床工作的年數分別為 45 (11)歲和 18 (10)年，55%目前使用汞齊填補牙齒，38%以前使用但現在沒使用汞齊，5%從未使用過汞齊。參加者最常自訴的症狀依次為眼睛乾澀或疲勞(56%)、記憶力減退(35%)、鼻子過敏(29%)等，最常見的經醫師診斷之疾病為脂肪肝(20%)和高血壓(15%)。在未考慮其他因素時，臨床工作內容和汞齊的使用與許多經醫師診斷之疾病、以及自訴的症狀顯著相關。在以 logistic regression 控制性別、牙科臨床工作的年數、吸菸、喝酒等因素之後，有進行口腔外科手術的牙醫師顯著地比其他牙醫師有較多之接觸性皮膚炎(odds ratio, OR = 1.60, 95% confidence interval, CI = 1.08-2.35)和幽門螺旋桿菌感染(OR = 1.89, 95% CI = 1.28-2.77)。從未使用汞齊者比目前使用者不易自訴有記憶力減退(OR = 0.55, 95% CI = 0.31-1.00)，臨床工作為根管治療、牙齒矯正、或做固定假牙者有顯著較多的自訴胸痛或胸悶(OR 分別為 2.92、1.42、2.24)。本研究之參加率低，樣本之代表性可能不足，結果可能受 selection bias 之影響。然而，本研究結果有助於了解牙醫師的各種職業暴露與疾病/症狀之關係，未來我們將持續追蹤調查願意參加世代研究之牙醫師。

關鍵詞：牙醫師、職業暴露、丙烯酸甲酯、生物氣膠、汞

Abstract

The occupational exposures and health status of dentists in Taiwan are not well understood. This study aimed to implement a national survey for assessing the health problems and occupational exposures among dentists and to establish a cohort for assessing the effects of occupational exposures on incidence of diseases/symptoms among dentists in the future. All 11125 licensed dentists were invited to participate in the study by a mailed questionnaire and an invitation letter. In total, 1493 dentists participated in the questionnaire survey, with a response rate of 13.42%. Among them, 357 dentists agreed to participate in the cohort study in the future. The mean age (standard deviation) and duration of dental practice was 45 (11) years and 18 (10) years, respectively. Fifty-five percents of the participants were current amalgam users, 38% were former users, and 5% never used amalgam before. Physician-diagnosed diseases with the highest prevalence were fatty liver (20%) and hypertension (15%). The most frequently reported symptoms were dryness or fatigue of the eyes (56%), poor memory (35%), and allergy of nose (27%). After controlling for sex, duration of dental practice, cigarette smoking and alcohol drinking, dentists conducting oral surgery were significantly more likely to have contact dermatitis (odds ratio, OR=1.60, 95% confidence interval, CI=1.08-2.35) and *Helicobacter pylori* infection (OR= .89, 95% CI = 1.28-2.77). Dentists never used amalgam were less likely to report memory loss than did current amalgam users (OR=0.55, 95% CI = 0.31-1.00). Subjects doing root canal treatment, orthodontic treatment, or fixed prostheses were significantly more likely to report chest pain or tightness (OR=2.92, 1.42, 2.24, respectively). This study was limited by low response rate, and the results could be affected by selection bias. However, findings from this study help to clarify the association between various occupational exposures and diseases/symptoms among dentists.

Keywords: dentist; occupational exposure; bioaerosols; mercury

Background and significance

Dentists have multiple occupational exposures, which may have adverse effects on their health. The potential occupational risk factors include biological, chemical, physical, psychological, ergonomic, and other job-related factors (Gijbels et al., 2006; Horsted-Bindslev, 2004; Lindfors et al., 2006; Pankhurst and Coulter, 2007; Schedle et al., 2007; Szymanska, 2005, 2007). Several studies have been conducted to investigate the potential health effects of a variety of occupational exposures among dentists. Major concerns are the potential adverse effects from inhalation of contaminated bioaerosol, mercury from amalgam, methacrylates from acrylic resin-based composites, radiation, and dusts from preparing teeth and grinding/polishing of metal alloys, resins, and ceramics. The others include reactions from dermal contact with latex gloves or resin-based materials, noises and vibration from handpieces, and stress. Several studies are reviewed and summarized as follows.

