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Association between pulp and periapical conditions and dental emergency visits involving pain relief: epidemiological profile and risk indicators in private practice in Australia

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Abstract

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Aim To assess the prevalence of dental emergency visits (DEV) involving pain relief and their relationship with socio-economic and clinical factors in an Australian representative sample in the primary care setting.

Methodology Data on reason for visit and patient characteristics were collected from a representative random sample of Australian dentists in private practice surveyed in 2009–2010. Information regarding socio-economic (gender, age, health insurance) and clinical factors (number of teeth, number of decayed teeth, diagnosis and reason for visit [DEV, check-up, other reasons not involving pain relief]) were retrieved from compiled questionnaires. Descriptive statistics were reported, and Poisson regression models were used to assess the association between socio-economic and clinical factors and DEV. Prevalence ratio (PR) and 95% confidence interval (CI) were calculated.

Results A total of 1148 dentists responded (67%), resulting in records from 6504 patients. The overall prevalence of DEV was 20.8%. The unadjusted analysis, according to the reason of visit, revealed the following predictors for DEV: male gender (PR = 1.18; 95% CI = 1.08–1.29), age 18–64 years (PR = 2.70; 95% CI = 2.19–3.33) and over 65 years (PR = 2.64, 95% CI = 2.10–3.32), uninsured patients (PR = 1.36; 95% CI = 1.24–1.49), patients with <20 teeth (PR = 1.19; 95% CI = 1.06–1.33), decayed teeth (PR = 1.64; 95% CI = 1.48–1.81). After adjustment for confounding factors (gender, age, insurance status, number of teeth and decayed teeth) apart from 'dental trauma' (PR = 1.37), all remaining diagnoses had lower PR ('other' PR = 0.19, 'decay' PR = 0.34, 'periodontal' PR = 0.51, 'failed restoration' PR = 0.45) compared with 'pulp/periapical disease'.

Conclusions In the primary care setting, the diagnoses 'pulp/periapical' and 'dental trauma' had a stronger association with DEV compared with visits not involving relief of pain. Both socio-economic (male gender, older age and uninsured individuals) and clinical factors (tooth loss, decayed teeth, endodontic diseases and dental trauma) were identified as independent risk indicators for DEV in this population. Future public health policies should include specific preventive strategies addressing these factors, aiming to reduce the need for DEV.

Keywords: emergency treatment, pain, primary health care, periapical periodontitis, pulpitis.

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Introduction

Dental emergency visits (DEV) are related to orofacial and/or dental pain and have a negative impact on daily activities, such as sleeping, eating, working or socializing and overall quality of life (Cavalheiro *et al.* 2016). Amongst the various clinical scenarios, a relationship between endodontic conditions and DEV should be anticipated, considering that pain is a presenting complaint for patients suffering from symptomatic pulpitis and symptomatic apical periodontitis (Gulabivala & Ng 2014). In fact, a prevalence of up to 50% for emergency visits for issues of endodontic origin has been reported outside the primary care setting (Quiñonez *et al.* 2009, Verma & Chambers, 2014, Farmakis *et al.* 2016, Figueiredo *et al.* 2017).

The vast majority of aetiological factors related to DEV should be considered preventable. The reasons that often lead patients to seek care only in an emergency situation range from the lack of information regarding the prevention of oral diseases, anxiety regarding dental consultation, and service costs or lack of availability of suitable dental appointment hours (Sakai *et al.* 2005, Verma & Chambers 2014). However, this may vary depending on the setting and be influenced by social and economic factors of the study population. According to the Australian Institute of Health and Welfare, in 2012, 79.7% of clinical services in dentistry in this country were delivered in the private practice setting (Australian Institute of Health & Welfare 2014). Over the years, there has been a change in the type of services provided by dentists, which has shifted from the replacement of missing teeth to a greater emphasis on diagnosis, prevention and tooth retention (Brennan *et al.* 2016b). However, DEV accounted for 21.7% of all dental consultations in private practice in Australia (Brennan *et al.* 2016a). This highlights the need to investigate the characteristics of these patients to establish their clinical and sociodemographic profile for a better understanding and establishment of specific future actions for the reduction in DEV. Furthermore, there has been no previous study assessing DEV focusing on the private dental practice setting based on a population representative of an entire country.

