Prevalence Estimates and Associated Factors for Dental Pain: A Review

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Purpose: To assess the methodological quality of epidemiological studies on dental pain and review the published literature for its prevalence, and association with age, gender and socio-economic status.

Materials and Methods: Medline and reference lists of relevant articles were searched for observational studies published in English from 1966 to 2001 carried out on humans aged 19 years and over. Articles for reading of the full text were selected by two reviewers independently. Selected articles were assessed independently by the two reviewers according to a set of 8 standardized criteria. Inter-rater agreement was measured using the *kappa* statistic. Disagreements were discussed and a final score for each study agreed. Data on prevalence estimates and their distribution by age, gender and socio-economic factors were extracted.

Results: 422 studies were identified, and 23 selected for review. Inter-rater agreement was high for all 8 criteria used (*kappa* > 0.6). Methodological quality was poor with the number of criteria fulfilled by each study ranging from 1 to 6, median score 3. The prevalence estimates for 5 case definitions identified were: 'toothache' 7–32%, 'pain in teeth with hot, cold or sweet things' 25–38%, 'pain and discomfort needing medication or treatment' 7–9%, 'pain or discomfort in the mouth, teeth or gums' 19–66%, and 'oral and facial pain'40–44%. Younger subjects and those from lower socio-economic groups were more likely to report pain. Gender was not associated with dental pain.

Conclusion: Epidemiological data on dental pain are sparse and of poor quality. There is a need for well-designed surveys using randomly selected community samples and standardized measurement criteria to fill this knowledge gap.

Key words: dental pain, toothache, prevalence

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Dental pain may be defined as pain that originates from the innervated tissues within the tooth or immediately adjacent to it (Sharav et al, 1984). It is frequently subsumed under the broad term of 'oro-facial' pain. Oral pain refers to pain that is experienced in the oral cavity and around the mouth region, and includes dental pain, whereas facial pain covers the area below the orbitomeatal line, above the neck and anterior to the ears (Zakrzewska and Hamlyn, 1999). The 1998 UK Adult Dental Health Survey reported that in the 12 months preceding the survey, the most frequently experienced oral health problem, by 40% of dentate adults, was oral pain (Nuttall et al, 2001). In this survey, oral pain is described as 'painful aching in the mouth or uncomfortable to eat any food'. This broad description of oral pain encompasses pain due to oral soft tissue lesions (such as burning mouth syndrome or traumatic ulcers) and dental causes (such as toothache).

Dental pain can have social, psychological and economic consequences on individuals and communities. Adulyanon et al (1996) reported that

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toothache is the major causal impairment for almost all aspects of daily performance. Individuals who suffer from toothache avoid chewing hard things, are prevented from eating certain foods and have trouble sleeping (Gilbert et al, 1997). The average number of emergency patients treated by a general dental practitioner per working day in a British urban area has been estimated to be 3.2, with a range of one and ten (Burke et al, 1994). In two large cities in Finland, 60% of people who used organized emergency dental services had been in pain for 1 to 3 days (Widstrom et al, 1988). In a sample of regular dental attenders, it has been estimated that pain accounts for 19% of emergency visits made in the public dental health services in a county in Sweden (Halling and Ordell, 2000). A survey of patients attending a British dental teaching hospital for emergency care reported that 77% of the patients attended because of pain (Scully, 1995). It has also been reported that 70.3 million days of work that are lost a year in the USA are due to dental pain, accounting for USD 2.25 billion in lost productivity (Sternbach, 1986). Furthermore, dental pain has been identified as the major reason for extraction (Reich and Hiller, 1993), and having no dental pain is proposed as a predictor of positive perceived oral health (Atchison et al, 1997).

Given the impact of dental pain on the individual, society and health service utilization, it would seem important to have a more complete and realistic representation of the scope of the public health problem posed by dental pain. Prevalence estimates of dental pain provides an indication of the burden it levies on the individual and on society. Its impact on oral health service planning and provision can be more fully measured if the clinical conditions that cause dental pain or the characteristics of the pain experience are known.

Studies have been carried out to estimate the prevalence of pain complaints in adult populations, some of which have included aspects of oral pain, for example, burning mouth in New Zealand (James et al, 1991), and head, face and mouth pain in Sweden (Brattberg et al, 1989). Epidemiological surveys specifically related to dental, oral and facial pain, have been carried out in the United States (Lipton et al, 1993), Canada (Locker and Grushka, 1987) and the United Kingdom (Nuttall et al, 2001; Macfarlane et al, 2002). The descriptions of dental pain used in these studies ranged from those referring to pain quality (sharp, shooting) to site of pain (toothache) to oral functioning (discomfort when eating).