Previous studies of dentists or other dental personnel reported high prevalence of occupational health problems, such as musculoskeletal pain (Chowanadisai et al., 2000; Lindfors et al., 2006; Leggat and Smith, 2006), percutaneous injury (Chowanadisai et al., 2000), carpal tunnel syndrome (Hamann et al., 2001), conjunctivitis and atopic dermatitis (Al Wazzan et al., 2001; Lonroth and Shahnava, 1998), respiratory disease/symptoms (Andreasson et al., 2001;), work stress-related symptoms (Ahola and Hakanen, 2007; Myers and Myers, 2004), and percutaneous injuries (Leggat and Smith, 2006; McCarthy et al., 1999). Results for liver cancer risk were conflicting, incidence of liver cancer was significantly increased in one study (Eklund et al., 1990), but significantly decreased in another study (Tanaka et al., 2004) of male dentists. Lung cancer risk was consistently found to be decreased in male dentists (Nishio et al., 2004; Haldorsen et al., 2004; Ji and Hemminki, 2005).

Previous studies also consistently revealed that dentists were exposed to bacteria, viruses, and other contaminants in bioaerosol during dental procedures (Al Maghlouth et al., 2004; Decraene et al., 2008; Toroglu et al., 2003). Bacteria in dental unit waterlines was significantly associated with developing asthma (Pankhurst et al., 2005). Studies of *Helicobacter pylori* infection in dentists had inconsistent findings. Three of the studies reported no significant difference in seroprevalence between dentists and controls (Banatvala et al., 1995; Lin et al., 1998; Malaty et al., 1992), but two studies found significantly higher *H. pylori* infection in dentists (Honda et al., 2001; Matsuda and Morizane, 2005).

Studies of mercury exposures in dentists found higher blood or urinary levels of mercury in dental personnel than in controls (Aydin et al., 2003; Ritchie et al., 2002). Urinary level of mercury or mercury amalgam exposure was significantly associated with lower logical memory and total retention score and increased scores of anxiety (Aydin et al., 2003), many self-reported symptoms and mood (Heyer et al., 2004), and miscarriage (Lindbohm et al., 2007), but mercury exposure was not significantly associated with musculoskeletal symptoms (Akesson et al., 2000), psychomotor response (Ritchie et al., 2002), or coronary heart disease (Yoshizawa et al., 2002). Several studies evaluated the dentists' exposure to methacrylates and its potential health effects. Uses of methacrylates were related to increased adult-onset asthma, nasal symptoms, and work-related cough or phlegm (Jaakkola et al., 2007), allergy (Aalto-Korte et al., 2007), and higher incidence of respiratory hypersensitivity/diseases (Piiirila et al., 2002), but not miscarriage (Lindbohm et al., 2007).

Previously, we have analyzed the 1997 data for dental treatments in Taiwan from the National Health Insurance Research Database. The result showed that 42.3% of the teeth were restored with amalgam, and the rest with acrylic resin-based composites or glass ionomer (Hu et al., 2002). In a survey of dental students in Taiwan during 2001 school year, about 74% of the participants were immunized for hepatitis B virus, and the students were less knowledgeable about hepatitis C virus infection (Hu et al., 2004). Furthermore, in our study of dental technicians' exposure to methyl methacrylate and particulates and lung function, levels of methyl methacrylate were low in the participating laboratories and workplace PM_{2.5} (particulate matter with aerodynamic diameter less than 2.5 mm) was associated with a non-significant decrease in lung function of dental technicians (Hu et al., 2006).

In summary, previous studies reported that dentists had high prevalence of occupational health problems and were exposed to bioaerosol contaminated with viruses or bacteria, mercury from amalgam, and methacrylates from acrylic resin-based composites. These exposures were found to be associated with some disease/symptoms among dentists. However, previous studies of the effects of occupational exposures on dentists usually either used a cross-sectional design (for disease/symptoms and exposures) with dental students/nurses/assistants as the comparison group or used the registry data (for cancer incidence) with general population as the comparison. It is necessary to conduct a long-term follow-up of this occupational group for incidence of diseases and changes in exposures (e.g. there is a decreasing trend for use of dental amalgam) and to delineate the exposures-disease incidence relationship. Furthermore, the occupational exposures and health status of dentists in Taiwan are not well understood and merit further investigation.

