

Practice activity patterns of dentists in Australia

Trends over time by age of patients

DS Brennan, AJ Spencer



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Practice activity patterns of dentists in Australia: trends over time by age of patients

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Summary

Trends in characteristics of patients and visits over time

At each time of the study just over half of the patients in private general dental practice were female. However, the age distributions of patients changed over time, reflecting a shift towards adults. Between 1993–94 and 2003–04 the percentage of patients aged 45–64 years increased from 28.2% to 34.6% and the percentage of patients 65 years or more increased from 11.3% to 14.1%.

The percentage of patients with dental insurance decreased from 56.3% in 1993–94 to 48.2% in 1998–99 before increasing to 60.6% in 2003–04. Check-up was the most common reason for a dental visit at each time of the study, while the percentage of patients attending for relief of pain decreased over time from 31.4% in 1993–94 to 26.7% in 2003–04.

The majority of patients were dentate at each time of the study, with the percentage who were edentulous decreasing from 3.1% in 1993–94 to 1.3% in 2003–04. Among dentate patients, the number of teeth per patient increased from 24.7 teeth in 1993–94 to 25.2 teeth in 2003–04.

The highest ranked categories of diagnosis or main dental condition were recall/maintenance care and coronal caries, ranging between 22.5% and 25.8% at each time of the study, and together accounting for 50.3% of patients in 2003–04. Between 1993–94 and 2003–04 there were increases in the percentages of patients visiting for recall/maintenance care (22.5% to 25.8%), cuspal fractures (5.9% to 6.7%), failed restorations (8.4% to 9.1%) and root caries (1.0% to 1.7%). There were corresponding decreases between 1993–94 and 2003–04 in the percentages of patients visiting for aesthetic problems (4.5% to 2.2%), periodontal disease (6.1% to 4.7%) and trauma (1.7% to 1.1%).

Trends in characteristics of patients and visits over time by age

The trends in insurance coverage among children and adolescents were mixed, but there were higher percentages of 18–24- and 25–44-year-old patients with insurance in 2003–04 compared to 1993–94. With the shift towards adult patients there is increasing interest in trends among patients in the 45–64 years and 65 years or older age groups. Patients aged 45–64 years and 65 years or more reflected the overall trend towards increased insurance coverage between 1993–94 and 2003–04.

Children and adolescents showed no significant change in the percentage visiting for relief of pain. Patients aged 18–24 years showed an increase in the percentage visiting for relief of pain between 1993–94 and 2003–04, while 25–44-year-old patients showed a consistent decrease in the percentage visiting for relief of pain over the study period. For patients in both the 45–64 years and 65 years or older age groups the percentages of emergency visits for relief of pain were lower in 2003–04 compared to 1993–94.

While the percentages of edentulous patients decreased over time for patients who were aged 25–44, 45–64 and 65+ years, this was most marked among patients aged 65 years or more, with 15.6% edentulous in 1993–94 and 4.7% in 2003–04.

Reflecting the decline in tooth loss, the percentages of patients visiting for denture problems decreased from 10.8% in 1993–94 to 5.7% in 2003–04 for 45–64-year-olds, and from 30.3% to 15.8% among patients aged 65 years or more. There were corresponding increases in the percentages of patients attending for recall/maintenance care between 1993–94 and 2003–04, from 15.8% to 18.7% among 45–64-year-olds and from 11.4% to 20.9% among patients aged 65 years or more. Patients aged 25–44 years also showed an increased percentage of recall/maintenance care and decreased percentage of denture problems, as well as a decline in periodontal disease. There were few changes in main diagnoses among children and adolescents, but patients aged 18–24 years showed an increase in pulpal infection diagnoses over the study period.

Trends in service patterns over time by age

The number of diagnostic services per visit increased among patients aged 5–11 years and among all patient age groups from 18–24 years through to those aged 65 years or more. The trends in overall rates of diagnostic services reflected increased rates of examination among patients aged 25–44 years and older, and increased rates of radiograph services among patients aged 12–17 years through to patients aged 65 years or more.

There were increased rates of preventive services per visit among patients aged 12–17 years through to those aged 45–64 years, reflecting increased rates of dental prophylaxis services among patients aged 12–17 years through to 25–44 years and increased rates of topical fluoride services among patients aged 25–44 years and 45–64 years.