Therefore, this study aimed to assess the prevalence of DEV (involving pain relief) in the primary care service provision (private practice) setting and its relationship with socio-economic and clinical factors (including pulp/periapical conditions and dental trauma, amongst others) in an Australian representative sample.

Materials and methods

Ethical considerations

The present research was conducted in full accordance with ethical principles, including the World Medical Association Declaration (2008) and the additional requirements of Australian law. The study was undertaken with the understanding and written consent of each subject (i.e. dentists) and according to the above-mentioned principles. The study was independently reviewed and approved by the Australian Institute of Health and Welfare Ethics Committee (Register No. EC 191). The study was designed following the STROBE checklist and statement (von Elm *et al.* 2008).

Study design and sample selection

The data from this cross-sectional study originate from a national survey carried out from 2009 to 2010, which is part of a series of surveys (conducted between the years of 1983–1984, 1988–1989, 1993–1994, 1998–1999, 2003–2004 and 2009–2010). Data regarding the dental services were collected through a mailed questionnaire in a sample comprising 10% of male and 40% of female dentists randomly selected from the dental registers for each state or territory in Australia in 1983–1984, resulting in a total of 7427 dentists. As females comprised a lower percentage of registered dentists than males, a higher sampling rate for female dentists was intended to include sufficient numbers for comparison by gender of the dentist. The dental service records were prepared by dentists from a typical day of practice. The number of patients and records varied according to the dentist. The data are representative of the age and gender distribution of Australian private practice dentists around the time of the survey as they were weighted using the dental board registration statistics from 2009 (Chrisopoulos & Nguyen 2012).

Data collection, exposures and main outcome

Patient information regarding sociodemographic and clinical characteristics and visit factors was collected.

Such information included the age of the patient, gender, number of teeth present, decayed teeth, private dental insurance status, diagnosis and reason for visit. For analytical purposes, some exposure variables were categorized as the following: age was stratified into three groups: 1–17, 18–64 and over 65 years; the number of remaining teeth was coded into 20 teeth or more, or fewer than 20 teeth and the number of decayed teeth was coded into the presence of any decayed teeth or no decay (Brennan *et al.* 2016a); diagnoses were grouped as follows: (i) pulp/periapical, (ii) decay, (iii) dental trauma, (iv) periodontal, (v) failed restoration and (vi) other (including diagnoses related to prosthesis, aesthetic, recall or maintenance, orthodontics, TMD, surgeries, pathologies or other diagnoses that did not fit the aforementioned classifications). The outcome variable was the reason for visit indicated by the dentist, who could classify it into one of the following three categories: check-up, emergency visit requiring pain relief or other reason (i.e. dental problem not involving pain relief). For the analysis, the main outcome was dichotomized as an emergency or nonemergency visit.

Statistical analysis

Descriptive statistics (*N* and %) were reported, with the patient as the unit of analysis. Statistical analysis was performed using weighted sample data based on dentist age and gender distribution. Bivariate and multivariate Poisson regression models with robust variance were carried out to estimate the association [prevalence ratios (PR) and 95% confidence intervals (95% CI)] between socio-economic and clinical factors and the outcome DEV. The value for rejection of the null hypothesis was set at 5%. Data were analysed using SPSS v.25 (IBM, Chicago, IL, USA).

Results

The response rate to the survey was 67% (1148 dentists). The log comprised data from 6504 patients. The prevalence of diagnosis of more than half of the patients was classified as 'other' (58.4%) and 'decay' (21%). The remaining diagnoses were less prevalent: 'pulp/periapical' (7.9%), 'failed restoration' (7.6%), 'periodontal' (4.4%) and 'dental trauma' (0.7%). The overall prevalence of DEV was 20.8%. In the unadjusted analysis (Table 1), there was a significant association between DEV and male gender, age group of 18–64 and over 65 years, uninsured patients, number of teeth <20, decayed teeth and diagnosis pulp/periapical versus 'other', 'decay', 'periodontal' and 'failed restoration'.

A multivariate model testing the association of DEV and diagnosis adjusted for gender, age, insurance status, number of teeth and decayed teeth is shown in Table 2. Apart from 'dental trauma' (PR = 1.37), all remaining diagnoses had lower PR ('other' PR = 0.19, 'decay' PR = 0.34, 'periodontal' PR = 0.51, 'failed restoration' PR = 0.45) compared with 'pulp/periapical disease'.