Specific aims

The purpose of this epidemiological study was to investigate the occupational exposures and health status of dentists in Taiwan. The specific aims were: (1) to implement a national survey for the health problems and occupational exposures among dentists; (2) to establish a cohort study to assess the effects of occupational exposures on incidence of diseases/symptoms among dentists.

Methods

This one-year epidemiological study had two main parts. The first part was a nationwide survey of dentists in Taiwan. The second part was to establish a cohort of dentists for further follow-up in the future. The study protocol has been reviewed and approved by the Institutional Review Board (IRB) of Chung Shan Medical University Hospital. Subjects eligible for this study were invited to participate in this study after signing an informed consent.

Study design and study subjects

This study was conducted on all licensed dentists in Taiwan. The list of 11243 licensed and practicing dentists was obtained from the Taiwan Department of Health. The participants were categorized into exposed and comparison (internal control) groups according to their job contents.

Mailed questionnaire and invitations

A self-administered questionnaire letter was mailed to all 11125 dentists with complete information for their addresses. The occupational exposure history, health problems, and other important factors of all participants were assessed by a structured self-administered

questionnaire. The questionnaire was developed and contained: (1) questions for physician-diagnosed diseases and infection of hepatitis B or C; (2) questions about other self-reported health problems; (3) items for detailed occupational history, including specialty, types of dental clinics, frequency of various dental treatment procedures, uses of dental materials, working hours, and duration of dental practice; (4) oral health (including dental caries and periodontal diseases); and (5) demographic information and life-style factors.

Along with the questionnaire was a cover letter for invitation and a detailed explanation of the study, an informed consent (for willingness to participate in the cohort study), and a postage-paid return envelope. Furthermore, a reminding letter was mailed to all dentists within one or two weeks after the mailing of questionnaire.

Statistical analysis

The replied questionnaires were entered into computer, edited, and analyzed. Data analysis included (1) descriptive statistics for distribution of continuous variables and for frequencies/prevalence of each self-reported health problem, (2) bivariate analysis, such as chi-square test, t-test, or analysis of variance, for unadjusted associations between each of the exposure variables (such as specialty, job contents and use of amalgam) and each of the health outcomes, and (3) multiple logistic regression for assessing the association between each health outcome and a particular exposure, respectively, adjusting for other important confounding factors. The SAS version 9.1 software (SAS Institute Inc., Cary, NC) was applied for the analyses. An alpha (α) level of 0.05 was used for all statistical tests.

Future follow-up of the cohort

Along with the questionnaire survey, we invited all dentists to participate in a cohort of dentists for the follow-up study. Periodic follow up of the cohort will be conducted every 12 months by mailed questionnaires and phone calls in the future. Health outcomes to be collected include: respiratory diseases (asthma and chronic obstructive pulmonary diseases), cardiovascular diseases, diseases of the neural systems, cancers, and mortality.

Results and discussion

Characteristics of participants and prevalence of important outcomes

In total, 1493 dentists participated in the questionnaire survey, with a response rate of 13.42%. Among them, 357 dentists agreed to participate in the cohort study in the near future. Seventy-six percent of the participants were males. The mean age (standard deviation, SD) was 45 (11) years. About 7% of the participants were current smokers, and 12% drank alcohol. The mean (SD) duration of dental practice was 18 (10) years. The majority (88%) of participants practiced dentistry in clinics. Regarding the number of dentists in the workplace, 44% of the participants worked in a single-dentist clinic, and 38% worked in clinics with 2-5 dentists. As to the use of dental amalgam, 55% of the participants were current users, 38% were former users, and 5% never used amalgam before.

The usage of protection equipments at work are described as follows. Almost all of the participants wore surgical mask (99%) and gloves (98%), but only half of them used goggles (48%) or face mask (49%). Special protection gown was worn by 29% of them. Regarding the occupational exposures, dust was reported by 72%, noise by 82%, aerosols by 86%, irritants to nose by 64%, and irritants to eyes by 44% of the dentists. More than 80% of the participants reported having to keep their hand, head and neck, or upper body in the same position for a long time during work.

Regarding self-reported health status, sleep quality and work-related stress, 36% of the participants reported having good general health, 35% having good sleep quality, and 35% having high stress. As to physician-diagnosed diseases, 15% of the dentists had hypertension, 8% had *Helicobacter pylori* infection, 12% had hepatitis B infection, and 20% had fatty liver. The most frequently reported symptoms within three months were: dryness or fatigue of the eyes (56%), poor memory (35%), having difficulty sleeping (29%), allergy of the nose (27%), headache (24%), and allergy of the eyes (22%).