The rates of crown and bridge services per visit increased among patients aged 65 years or more. Among 25–44- and 45–64-year-old patients the rates of crown and bridge services were lower in 2003–04 compared to 1993–94.

There was a significant decrease in the overall rate of denture services among 25–44 year-old patients. While the overall rates of denture services per visit showed no significant changes over time among patients aged 45–64 years and 65 years or more, there were significant decreases in rates of full dentures and partial upper dentures among patients aged 45–64 years and 65 years or more, and an increase in the rate of partial lower dentures among patients aged 65 years or more.

The total number of services per visit increased among patients aged 5–11 years and all patients aged between 18–24 years and 65 years or more.

Conclusions

There are increasing numbers of older patients who are retaining their teeth, and these patients may have complex treatment needs that require more services and take longer to complete. Such changes in oral health, demographics and use of services are expected to have an impact on the practice activity of dentists.

Abbreviations

ABS	Australian Bureau of Statistics
AIHW	Australian Institute of Health and Welfare
ARCPOH	Australian Research Centre for Population Oral Health
DSRU	Dental Statistics and Research Unit
OECD	Organisation for Economic Cooperation and Development

Symbols

%	percentage
—	zero or rounded to zero
n	number
S.E.	standard error

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1 Introduction

An interest in the monitoring of dentists' practice activity relates to the widespread nature of dental problems and frequent use of dental services, and the changes in factors such as oral health status and population demographics which may be expected to be reflected in changes in dental practice. In contrast to the widespread nature of dental problems and the frequent use of dental services, there has been limited routine monitoring of dentists' practice activity.

The Longitudinal Study of Dentists' Practice Activity has provided periodic monitoring of dentists' practice activity since the early 1980s that has filled this gap in public health information. This report is based on data collected for The Longitudinal Study of Dentists' Practice Activity over the 20-year period spanning 1983-84 to 2003-04.

1.1 Background: oral health and demographic trends

Australians have had one of the highest levels of caries experience among comparable OECD countries. In the decade or so immediately after the Second World War the problem with dental caries experience was unmanageable in Australian children and Australian adults had very high rates of tooth extraction as a result of dental caries. With the introduction of water fluoridation in major population centres and fluoridated toothpaste across the country in the late 1960s and early 1970s, a rapid decrease began in caries experience in children and tooth loss in adults. The decrease in caries experience in adolescents has been attributed predominantly to water fluoridation, followed by fluoridated toothpaste (Spencer 1986). The decrease in caries experience among middle-aged adults has been limited (Spencer 2001) either because it is dependent on cohorts born in a post-fluoride era reaching middle-aged adulthood or that risk of caries persists and slowly erodes the gains made among children, adolescents and young adults. However, there has been a reduction in tooth loss among dentate middle-aged and older adults. While this may largely reflect changes in treatment preferences among patients and dentists, success in caries prevention may both directly lower the incidence and increment of caries and indirectly help shape more positive attitudes to tooth retention.

The success of the 30 years after the introduction of fluorides needs to be qualified by both the burden of disease still experienced and recent trends. Dental caries was the most frequently experienced health problem and had the second highest number of new cases a year at the beginning of the 1990s (AIHW 2000). This burden of disease is associated with impacts on the daily lives of Australians including pain, infection, and interference with normal functions such as eating and speaking. The most recent evidence indicates that caries experience is increasing in children and adolescents (ARCPOH 2004). Increases in caries experience of adults visiting the public dental services between 1995-96 and 2001-02 have been described (Brennan & Spencer 2004), leading to speculation (Spencer 2004) of a polarisation in oral health whereby those with higher caries experience have become worse, while those with lower

caries experience have either maintained that level or improved. Caries still creates an enormous burden on the Australian population.

In summary: the Australian population has shown improved oral health over recent decades, with generally reduced caries experience among children (ARCPOH 2004, Spencer et al. 1994) and decreased tooth loss among adults (ABS 1979; AIHW DSRU: Carter et al. 2001). Demographic changes are projected to maintain the pool of children and young adults, while the pool of middle-aged to older adults is projected to increase (AIHW 2002; NHMRC 1993). With more people retaining their teeth and the age structure of the population changing, shifts in service provision have been observed among dental patients in private general practice (Brennan & Spencer 2003).

With the decline in both edentulism and numbers of missing teeth, the dental needs of adults may increase due to the larger pool of teeth at risk (Joshi et al. 1996). Changing demographics and technological advances are expected to lead to higher patient expectations and a greater demand for oral health care (Douglass & Sheets 2000).