Recent reviews of the literature on the epidemiology of facial pain (Zakrzewska and Hamlyn, 1999) and oro-facial pain (Macfarlane et al, 2001) have been published. No reviews on the epidemiology of dental pain have been identified. This paper reports the results of a review that was carried out to:

1. assess the quality of published research on the prevalence of dental pain in community dwelling and clinically recruited adult populations
2. identify and describe the various descriptions of dental pain used in epidemiological research
3. determine the prevalence estimates for different descriptions of dental pain, and its association with age, gender and socio-economic factors.

MATERIALS AND METHODS

A Medline search of the literature published during the period 1966 to 2001 was carried out using a combination of 2 groups of words. The first group was: toothache, dental pain, oral pain, tooth pain, teeth pain, dental pulp pain, odontalgia, periodontal pain and oro-facial pain. The term oro-facial pain was included because some articles reporting the prevalence of oro-facial pain have also included dental pain. The second group was: prevalence, epidemiology, incidence and distribution. The search was limited to articles published in English on humans aged 19 years and over. The titles and the abstracts of these studies were read to assess whether they referred to prevalence or hypotheses testing studies. Studies that did not report the prevalence of dental pain were excluded. For example, studies that investigated the association of certain oral pain symptoms with certain medical conditions were excluded. Letters, editorials, PhD theses, reviews and case study reports were also excluded. Two authors (AKHP and RC) selected the relevant articles for reading of the full text. Articles that were selected by one author and not the other were re-assessed until agreement was reached on the final selection. The same two authors read the full text of the selected articles. Articles that reported prevalence estimates for dental pain were identified and the reference lists of these articles were searched for further studies.

The relevant articles selected were assessed for their quality. They were assessed independent-

Table 1 Flow chart showing the number of studies for review at each stage of the selection process

Steps in selecting studies for review	No. of studies selected	No. of studies excluded
Medline search combining 2 groups of keywords: (toothache, dental pain, oral pain, tooth pain, teeth pain, dental pulp pain, odontalgia, periodontal pain and oro-facial pain) AND (prevalence, epidemiology, incidence and distribution)	422	
After reading the titles of studies identified	77	345
After reading the abstracts of selected studies	29	48
After reading full text articles	16	13
After checking the reference lists of the 16 selected studies	7	
Total selected for review	23	

Studies were excluded if:
- they were reviews of issues related to treatment-seeking or healthcare provision
- they focused on specific cases such as TMJ pain, post-operative pain, third molar pain
- they focused on assessment of treatment needs, reasons for seeking care or service utilization
- they focused on attitudes, knowledge or behaviors in relation to dental pain
- the samples were patients with specific conditions such as periodontal patients or patients seeking emergency dental care
- they focused on pain description, diagnosis or screening
- they focused on association with systemic health
- they focused on oral health status other than dental pain
- they focused on impact or quality of life

ly by the two reviewers according to a set of criteria proposed by Altman (1999), presented in Table 2. The two reviewers first discussed and agreed on the interpretation of the criteria. Next the two reviewers independently applied the criteria to the selected studies. For each study, individual criteria were scored as 'yes' or 'no'. Where the reviewer was not sure because the information was not reported or was not clear, that criterion was scored as 'no'. The results were compared using the *kappa* statistic. Disagreements between the reviewers were identified and discussed. Once agreement was reached, each study was given a final score that represented the number of criteria scored positively. For each criterion, the total number of studies that scored positively was also reported.

For each study in the review, data were extracted on year of publication, country of study, source of sample and population type, sample size, age and sex, time frame the pain is referred to, case definition, overall prevalence, and prevalence by gender and age.

RESULTS

422 published studies were identified in the initial search (Table 1). From reading the titles, 77 abstracts were selected. After checking the abstracts, 29 studies were selected for reading of the full text. Of these 29, only 16 reported the prevalence estimates for dental pain. From the reference lists of the 16 studies, seven further studies were identified making a total of 23 studies selected for review. Of these 23 studies, two referred to randomly selected national samples, three used randomly selected local community samples of adults of all age groups, and six used community samples of older adults. The other 12 studies were based on homogeneous samples not representative of the community.