Discussion

The present study identified socio-economic (male gender, older age and uninsured individuals) and clinical factors (tooth loss, decayed teeth, endodontic diseases and dental trauma) as independent risk indicators for DEV involving pain as per definition. Finally, pulpal and periapical condition were identified as an indicator of a greater chance of needing to attend for DEV, and therefore pain relief, instead of different reasons for visit.

The results of the present study are representative of the context of private dental care in Australia and can be generalized within this country since a comprehensive and randomly selected sample was used with adequate response rates. Furthermore, the raw data have been analysed in previous studies regarding preventive services, services rates and visit characteristics (Brennan *et al.* 2016a, 2016b). Finally, it should be noted that in Australia, public dental care provides higher levels of emergency services and dental extractions, when compared to the private practice environment (Brennan *et al.* 1997).

In the absence of previous literature assessing the epidemiological profile and risk indicators for DEV focussing on private practice based on nationwide data, direct comparison is difficult. In a similar study using a database in Taiwan, the prevalence (per 10 000 persons) of acute clinical problems was 4.83 in 2013 and was commonly associated with reasons codes as 'pulp and periapical tissues', 'pulpitis', 'acute periodontitis', 'caries' and 'loss of teeth due to trauma', amongst other (Huang *et al.* 2019). Therefore, comparable with the findings of the present study, the Adult Health Survey in the United Kingdom in 2009 highlighted that nine per cent of adults reported current pain related to their teeth (Steele & O'Sullivan 2011).

Table 1 Sociodemographic and dental characteristics of the participants (*N*, %) according to the reason of visit (emergency or nonemergency dental visit)

	Reason for visit *N* (%)				
	N (%)	Nonemergency	Emergency	PR (95% CI)	*P**
Gender					
Male	2878 (44.3)	2115 (76.7)	644 (23.3)	1.18 (1.08–1.29)	<0.001
Female	3574 (55)	2749 (79.8)	696 (20.2)	Ref.	
Age group					
65+	1026 (15.8)	765 (77.2)	226 (22.8)	2.64 (2.10–3.32)	<0.001
18–64	4498 (69.2)	3311 (76)	1047 (24)	2.70 (2.19–3.33)	<0.001
0–17	861 (13.2)	757 (91.5)	70 (8.5)	Ref.	
Dental insurance					
Uninsured	2377 (36.5)	1711 (74.1)	598 (25.9)	1.36 (1.24–1.49)	<0.001
Insured	3905 (60)	3046 (81)	715 (19)	Ref.	
Number of teeth					
<20	1019 (15.7)	746 (74.8)	251 (25.2)	1.19 (1.06–1.33)	<0.01
20+	5105 (78.5)	3948 (79.2)	1036 (20.8)	Ref.	
Decayed teeth					
1 + decayed teeth	2544 (39.1)	1818 (72.5)	689 (27.5)	1.64 (1.48–1.81)	<0.001
No decayed teeth	2795 (43)	2294 (83.7)	447 (16.3)	Ref.	
Diagnosis					
Other	3799 (58.4)	3181 (89)	394 (11)	0.16 (0.15–0.18)	<0.001
Decay	1367 (21)	1011 (74.6)	344 (25.4)	0.37 (0.33–0.41)	<0.001
Dental trauma	43 (0.7)	12 (27.9)	31 (72.1)	1.03 (0.86–1.24)	0.702
Periodontal	286 (4.4)	171 (61.3)	108 (38.7)	0.56 (0.48–0.65)	<0.001
Failed restoration	495 (7.6)	348 (71.5)	139 (28.5)	0.43 (0.38–0.50)	<0.001
Pulp/periapical	513 (7.9)	166 (32.9)	339 (67.1)	Ref.	

PR from bivariate Poisson regression with robust variance.
**P*-value for bivariate analysis, Poisson regression.

Some limitations are inherent in the methodology of the present study. These findings may have limited validity outside Australia; however, these may improve the understanding of the presentation of DEV locally and globally in a similar setting, the latter when taken into account with other similar future studies. Similarly, data from 2009 to 2010 may not be current, though the absence of previous similar studies needs to be reiterated. Considering the human and financial resources required to establish and support similar studies (Doğramaci & Brennan 2019b), this study represents a rare opportunity to view the prevalence of DEV in the primary care service setting and its relationship with socio-economic and clinical factors.