1.2 Aims

Consistent with trends among the population towards retention of teeth and a shift towards an increase in the number of older adults, the aims of this report involve exploring practice activity patterns based around patient and visit characteristics, with an emphasis on practice patterns of treatment of patients aged 45 years and older.

2 Methods

The Longitudinal Study of Dentists' Practice Activity is based on a random sample of dentists in Australia. A longitudinal component is maintained by including those who were sampled in previous waves of the study and who are still registered into subsequent waves of the study. A sample supplementation procedure at each wave of the study selects dentists who were not registered at the previous wave. This sampling procedure provides representative cross-sectional samples at each wave of the study but also maintains a longitudinal component.

2.1 Sampling

The Longitudinal Study of Dentists' Practice Activity is based on a random sample of 10% of male dentists and 40% of female dentists. These sampling fractions were initially selected in 1983 for the baseline data collection in order to provide sufficient numbers of female dentists. The higher sampling fraction for female dentists was required due to the lower number of female dentists compared to male dentists in Australia. This allows for stratified analyses of male and female dentists, but biases the combined estimates, hence weighting is required for analyses that are not stratified by sex of dentist.

Dental registers in each State or Territory of Australia were used as the sampling frame for each wave of the study. Dentists registered at overseas addresses were excluded. Registers were cross-checked, and where dentists were registered on multiple registers they were only included for sampling purposes on their home address state or territory register.

2.2 Mode of collection

Data were collected by mailed self-completed questionnaires following the procedures of the Total Design Method (Dillman 1978, 1991; Salant & Dillman 1994). The initial mailing of the questionnaire included a letter of support from the President of the Australian Dental Association. In subsequent waves of the study a primary approach letter was sent prior to the questionnaire and included a summary report of the main findings from the previous wave of the study. Questionnaires were identified by code numbers, and dispatch and return control registers were maintained to enable follow-up mailings of replacement questionnaires to non-respondents.

The questionnaire was structured into two sections. Section A comprised check boxes and short-answer responses to a range of questions covering demographics, educational background, practice type and practice activity. Section B included a service log of a typical clinical day.

2.3 Practice activity measures

Respondents completed questions related to their current practice experience. Practitioners provided estimates of the number of patients treated per day, and the number of hours per day, days per week and weeks per year devoted to work.

From these estimates three key dependent variables – hours per year, patient visits per hour and patient visits per year – were calculated as follows:

- hours per year = (hours per day) x (days per week) x (weeks per year)
- patient visits per hour = (patients per day) ÷ (hours per day)
- patient visits per year = (patient visits per hour) x (hours per year).

2.4 Service provision measures

Practitioners recorded the types of services provided over one to two self-selected typical days of practice. The number of patients sampled by each dentist varied according to their typical level of activity, and dentists were free to choose which days to include in their service log. The data reported here were restricted to private general practitioners, and only sampled dentists within any group practice provided data. Dentists were instructed to record for each patient treated on their selected typical days the services provided regardless of whether or how they were charged to the patient. A patient may receive a number of services per visit across the range of 10 main areas of service. Services were classified into main areas of service following the Australian Dental Association's *Schedule of Dental Services* (1992). Extraction services correspond to the area listed as oral surgery in the schedule.

2.5 Weighting

The data were weighted using the estimated number of practising private general practice dentists at December 1983 and 1988 (Barnard 1987, 1989), together with the age and sex distribution of dentists from the 1981 and 1986 population censuses of Australia (AIH 1988a, 1988b), and dental board registration statistics from 1992 (AIHW 1994), 1994 (Szuster & Spencer 1997) and 2000 (Teusner & Spencer 2003). This weighted measure of practice activity was representative of the age and sex distribution of Australian private practice dentists at each time.

2.6 Validation of log data

Results of a validation study (Brennan & Spencer 2002) indicated that estimates derived from one-day logs provide adequate measures for aggregates of practitioners (e.g. dentist age groups) rather than for individual practitioners, given the operation of other factors such as random sampling, absence of non-response bias and sufficient sample size. The use of a self-selected typical day rather than some other systematic or random start sampling provided similar estimates to the remaining days of the survey, indicating that this approach provided representative estimates.