Assessment of Selected Studies

Although all the studies reviewed were cross-sectional surveys, some were designed for develop-

Table 2 Inter-rater agreement and number of studies scored positively for each of the criteria used in the assessment by the two reviewers (n=23)

	kappa statistic for inter-rater agreement	no. of studies scored positively	% of studies scored positively
1. Was the source of the subjects clearly described?	1	22	95.7
2. Was the method of selection of subjects clearly described (i.e. inclusion and exclusion criteria)?	0.775	16	69.6
3. Was the sample size based on pre-study considerations of statistical power?	0.646	1	4.3
4. Was the sample of subjects appropriate with regard to the generalisability of the findings?	0.862	4	17.4
5. Was the data collection instrument valid and reliable?	0.725	7	30.4
6. Was the design of the study acceptable?	0.738	9	39.1
7. Was a satisfactorily high response rate achieved?	1	10	43.5
8. Was there a statement adequately describing or referencing all the statistical procedures used?	0.732	12	52.2

ment of oral impact measurement scales (Cushing et al, 1986; Atchison and Dolan, 1990) and others were designed to collect epidemiological data. After discussion it was agreed that the cross-sectional survey design was appropriate although the aims of the studies were varied. On all eight criteria used to assess the methodological quality of the studies, *kappa* was greater than 0.6, with perfect agreement on the two criteria 'Is the source of the subjects clearly described?' and 'Was a satisfactorily high response rate achieved? (Table 2).

Methodological Quality

Over 50% of the studies scored positively on only three of the eight criteria. Only one study scored positively on the criterion 'Was the sample size based on pre-study considerations of statistical power?' However, except for two studies, the sample size was acceptable, ranging from 293–42,370 subjects. The quality scores ranged from one to six, out of a possible maximum score of eight, with a median score of three (Table 3). The source and selection of subjects were clearly described. The method of selection of subjects was clearly described in 16 of the studies (70%). The findings from four studies (17%) were generalisable to the general adult population. Data collection was carried out through self-complete questionnaire (7 studies), face to face interview (7), telephone interview (3), self-complete questionnaire and clinical examination (2), face to face interview and clinical examination (3), and dental records and clinical examination (1). The reliability and validity of the instruments used were rarely reported. Only seven studies (30%) used tried and tested data collection instruments or reported tests results for validity or reliability. Only 10 studies (44%) reported the response rate. In these, the response rate ranged from 72–93%. None of the studies presented confidence intervals for the prevalence estimates reported.

Case Definitions

The pain questions asked varied from one study to another. Toothache was the most commonly asked question. In addition, some studies also asked about pain upon stimulation 'with hot or cold fluids or sweet things', or about quality of pain such as sharp shooting pain or 'burning sensation' (Locker and Grushka, 1987; Atchison and Dolan, 1990). Others used more general pain descriptions, such as 'painful aching in the mouth or discomfort when eating' (Nuttall et al, 2001), 'teeth, gums or mouth

causing pain or discomfort' (Atchison et al, 1997; Petersen et al, 2000), or 'dental pain' (Sternbach, 1986). Slade et al (1990) reported a combined prevalence for 'toothache, sensitivity to hot/cold or painful gums'. Data were also presented for the umbrella description of 'oral and facial pain' (Locker and Grushka, 1987; Jaafar et al, 1989; Richards and Scourfield, 1996). Three studies reported prevalence of pain where pain relief (Atchison and Dolan, 1990; Galan et al, 1995) or urgent treatment was required (Cheong and Chong, 1988).

From these different definitions of dental pain, five categories were identified. These were toothache, pain in teeth with hot/cold/sweet things, pain/discomfort needing medication or treatment, pain/discomfort in mouth, teeth or gums, and oral and facial pain.

Prevalence Estimates for Oral Pain

The prevalence estimates for the five categories of dental pain are presented in Table 4. Fourteen studies reported the prevalence estimates for 'toothache', ranging from 7–32%. Five studies reported the prevalence for 'pain in teeth with hot, cold or sweet things' at 25–38%. The prevalence of 'pain and discomfort needing medication or treatment' was reported by 3 studies. This ranged from 7–9%. Seven studies reported prevalence for 'pain or discomfort in the mouth, teeth or gums' to range from 19–66%. The prevalence of 'oral and facial pain', reported by three studies, ranged from 40–44%. Overall, the prevalence estimates for dental pain ranged from 7–66%.

There were wide variations in the time frames used, from point prevalence (Gilbert et al, 1997) to prevalence over the past 12 months (Sternbach, 1986; Riley et al, 1998; Cushing et al, 1986). There does not appear to be clear patterns to the recall of dental pain in relation to the time frames used (Table 4).