As records are made by dentists, differences in the interpretation of the data (e.g. clinical findings) and other operator-based variability may have influenced the results (Ranade *et al.* 2019), though the use of service data from dentists representative 'self-selected typical day' has been validated in a previous study (Brennan *et al.* 1996). Furthermore, questionnaires and dental logbooks have been used in endodontic research (Chew *et al.* 2019). This approach is favoured to one relying solely on a participant or patients self-reported recollection of treatment completed in the past, which can be influenced by recall bias or Hawthorne effect (Doğramaci & Brennan 2019a, 2019b). It should be noted that data regarding the treatment modalities were not collected. Finally, considering that caries is a common cause of pulp demise (Yu & Abbott 2007), in some situations, the operators may have had some difficulties in the allocation of the case to a specific diagnosis.

The association between endodontic diseases and DEV was confirmed. Due to the likely severity of severe endodontic pain (Gulabivala & Ng 2014, Yu & Abbott 2018), it is reasonable to expect that patients seek care for the relief of symptoms without a previous appointment (Law *et al.* 2014), which constitutes an emergency, thus consistent with the results of this study. Furthermore, pain related to endodontic problems often interferes directly with daily activities of the subject (Cavalheiro *et al.* 2016) and, as it is rarely suppressed with the use of analgesics, immediate dental treatment is sought. Conversely, chronic apical

Table 2 Multivariate analysis for the association between sociodemographic and dental characteristics of the participants according to the reason of visit (emergency or nonemergency dental visit)

	Reason of visit	
	PR (95% CI)	*P**
Gender		
Male	1.12 (1.02–1.22)	<0.05
Female	Ref.	
Age		
65+	1.80 (1.42–2.29)	<0.001
18–64	1.84 (1.49–2.29)	<0.001
0–17	Ref.	
Insurance status		
Uninsured	1.20 (1.09–1.32)	<0.001
Insured	Ref.	
Number of teeth		
<20	1.21 (1.07–1.38)	<0.01
20+	Ref.	
Decayed teeth		
1 + decayed teeth	1.24 (1.11–1.38)	<0.001
No decayed teeth	Ref.	
Diagnosis		
Other	0.19 (0.17–0.22)	<0.001
Decay	0.34 (0.31–0.39)	<0.001
Dental trauma	1.37 (1.10–1.70)	<0.01
Periodontal	0.51 (0.43–0.62)	<0.001
Failed restoration	0.45 (0.39–0.53)	<0.001
Pulp/periapical	Ref.	

PR from adjusted Poisson regression with robust variance.
**P*-value for multivariate analysis, Poisson regression.

periodontitis is asymptomatic in the vast majority of cases and may present as a primary lesion or a persistent infection following root canal treatment (Nair 2006). The latter, being a silent disease, patients are generally not aware of the condition, which becomes obvious with an exacerbation of the process, or when a lesion is detected radiographically (Franciscatto *et al.* 2019). Therefore, chronic apical periodontitis should not be expected to be associated with DEV.

Several previous studies have evaluated the characteristics of patients seeking care in emergency departments due to dental reasons (Quiñonez *et al.* 2009, Anderson *et al.* 2011, Hong *et al.* 2011, Lewis *et al.* 2015, Figueiredo *et al.* 2017). Pulpal and periapical pain are also responsible for more than half of the cases of emergency dental care in emergency departments in hospitals (Quiñonez *et al.* 2009). This is relevant since, in some studies, the prevalence of DEV in the secondary care setting was even greater than some systemic conditions such as hypertension and diabetes (Quiñonez *et al.* 2009) and was amongst the major causes of pain reported by patients (Lewis *et al.*, 2015). Also, oral abscesses due to pulpal infection seldom evolve into real medical emergencies (de Medeiros *et al.* 2012, Shemesh *et al.* 2019). Apart from pulpal and periapical diseases, dental trauma, which is also within the scope of endodontics (European Society of Endodontology 2006), was also associated with DEV. Dental trauma may affect dental hard tissues, the pulp and the periodontium; therefore, endodontic management may be required (European Society of Endodontology 2006). This finding is intuitive since dental trauma itself is already an emergency, considering that its occurrence, although often preventable, is unpredictable. The importance of prevention of traumatic dental injuries should be reiterated, through interceptive orthodontic treatment when required, and/or the use of mouthguards (Arraj *et al.* 2019), aiming to reduce the risk of this cause of DEV and the long-term consequences of traumatic dental injuries.