3 Response

The Longitudinal Study of Dentists' Practice Activity has been conducted at five points in time at five-year intervals since 1983. At all five waves of the study a response rate in excess of 70% was obtained, ranging from 71.2% in 1998–99 to 76.0% in 2003–04. Sample supplementation components, as shown in Table 1, indicate how the sample was supplemented by practitioners who were new to the dental registers at each point in time, while maintaining those who were sampled previously and have remained registered. The number included within each sample component has decreased over time as practitioners leave the dental registers for reasons such as retirement.

Table 1: Response by sample components over time

		Sample components over time				
		1983	1988	1993	1998	2003
1983–84	Sampled	1033	—	—	—	—
	Contacted	994	—	—	—	—
	Responded	730	—	—	—	—
	Response (%)	73.4	—	—	—	—
1988–89	Sampled	795	371	—	—	—
	Contacted	784	349	—	—	—
	Responded	584	271	—	—	—
	Response (%)	74.5	77.7	—	—	—
1993–94	Sampled	635	295	282	—	—
	Contacted	609	261	235	—	—
	Responded	454	184	179	—	—
	Response (%)	74.5	70.5	76.2	—	—
1998–99	Sampled	538	260	244	374	—
	Contacted	517	248	232	327	—
	Responded	372	161	155	255	—
	Response (%)	72.0	64.9	66.8	78.0	—
2003–04	Sampled	446	245	235	302	339
	Contacted	401	217	185	235	227
	Responded	309	164	129	181	179
	Response (%)	77.1	75.6	69.7	77.0	78.9

Response = no. contacted / no. responded

Consistent with the aims of exploring practice activity patterns based around patient characteristics collected from variables added to the service log from 1993–94, the remainder of this report was restricted to data from private general dental practitioners collected during 1993–94, 1998–99 and 2003–04.

4 Characteristics of patients and visits by time of study

The sex and age distributions of patients by time of study are shown in Table 2. The percentage of male and female patients was similar at each time of the study, with approximately 55% of patients being female. The age distributions of patients were similar across each time of the study in terms of having high percentages of patients aged 25–44 and 45–64 years. However, significant differences in the age distributions were observed over time, with increased percentages of patients aged 45–64 and 65 years or more.

Table 2: Sex and age distributions of patients by time of study (%)

	Time of study		
	1993–94	1998–99	2003–04
Sex of patient			
Male	45.0	46.0	44.9
Female	55.0	54.0	55.1
Age of patient**			
<5 years	1.1	0.8	0.7
5–11 years	6.6	5.4	5.7
12–17 years	7.7	5.7	5.9
18–24 years	8.7	7.2	6.9
25–44 years	36.4	34.2	32.2
45–64 years	28.2	33.6	34.6
65+ years	11.3	13.0	14.1

**($P < 0.01$) χ^2 test

Dental insurance status and reason for dental visit by time of study are shown in Table 3. The percentage of patients with dental insurance decreased between 1993–94 and 1998–99, but increased again in 2003–04. Check-up was the most common reason for dental visits at each time of the study, while visits for relief of pain decreased at each time of the study, and visits for other dental problems not involving relief of pain increased between 1993–94 and 1998–99.

Table 3: Insurance status and reason for visit by time of study (%)

	Time of study		
	1993–94	1998–99	2003–04
Insurance status**			
Insured	56.3	48.2	60.6
Uninsured	43.6	51.8	39.4
Reason for visit**			
Check-up	48.4	41.1	43.2
Relief of pain	31.4	28.4	26.7
Other dental problem	20.3	30.5	30.2

**($P < 0.01$) χ^2 test

Dentate status and main diagnosis by time of study are shown in Table 4. At each time of the study the majority of patients were dentate, and the percentage of dentate patients increased over time. The distribution of main diagnoses or dental conditions at each time of the study had high percentages of patients visiting for coronal caries and recall/maintenance care. However, the distribution of main diagnoses changed over time, with decreased percentages of patients with aesthetic problems, periodontal disease and dental trauma, and increased percentages of patients with cuspal fractures, root caries, failed restorations and recall/maintenance care.