Association between Age, Gender and Socio-economic Factors and Prevalence of Dental Pain

Of the four studies that reported the prevalence of 'toothache' for males and females, two reported higher figures for males, whereas the other two reported similar figures for both sexes. Four studies reported the prevalence estimates for general 'oral and facial pain' symptoms and two for 'toothache when biting or chewing' according to age groups. A higher proportion of younger adults when compared to older adults reported 'oral and facial pain' symptoms and 'toothache'. Similarly, very few studies included an indicator of social class or socio-economic status. Studies that used samples from lower socio-economic groups, as defined by occupation (Jaafar et al, 1989; Cushing et al, 1986) or housing status (Westaway et al, 1999; Gelberg et al, 1990), reported higher prevalence estimates, at 16–26%, when compared to those that used samples from higher socio-economic groups (Marcenes et al, 1993) at 10% (Table 3). The prevalence estimates for those studies that used community samples (Gilbert et al, 1997; Lipton et al, 1993; Locker and Grushka, 1987; Riley et al, 1998) lie in between, at 11–14%. Vargas et al (2000) focused on 'tooth pain' and its socio-demographic correlates. They reported that self-reported 'tooth pain' was more

Table 3 The number of criteria fulfilled by each study out of a possible maximum score of 8

Authors and year of study	Number of criteria fulfilled by each study
Locker and Grushka, 1987	6
Gelberg et al, 1990	6
Lipton et al, 1993	5
Marcenes et al, 1993	5
Nuttall et al, 2001	5
Slade et al, 1990	5
Gilbert et al, 1997	4
Locker and Miller, 1994	4
Richards and Scourfield, 1996	4
Atchison and Dolan, 1990	4
Riley et al, 1998	4
Cushing et al, 1986	3
Gooch et al, 1989	3
Petersen et al, 2000	3
Cheong and Chong, 1988	3
Leao and Sheiham, 1995	3
Jaafar et al, 1989	3
Atchison et al, 1997	2
Sindet-Pedersen et al, 1985	2
Miller et al, 1975	2
Sternbach, 1986	2
Westaway et al, 1999	2
Galan et al, 1995	1

Table 4 Description of studies reporting prevalence estimates for dental and oral pain

Reference and country of study	Sample	No. Females	No. Males	Sample Size	Time Frame	Case Definition	Data Collection	Age (yrs)	Prevalence		
									Overall (%)	Males (%)	Females (%)
Studies using community samples of all age groups											
Nuttall et al, 2001, UK	Community-dwelling dentate adults	2922	2489	5411	12 mths	Painful aching in mouth, discomfort when eating	Face to face interview and clinical examination	16+	40		
								16-34	40		
								35-54	42		
								55and over	36		
Locker and Miller 1994, Canada	Community-dwelling adults	305	248	553	4 wks	Oral pain symptoms	Self-complete questionnaire	18+	33		
				66				18-29	43.5		
				190				30-49	36.7		
				181				50-64	28.5		
				116				65+	28.1		
Lipton et al, 1993, USA	Community-dwelling adults			42370	6 mths	Toothache when biting or chewing	Face to face interview	20+	12	12	12.5
								18-34	17		
								35-54	12		
								55-74	7		
								75+	3		
Locker and Grushka 1987, Canada	Community-dwelling adults	362	232	594	4 wks	Toothache	Self-complete questionnaire	18+	14		
						Pain in teeth with hot or cold fluids or sweet things		18+	29		
				594		Oral and facial pain		18+	40		
				76		Oral and facial pain		18-24	63		
				173		Oral and facial pain		25-34	49		
				94		Oral and facial pain		35-44	37		
				77		Oral and facial pain		45-54	34		
				76		Oral and facial pain		55-64	25		
				53		Oral and facial pain		65-74	26		
				34		Oral and facial pain		75+	18		
Sternbach, 1986, USA.	Community	652	602	1254	12 mths	Dental pains	Telephone interview	18+	27		

Table 4 Description of studies reporting prevalence estimates for dental and oral pain (Continued)

Reference and country of study	Sample	No. Females	No. Males	Sample Size	Time Frame	Case Definition	Data Collection	Age (yrs)	Prevalence		
									Overall (%)	Males (%)	Females (%)
Studies using community samples of older adults											
Petersen et al, 2000, Lithuania	Community			381	12 mths	Teeth or mouth caused pain	Self-complete questionnaire	35-44	66		
Riley et al, 1998, USA	Community	1062	574	1636	12 mths	Toothache	Telephone interview	65+	12	14	10
Atchison et al, 1997, USA	Community			2291	12 mths	Teeth or gums caused pain or discomfort	Face to face interview	35-44	41		
				2117	12 mths	Teeth or gums caused pain or discomfort		65-74	24		
Gilbert et al, 1997, USA	Community	491	383	874	Current	Toothache pain	Face to face interview and clinical examination	45+	11		
						Dental sensitivity		45+	30		
Leao and Sheiham, 1995, Brazil	Community			662	Current	Spontaneous pain, pain when eating/hot or cold, changing food because of pain, TMJ pain	Face to face interview and clinical examination	35-44	35		
Slade et al, 1990, Canada	Community	129	199	328	4 wks	Toothache, sensitivity to hot/cold or painful gums	Face to face interview and clinical examination	65-92	19		