The results were consistent with previous findings of high prevalence of occupational health problems in dentists (Chowanadisai et al., 2000; Lindfors et al., 2006; Leggat and Smith, 2006; Al Wazzan et al., 2001; Lonroth and Shahnava, 1998; Andreasson et al., 2001).

Factors associated with diseases and symptoms

Specialty, job contents, or duration of dental practices (in quartiles) were significantly with various physician-diagnosed diseases. Oral surgeon or those conducting oral surgery had significantly more *Helicobacter pylori* infection, peptic or duodenum ulcers, and fatty liver, respectively. Dentists specialized in orthodontics had significantly more herniation of intervertebral disc (HIVD) in the cervical spine. Oral surgeons had significantly higher prevalence of HIVD in the lumbar spine. The frequency of tennis elbow was significantly higher in those specialized in oral surgery, prosthodontics, and endodontics, respectively, as well as in those with longer duration in practicing dentistry. Contact dermatitis was significantly more prevalent in dentists conducting oral surgery.

Furthermore, specialty, job contents, or duration of dental practices were significantly associated with various self-reported symptoms. Dentists performing sedation reported significantly more difficulty in sleeping and hearing loss, respectively. Amalgam use was significantly associated with memory loss. Duration of dental practices was significantly associated with most of the self-reported symptoms. Participants with shorter duration reported significantly higher frequency of headache, dizziness, tremor, dryness of eyes, nasal allergy, upper respiratory tract infection, and stomach ache, respectively, than did those with longer duration. However, dentists with longer duration reported significantly higher frequency of memory loss, eyesight loss, and frequent urination, respectively.

Self-reported health status was significantly associated with current amalgam use (current users were less likely to report good health) and duration of practice (those in 3rd or 4th quartiles were more likely to report good health). Dentists with longer duration reported significantly less work-related stress. Dentists conducting periodontal surgery, dental implant, and oral surgery, respectively, reported significantly higher work-related stress.

Studies of mercury exposures in dentists found that amalgam exposure was significantly associated with many self-reported symptoms (Heyer et al., 2004), and miscarriage (Lindbohm et al., 2007), but not significantly associated with musculoskeletal symptoms (Akesson et al., 2000) or coronary heart disease (Yoshizawa et al., 2002). The findings were consistent with the results of this study.

Finally, job contents significantly associated with physician-diagnosed diseases in the multivariable logistic regression are shown on Table 1. Dentists conducting oral surgery were more likely to have contact dermatitis, *Helicobacter pylori* infection, and peptic or duodenum ulcer (Table 1). Job contents were also significantly associated with several self-reported symptoms (data not shown on tables), with adjustment for other factors in the logistic regression analyses. Current amalgam users were more likely to have memory loss than those

never used amalgam before. Dentists conducting root canal treatment, orthodontic treatment, or making fixed prostheses were more likely to have chest pain/tightness.

Note that this study had low response rate. The participants may not be able to represent all dentists in Taiwan, and the results could be affected by selection bias. However, findings from this study helped to clarify the association between various occupational exposures and diseases/symptoms among dentists. In conclusion, job contents were significantly associated with several diseases/symptoms in dentists. Further follow-up of dentists agreeing to participate in the cohort study is underway.

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Table 1. Job contents significantly associated with physician-diagnosed diseases, results of the logistic regression analysis.

Physician-diagnosed diseases	Job contents	OR ^a	95% CI, lower	95% CI, upper
Contact dermatitis	Oral surgery	1.60	1.08	2.35
deQuervain's tendonitis	Fixed prostheses	1.95	1.01	3.77
deQuervain's tendonitis	Removable prostheses	2.17	1.26	3.74
Helicobater pylori infection	Periodontal surgery	1.47	1.00	2.15
Helicobater pylori infection	Oral surgery	1.89	1.28	2.77
Peptic or duodenum ulcer	Periodontal surgery	1.41	1.02	1.97
Peptic or duodenum ulcer	Dental implant	1.56	1.12	2.18
Peptic or duodenum ulcer	Oral surgery	2.05	1.46	2.86

^a All models with adjustment for duration of dental practice (in quartiles), sex, smoking, and alcohol drinking.