Table 4: Dentate status and main diagnosis by time of study (%)

	Time of study		
	1993–94	1998–99	2003–04
Dentate status**			
Dentate	96.9	98.2	98.7
Edentulous	3.1	1.9	1.3
Main diagnosis**			
Aesthetic problem	4.5	4.2	2.2
Cuspal fracture	5.9	5.6	6.7
Coronal caries	24.0	23.3	24.5
Root caries	1.0	1.5	1.7
Denture problems	7.6	6.0	4.6
Dentinal sensitivity	1.6	1.3	1.1
Failed restoration	8.4	9.9	9.1
Occlusal problem	2.4	2.0	1.8
Periodontal disease	6.1	4.8	4.7
Pulpal infection	9.5	10.5	9.5
Recall/maintenance	22.5	25.5	25.8
Trauma	1.7	1.1	1.1
Other	5.0	4.5	7.1

**($P < 0.01$) χ^2 test

The mean number of teeth by time of study among those patients who were dentate is shown in Table 5. The number of teeth per patient increased at each time of the study.

Table 5: Number of teeth by time of study - dentate patients

	Time of study					
	1993–94		1998–99		2003–04	
	Mean	S.E.	Mean	S.E.	Mean	S.E.
Number of teeth**	24.7	0.07	24.8	0.09	25.2	0.08

**($P < 0.01$) General Linear Model

4.1 Patient and visit characteristics by age of patient

The following section breaks down the trends over time in patient and visit characteristics by age of patient.

Patients aged <5 years

The sex of patient, insurance status and reason for visit by time of study are shown in Table 6 for patients aged less than 5 years. At each time of the study the majority of patients were male, had dental insurance cover and visited for a check-up.

Table 6: Sex of patient, insurance status and reason for visit by time of study (%) - patients aged <5 years

	Time of study		
	1993–94	1998–99	2003–04
Sex of patient			
Male	58.5	53.1	46.5
Female	41.6	47.0	53.5
Insurance status			
Insured	51.7	58.6	70.6
Uninsured	48.3	41.4	29.4
Reason for visit			
Check-up	69.9	62.8	78.4
Relief of pain	22.8	20.6	18.4
Other dental problem	7.3	16.7	3.2

At each time of the study the highest percentages of patients aged less than 5 years visited for recall/maintenance care and coronal caries (Table 7).

Table 7: Dentate status and main diagnosis by time of study (%) - patients aged <5 years

	Time of study		
	1993–94	1998–99	2003–04
Dentate status**			
Dentate	—	—	—
Edentulous	—	—	—
Main diagnosis			
Aesthetic problem	1.4	—	—
Cuspal fracture	0.5	1.3	—
Coronal caries	26.5	23.1	20.4
Root caries	—	—	—
Denture problems	—	—	—
Dentinal sensitivity	—	—	—
Failed restoration	0.6	—	—
Occlusal problem	0.5	—	—
Periodontal disease	—	—	—
Pulpal infection	7.0	4.7	3.5
Recall/maintenance	46.3	61.0	63.9
Trauma	12.7	6.5	9.9
Other	4.4	3.4	2.4

Patients aged 5–11 years

The sex of patient, insurance status and reason for visit by time of study for patients aged 5–11 years are shown in Table 8. At each time of the study approximately half of the patients were female and the majority visited for a check-up. The percentage of 5–11-year-old patients with dental insurance coverage decreased between 1993–94 and 1998–99, before increasing again by 2003–04.

Table 8: Sex of patient, insurance status and reason for visit by time of study (%) – patients aged 5–11 years

	Time of study		
	1993–94	1998–99	2003–04
Sex of patient			
Male	48.1	52.7	49.7
Female	52.0	47.3	50.3
Insurance status**			
Insured	67.1	53.8	61.9
Uninsured	32.9	46.2	38.1
Reason for visit			
Check-up	69.8	68.5	72.3
Relief of pain	16.9	20.1	15.3
Other dental problem	13.3	11.4	12.4

**($P < 0.01$) χ^2 test

At each time of the study the highest percentages of patients aged 5–11 years visited for recall/ maintenance care and coronal caries (Table 9).