highly distributed to those with 0–11 years of education (16.1%), those below the poverty threshold (21.2%) and those who were uninsured (14.4%) when compared to their counterparts.

DISCUSSION

This review has searched the Medline database for studies that reported the prevalence estimates for dental pain, and selected 23 studies for review. Prevalence estimates for five categories of dental pain were reported. Younger adults and those from lower socio-economic classes were more likely to experience dental pain. The association with gender was not conclusive.

Two reviewers independently read the titles and abstracts to select relevant studies for reading of the full text. A standardized checklist of criteria was used (Altman, 1999) to assess the selected studies for their methodological quality. Various checklists have been proposed for reviewing the literature (Crombie, 1996; Greenhalgh, 1997; Macfarlane et al, 2002), but with similar underlying em-

Table 4 Description of studies reporting prevalence estimates for dental and oral pain (Continued)

Reference and country of study	Sample	No. Females	No. Males	Sample Size	Time Frame	Case Definition	Data Collection	Age (yrs)	Prevalence		
									Overall (%)	Males (%)	Females (%)
Studies using homogeneous samples of all age groups											
Westaway et al, 1999, South Africa	Urban blacks in an informal settlement	155	138	293	Current	Toothache	Face to face interview	12+	32		
Richards and Scourfield, 1993, UK	Patients attending a general dental practice	548	449	997	4 wks	Toothache	Self-complete questionnaire	18+	15		
						Pain in teeth with hot or cold fluids or sweet things		18+	25		
						Oral and facial pain		18+	43		
Gelberg et al, 1990, USA	English-speaking homeless adults	141	380	521	I mth	Toothache	Face to face interview	18-78	26		
						Toothache		18-49	30		
						Toothache		50-78	3		
Jaafar et al, 1989, Malaysia	Factory workers	37	318	355	4 wks	Toothache	Face to face interview	18-70	16		
						Pain in teeth with hot or cold fluids or sweet things		18-70	25		
						Oral and facial pain		18-70	44		
Cushing et al, 1986, UK	Factory workers	103	251	354	12 mths	Toothache	Self-complete questionnaire and clinical examination	16-60	26	28	22
Sindet-Pedersen et al, 1985, Denmark	Patients attending general dental practices			35464	Current	Dental and oral pain conditions	Self-complete questionnaire	18-70	2.1		
Miller et al, 1975, UK	Participants of a research study	236	236	472	4 wks	Toothache	Self-complete questionnaire	17-59	7	6	8

Table 4 Description of studies reporting prevalence estimates for dental and oral pain (Continued)

Reference and country of study	Sample	No. Females	No. Males	Sample Size	Time Frame	Case Definition	Data Collection	Age (yrs)	Prevalence		
									Overall (%)	Males (%)	Females (%)
Studies using homogeneous samples of specific age groups											
Marcenes et al, 1993, UK	British civil servants	1080	2781	3861	14 days	Toothache/ trouble with gums	Self-complete questionnaire	35-55	10		
Galan et al, 1995, Canada.	Older adults resident in 2 Seniors housing centers	131	39	170	Current	Self-reported need for pain relief	Face to face interview	65-97	9		
Atchison and Dolan 1990, USA	Participants in a Health Promotion Study	1000	755	1755	3 mths	Teeth or gums sensitive to hot, cold or sweets	Telephone interview	65+	38		
						Medication to relieve pain or discomfort around mouth		65+	19		
Gooch et al, 1989, USA	Participants health insurance program	892	753	1645	3 mths	Toothache	Self-complete questionnaire and clinical examination	24-47	13		
Cheong YH, Chong LL, 1988, Singapore.	Armed Forces	0	454	454	Current	Oral discomfort requiring urgent treatment	Patients' records and clinical examination	20	7		

phasis on study design, sample selection and data collection. Altman's (1999) checklist was adopted because it contained criteria that were adequate and appropriate for this review. In choosing Altman's criteria, a balance was struck between robustness and sensitivity. An extended checklist might be considered more sensitive but would require greater calibration between reviewers and place greater demand on resources.