無衍生研發成果推廣資料

98 年度專題研究計畫研究成果彙整表

計畫主持人：胡素婉		計畫編號：98-2314-B-040-018-					
計畫名稱：台灣牙醫師的職業暴露與健康狀況之流行病學研究							
成果項目		量化			單位	備註（質化說明：如數個計畫共同成果、成果列為該期刊之封面故事...等）	
		實際已達成數（被接受或已發表）	預期總達成數（含實際已達成數）	本計畫實際貢獻百分比			
國內	論文著作	期刊論文	0	0	100%	篇	
		研究報告/技術報告	0	0	100%		
		研討會論文	0	0	100%		
		專書	0	0	100%		
	專利	申請中件數	0	0	100%	件	
		已獲得件數	0	0	100%		
	技術移轉	件數	0	0	100%	件	
		權利金	0	0	100%	千元	
	參與計畫人力（本國籍）	碩士生	3	3	100%	人次	
		博士生	0	0	100%		
		博士後研究員	0	0	100%		
		專任助理	0	0	100%		
國外	論文著作	期刊論文	0	0	100%	篇	
		研究報告/技術報告	0	0	100%		
		研討會論文	0	0	100%		
		專書	0	0	100%		章/本
	專利	申請中件數	0	0	100%	件	
		已獲得件數	0	0	100%		
	技術移轉	件數	0	0	100%	件	
		權利金	0	0	100%	千元	
	參與計畫人力（外國籍）	碩士生	0	0	100%	人次	
		博士生	0	0	100%		
		博士後研究員	0	0	100%		
		專任助理	0	0	100%		

<p>其他成果 (無法以量化表達之成果如辦理學術活動、獲得獎項、重要國際合作、研究成果國際影響力及其他協助產業技術發展之具體效益事項等，請以文字敘述填列。)</p>	<p>無</p>
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	成果項目	量化	名稱或內容性質簡述
科 教 處 計 畫 加 填 項 目	測驗工具(含質性與量性)	0	
	課程/模組	0	
	電腦及網路系統或工具	0	
	教材	0	
	舉辦之活動/競賽	0	
	研討會/工作坊	0	
	電子報、網站	0	
	計畫成果推廣之參與(閱聽)人數	0	

國科會補助專題研究計畫成果報告自評表

請就研究內容與原計畫相符程度、達成預期目標情況、研究成果之學術或應用價值（簡要敘述成果所代表之意義、價值、影響或進一步發展之可能性）、是否適合在學術期刊發表或申請專利、主要發現或其他有關價值等，作一綜合評估。

1. 請就研究內容與原計畫相符程度、達成預期目標情況作一綜合評估

達成目標

未達成目標（請說明，以 100 字為限）

實驗失敗

因故實驗中斷

其他原因

說明：

2. 研究成果在學術期刊發表或申請專利等情形：

論文： 已發表 未發表之文稿 撰寫中 無

專利： 已獲得 申請中 無

技轉： 已技轉 洽談中 無

其他：（以 100 字為限）

3. 請依學術成就、技術創新、社會影響等方面，評估研究成果之學術或應用價值（簡要敘述成果所代表之意義、價值、影響或進一步發展之可能性）（以 500 字為限）

本研究發現牙醫師的各種職業暴露情形有高盛行率(例如：86%有水霧與飛沫暴露、72%有粉塵暴露、64%有暴露到刺激鼻子的味道)。再者，參加研究之牙醫師有自訴症狀之比例亦高(有眼睛乾澀或疲勞者佔 56%、有記憶力減退者佔 35%、有鼻子過敏者佔 29%)。進一步分析牙醫師的疾病/症狀和其工作內容或職場暴露之關係後，有許多工作項目和暴露和自覺健康狀況、自覺工作壓力、經醫師診斷之疾病(例如：接觸性皮膚炎、肌腱炎或媽媽手、幽門螺旋桿菌感染、胃潰瘍或十二指腸潰瘍)、自訴症狀(例如：記憶力減退、眼睛過敏、視力減退、胸痛或胸悶、乾咳)等顯著相關，顯示我國牙醫師的工作環境有潛在的各種健康危害，未來應繼續追蹤調查牙醫師的疾病發生率，並且進行其工作場所空氣品質與噪音之監測。