Age and gender influenced the prevalence of DEV, with patients above 18 years of age having a higher prevalence. Previous analysis of this dataset demonstrated that young patients had more examinations (Brennan *et al.* 2016a) and preventive services (Brennan *et al.* 2016b), whereas patients aged between 18 and 44 year had more radiographic exposures (Brennan *et al.* 2016a), the latter being used for the confirmation of diseases rather than their early detection (Brennan *et al.* 2016a). Interestingly, rates of preventive services (Brennan *et al.* 2016b) or examination (Brennan *et al.* 2016a) were not related to the gender of the patient, though the present analysis identified male gender as an independent risk indicator for DEV. This is in agreement with data from the United Kingdom (Steele & O'Sullivan 2011).

An association between insurance status and DEV was evident. This is in agreement with a previous study suggesting that uninsured subjects attend the dentist mostly in the presence of toothache (Lewis *et al.* 2015). Assessment of the present dataset in previous studies suggests that having insurance is associated with higher examination rates (Brennan *et al.* 2016a) and preventive services (Brennan *et al.* 2016b), but not with radiographic examinations (Brennan *et al.* 2016a). Insurance status, visiting and attitudinal factors are associated in Australia (Teusner *et al.* 2013). Uninsured subjects may not have regular access to preventive and maintenance dental services, thus leading to poor oral health, including caries progression and subsequent pulp demise and eventually

periapical disease. A similar situation occurs in emergency departments in hospitals, where the search for this service to relieve odontogenic pain by uninsured individuals is even greater when compared to patients with insurance (Lewis *et al.* 2015). However, different results may be observed depending on the type and scope of health insurance (Ranade *et al.* 2019).

Patients with less than 20 teeth presented for DEV more often than those with a higher number. A positive relationship between the number of teeth retained and regular dental check-ups (Eguchi *et al.* 2018) and quality of life level (Park *et al.* 2019) have been reported previously. Regular visits to the dentist may decrease tooth loss, likewise, increase the likelihood of detecting carious lesions early, avoiding episodes of pain and the need for DEV.

The presence of decayed teeth was also associated with DEV. The term 'decayed' is well established as the key measure of caries experience in dental epidemiology (Broadbent & Thomson 2005). Despite that some lesions may not interfere with the viability of the pulp, the progression of dental caries leads to cavitation, which can lead to pain and discomfort (Gulabivala & Ng 2014). Furthermore, patients may attend for DEV in the presence of obvious cavitation in the absence of pulpal symptoms. Also, similar to the number of missing teeth, the presence of decayed teeth is an indicator of poor oral health related to low tooth brushing frequency and low rates of dental service use (Broadbent *et al.* 2016), which is also in line with the previously mentioned results regarding uninsured patients, reinforcing that fewer visits to the dentist increase the chances of emergency dental situations.

Outside the primary care service provision setting, a high number of DEVs may result in increased costs to the health system as it may lead the patient with a toothache to seek care at emergency hospital departments in a public health scenario. For example, in the USA, it has been purported that spending of over $6 million over 3 years can be avoided by reducing only 1% emergency department visits due to nontraumatic dental conditions in hospital emergency departments (Okunseri *et al.* 2008). Also, the association between insurance and DEV found in the present study highlights the importance of insurance coverage and prevention strategies for dental services in Australia. To reduce DEVs, public health policies should improve dental care access and include specific preventive strategies related to oral diseases and their likely consequences. Similarly, improving insurance coverage rates for the population may be of potential benefit. These should have a positive impact on the prevalence of DEV in different care settings.

Conclusions

The diagnosis of pulp and periapical diseases was associated with a greater chance of DEV attendance compared with other reasons for visit. Socio-economic (male gender, older age and uninsured individuals) and clinical factors (tooth loss, decayed teeth, endodontic diseases and dental trauma) were identified as independent risk indicators for DEV in this population.

Conflict of interest

The authors have stated explicitly that there are no conflicts of interest in connection with this article.

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