A measurement of the reliability of the review criteria and process was performed by calculating the *kappa* values (Marfarlane et al, 2001) for inter-rater agreement for each of the criterion used. For all the criteria, the *kappa* achieved was greater than 0.6, representing good agreement.

Few studies reporting the prevalence estimates of dental pain using national or randomly selected community samples were identified. Studies that reported dental pain as part of oral health status or as an impact of oral conditions have generally used homogeneous samples of specific age groups. Measures of pain prevalence quantify the proportion of the population in a specified state of pain. To allow generalisability, studies of pain prevalence estimates should use samples that are representative of the general population. Community samples reduce the effects of potential biases such as access to providers and care-seeking behavior. Homogeneous samples can introduce bias in the estimation of prevalence, for example, using a sample of

workers may underestimate the true prevalence in the population because of the 'healthy worker' effect (Hennekens and Burings, 1987).

Findings from the five studies that used community samples of adults from all age groups highlighted variability in the interpretation of two important methodological aspects: timeframe, and case definition and measurement of dental pain. Sternbach (1986) reported a 12-month prevalence of 27% for 'dental pains'. Lipton et al (1993) and Vargas et al (2000) reported 6-month prevalence figures of 12 and 14% respectively for 'toothache when biting or chewing' on more than one occasion. Locker and Grushka (1987) reported a 4-week prevalence of 14% for 'toothache'. Nuttall et al (2001) reported a prevalence of 40% for 'painful aching in mouth and discomfort when eating' in the past 12 months. Pain of less specific description such as 'pain in the mouth and discomfort when eating' has a higher prevalence when compared to a more defined description such as 'toothache'. Attempts were made by researchers to distinguish between the different clinical conditions presenting with dental pain but the validity of the data collection instruments for screening these conditions was not established. The results highlight that there is a lack of standardization in the descriptions of dental pain used in epidemiological research. As a result data comparison was difficult.

There is also an absence of sophisticated measurement techniques. For example, most of the studies reviewed did not attempt to quantify the intensity or frequency of pain complaints, and none of the studies measured or assessed the quality of the pain experienced. The experience of dental pain is multi-dimensional (Pau et al, 2000) and epidemiological surveys need to take into account measurement of the different aspects of the pain experience. Studies on dental pain as a symptom should include in their measurements such dimensions as emotion, ability to cope and restrictions of activities (Thomas et al, 1996), apart from measurement of pain intensity and temporal characteristics. A thorough understanding of these relationships will lead to identification of risk predictors for dental pain, development of interventions for prevention and better planning for treatment services. To achieve this goal, a consensus needs to be reached on valid and rigorous methods of measurement (Goodman and McGrath, 1991).

The definitions of dental pain used in the studies reviewed would appear to reflect certain clinical conditions. For example, 'toothache' may imply irreversible pulpitis or periapical periodontitis, whereas 'pain with hot, cold and sweet things' may characterize reversible pulpitis or dentine hypersensitivity. However, the screening or diagnostic capacity of the instruments used was not validated. Toothache may be caused by at least two dental conditions, i.e. reversible pulpitis and irreversible pulpitis (Grushka and Sessle, 1984), and manifested by some non-odontogenic conditions (Okeson and Falace, 1997). There is therefore a need to develop an instrument that can be used to screen for conditions that cause dental pain.

Although using representative samples with adequate age spread, the time frame used by studies on community samples was variable, ranging from 4 weeks to 12 months. As the measurement of pain depends crucially on the memory of participants, the results obtained are subject to recall bias. Locker and Grushka (1987) tested their questionnaire for reliability one week after administration, and reported high reproducibility. Some authors have argued that data collected two weeks after the event are likely to be less valid (Goodman and McGrath, 1991). There does not appear to be a consensus on which time frame would be the most appropriate for epidemiological research on acute pain. However, the results of this review did not indicate any clear patterns in the recall of oral pain in relation to the time frames used.

There are age and socio-economic differences in the types and prevalence estimates of dental pain reported in the literature, but no gender differences. Older people are more likely to report pain to hot and cold, whereas younger people are more likely to report toothache. This is expected because older people suffer more from exposed dentine due to recession, whereas younger people suffer more from pulpitis. The prevalence estimates of dental pain were higher for those in lower socio-economic groups, as defined by occupation, level of education or housing status, than for those in higher socio-economic groups. This inequality in the dental pain experience reflects the inequality reported for oral health status (Treasure et al, 2001). An aim of epidemiological research is to identify factors related to the etiology, progression and symptom representation of a condition. Few of the studies in the present review reported other factors than socio-demographic or economic factors. Macfarlane et al (2001) identified 17 associated factors in their review of oro-facial pain, which included dental

pain. Although the majority of oro-facial pain is due to dental causes such as acute toothache, their umbrella term of 'oro-facial' pain also included a wide range of chronic conditions such as burning mouth syndrome, temporo-mandibular joint dysfunction and atypical facial pain. As a result a range of local factors (such as joint clicking and parafunctions) were identified. In addition, chronic pain syndromes, unlike acute dental pain, are recognized to be intimately related to psychological and environmental factors (Crombie and Davies, 1999). Future surveys on dental pain need to include etiological and psycho-social factors associated with these symptoms.

The interpretation of the results in this review, in relation to age, gender and socio-economic status, should be made with caution as only studies published in English were selected from the Medline database for review, thus excluding non-English studies. Also, unpublished surveys on dental pain, for example, those carried out by local public health authorities may exist, but attempts were not made to identify these studies due to lack of resources. However, it is unlikely that these unpublished surveys would be of greater validity than the published literature reviewed here.

In conclusion, epidemiological data on dental pain are sparse and of poor quality. Only five studies have been carried out to determine the prevalence of dental pain in randomly selected community samples of adults from all age groups. The sample size used was often not based on pre-study considerations of statistical power, and data collection instruments used had not been psychometrically validated. There is a need for well-conducted population surveys using validated data collection instruments.

REFERENCES

1. Adulyanon S, Vourapukjaru J, Sheiham A. Oral impacts affecting daily performance in a low dental disease Thai population. Community Dent Oral Epidemiol 1996;24:385-389.
2. Altman DG. Practical statistics for medical research . Boca Raton, Fl : Chapman & Hall, 1999;94.
3. Atchison KA, Davidson PL, Nakazono TT. Predisposing, enabling and need for dental treatment characteristics of ICS-II USA ethnically diverse groups. Adv Dent Res 1997;11: 223-234.
4. Atchison KA, Dolan TA. Development of the Geriatric Oral Health Assessment Index. J Dent Educ 1990;54:680-687.
5. Brattberg G, Thorslund M, Wikman A. The prevalence of pain in a general population. The results of a postal survey in a county of Sweden. Pain 1989;37:215-222.
6. Burke FJ, McCord JF, Cheung SW. The provision of emergency dental care by general dental practitioners in an urban area. Dental Update 1994;21:184-186.
7. Cheong YH, Chong LL. Dental survey on soldiers of an infantry battalion of Singapore Armed Forces (SAF) at the time of completion of national service. Singapore Dent J 1988;13:27-30.
8. Crombie IK, Davies HTO. Requirements for Epidemiological Studies. In: Crombie IK (ed). Epidemiology of Pain. Seattle: IASP Press 1999;17-24.
9. Cushing AM, Sheiham A, Maizels J. Developing socio-dental indicators – the social impact of dental disease. Community Dent Health 1986;3:3-17.
10. Crombie IK. The pocket guide to critical appraisal. London: BMJ Publishing 1996;12-13.
11. Galan D, Brecx M, Heath MR. Oral health status of a population of community-dwelling older Canadians. Gerodontology 1995;12:41-48.
12. Gelberg L, Linn LS, Mayer-Oakes SA. Differences in Health Status Between Older and Younger Homeless Adults. J Am Geriatric Soc 1990;38:1220-1229.
13. Gilbert GH, Duncan RP, Heft MW et al. Oral disadvantage among dentate adults. Community Dent Oral Epidemiol 1997;25:301-313.
14. Gooch BF, Dolan TA, Bourque LB. Correlates of self-reported dental health status upon enrolment in the Rand Health Insurance Experiment. J Dent Educ 1989;53:629-637.
15. Goodman JE, McGrath PJ. The epidemiology of pain in children and adolescents: a review. Pain 1991;46:247-264.
16. Greenhalgh T. How to read a paper: Assessing the methodological quality of published papers. BMJ 1997;315: 305-308.
17. Grushka M, Sessle BJ. Applicability of the McGill Pain Questionnaire to the differentiation of 'toothache' pain. Pain 1984;19:49-57.
18. Halling A, Ordell S. Emergency dental service is still needed – also for regular attenders within a comprehensive insurance system. Swed Dent J 2000;24:173-181.
19. Hennekens CH, Buring JE. Epidemiology in Medicine. Boston: Little, Brown, 1987;160.
20. Jaafar N, Razak IA, Zain RB. The social impact of oral and facial pain in an industrial population. Ann Acad Med Singapore 1989;18:553-555.
21. James FR, Large RG, Bushnell JA, Wells JE. Epidemiology of pain in New Zealand. Pain 1991;44:279-283.
22. Leao A, Sheiham A. Relation between clinical dental status and subjective impacts on daily living. J Dent Res 1995; 74:1408-1413.
23. Lipton JA, Ship JA, Larach-Robinson D. Estimated prevalence and distribution of reported oro-facial pain in the United States. J Am Dent Assoc 1993;124:115-121.
24. Locker D, Grushka M. Prevalence of oral and facial pain and discomfort: preliminary results of a mail survey. Community Dent Oral Epidemiol 1987;15:169-172.
25. Locker D, Miller Y. Subjectively reported oral health status in an adult population Community Dent Oral Epidemiol 1994; 22:425-430

26. Macfarlane T, Blinkhorn AS, Davies RM, Kincey J, Worthington HV. Oro-facial pain in the community: prevalence and associated impact. Community Dent Oral Epidemiol 2002;30: 52-60.
27. Macfarlane TV, Glenny AM, Worthington HV. Systematic review of population-based epidemiological studies of oro-facial pain. J Dent 2001;29:451-467.
28. Marcenes WS, Croucher R, Sheiham A, Marmot M. The relationship between self-reported oral symptoms and life-events. Psychol Health 1993;8:123-134.
29. Miller J, Elwood PC, Swallow JN. Dental pain: an incidence study. Br Dent J 1975;139:327-328.
30. Nuttall NM, Steele JG, Pine CM, White D, Pitts NB. The impact of oral health on people in the UK 1998. Br Dent J 2001;190: 121-126.
31. Okeson JP, Falace DA. Nonodontogenic toothache. Dent Clin North Am 1997;41:367-383.
32. Pau AKH, Croucher R, Marcenes W. Perceived inability to cope and care-seeking in patients with toothache: a qualitative study. Br Dent J 2000;189:500-502.
33. Petersen PE, Aleksejuniene J, Christensen LB, Eriksen HM. Oral health behavior and attitudes of adults in Lithuania. Acta Odontol Scand 2000;58:243-248.
34. Reich E, Hiller KA. Reasons for tooth extraction in the western states of Germany. Community Dent Oral Epidemiol 1993; 21:379-383.
35. Richards W, Scourfield S. Oral ill-health in a general dental practice in South Wales. Prim Dent Care 1996;3:6-13.
36. Riley JL 3rd. Gilbert GH. Heft MW. Oro-facial pain symptom prevalence: selective sex differences in the elderly? Pain 1998;76:97-104.
37. Scully C. The pattern of patient attendance for emergency care in a British dental teaching hospital. Community Dent Health 1995;12:151-154.
38. Sharav et al. The spatial distribution, intensity and unpleasantness of acute dental pain. Pain 1984;20:363-370.
39. Sindet-Pedersen S, Petersen JK, Gotzsche PC. Incidence of pain conditions in dental practice in a Danish county. Community Dent Oral Epidemiol 1985;13:244-246.
40. Slade GD, Locker D, Leake JL, Wu ASM, Dunkley G. The oral health status and treatment needs of adults aged 65+ living independently in Ottawa-Carleton. Can J Public Health 1990; 81:114-119.
41. Sternbach RA. Survey of pain in the United States: The Nuprin Pain Report. Clin J Pain 1986;2:49-53.
42. Thomas RJ, McEwen J, Asbury AJ. The Glasgow Pain Questionnaire: A new generic measure of pain; development and testing. Int J Epidemiol 1996;25:1060-1067.
43. Treasure E, Kelly M, Nuttall N, Nunn J, Bradnock G, White D. Factors associated with oral health: a multivariate analysis of results from the 1998 Adult Dental Health survey. Br Dent J 2001;190:60-68.
44. Vargas CM, Macek MD, Marcus SE. Sociodemographic correlates of tooth pain among adults: United states, 1989. Pain 2000;85:87-92.
45. Westaway MS, Viljoen E, Rudolph MJ. Utilization of oral health services, oral health needs ad oral health status in a peri-urban informal settlement. SADJ 1999;54:149-152.
46. Widstrom E, Pietila I, Piironen P, Nilsson B, Savola I. Analysis of patients utilizing emergency dental care in two Finnish cities. Acta Odontol Scand 1988;46:105-112.
47. Zakrzewska JM, Hamlyn PJ. Facial pain. In: Crombie IK (ed). Epidemiology of Pain. Seattle: IASP Press 1999;171-202.