Table 9: Dentate status and main diagnosis by time of study (%) – patients aged 5–11 years

	Time of study		
	1993–94	1998–99	2003–04
Dentate status**			
Dentate	—	—	—
Edentulous	—	—	—
Main diagnosis			
Aesthetic problem	7.4	1.3	0.1
Cuspal fracture	0.7	—	—
Coronal caries	20.4	19.5	30.5
Root caries	—	—	—
Denture problems	—	0.5	—
Dentinal sensitivity	—	0.8	—
Failed restoration	1.6	2.1	0.6
Occlusal problem	3.0	3.5	1.4
Periodontal disease	0.6	0.2	—
Pulpal infection	3.5	6.8	4.5
Recall/maintenance	49.8	58.3	53.9
Trauma	4.9	3.3	1.3
Other	7.9	3.9	7.7

Patients aged 12–17 years

The sex of patient, insurance status and reason for visit by time of study for patients aged 12–17 years are shown in Table 10. At each time of the study approximately half of the patients were female and the majority visited for a check-up. The percentage of 12–17-year-old patients with dental insurance coverage decreased between 1993–94 and 1998–99, before increasing again by 2003–04.

Table 10: Sex of patient, insurance status and reason for visit by time of study (%) – patients aged 12–17 years

	Time of study		
	1993–94	1998–99	2003–04
Sex of patient			
Male	49.7	43.4	49.8
Female	50.4	56.6	50.2
Insurance status**			
Insured	68.3	50.1	63.0
Uninsured	31.7	50.0	37.1
Reason for visit			
Check-up	68.1	60.5	60.2
Relief of pain	10.1	11.8	12.4
Other dental problem	21.8	27.8	27.4

**($P < 0.01$) χ^2 test

At each time of the study the highest percentages of patients aged 12–17 years visited for recall/maintenance care and coronal caries (Table 11).

Table 11: Dentate status and main diagnosis by time of study (%) – patients aged 12–17 years

	Time of study		
	1993–94	1998–99	2003–04
Dentate status**			
Dentate	—	—	—
Edentulous	—	—	—
Main diagnosis			
Aesthetic problem	8.7	8.9	1.2
Cuspal fracture	0.9	0.4	0.2
Coronal caries	21.0	19.8	22.0
Root caries	—	—	—
Denture problems	—	0.6	—
Dentinal sensitivity	0.2	0.5	0.6
Failed restoration	0.6	0.5	1.5
Occlusal problem	2.9	6.3	4.5
Periodontal disease	1.1	0.4	1.6
Pulpal infection	3.1	1.7	5.1
Recall/maintenance	44.3	46.5	48.6
Trauma	1.6	2.3	1.6
Other	15.2	12.2	13.1

Patients aged 18–24 years

The sex of patient, insurance status and reason for visit by time of study for patients aged 18–24 years are shown in Table 12. At each time of the study over half of the patients were female. The percentage of 18–24-year-old patients with dental insurance coverage decreased between 1993–94 and 1998–99, before increasing again to peak by 2003–04. While the highest percentage of 18–24-year-old patients visited for check-ups at each time of the study, some change over time was observed with increased percentages of patients visiting for relief of pain and other dental problems in 1998–99 and 2003–04 compared to 1993–94.

Table 12: Sex of patient, insurance status and reason for visit by time of study (%) - patients aged 18–24 years

	Time of study		
	1993–94	1998–99	2003–04
Sex of patient			
Male	38.9	43.0	46.1
Female	61.1	57.0	53.9
Insurance status**			
Insured	45.9	30.2	53.1
Uninsured	54.1	69.8	46.9
Reason for visit**			
Check-up	58.1	44.7	49.7
Relief of pain	26.4	30.6	30.4
Other dental problem	15.5	24.7	19.9

**($P < 0.01$) χ^2 test

At each time of the study the highest percentages of patients aged 18–24 years visited for coronal caries and recall/maintenance care (Table 13). The distribution of main diagnoses varied by time of study, with increased percentages of patients aged 18–24 years visiting because of pulpal infections.

Table 13: Dentate status and main diagnosis by time of study (%) - patients aged 18–24 years

	Time of study		
	1993–94	1998–99	2003–04
Dentate status**			
Dentate	—	—	—
Edentulous	—	—	—
Main diagnosis**			
Aesthetic problem	4.4	3.2	2.9
Cuspal fracture	2.0	2.1	1.0
Coronal caries	31.2	33.5	36.8
Root caries	0.2	1.3	1.1
Denture problems	0.2	—	1.0
Dentinal sensitivity	1.9	1.2	1.0
Failed restoration	2.9	4.0	2.1
Occlusal problem	3.6	1.1	0.6
Periodontal disease	4.8	1.7	3.4
Pulpal infection	6.3	9.1	10.4
Recall/maintenance	28.8	31.0	30.8
Trauma	3.8	2.4	0.7
Other	9.7	9.6	8.2

**($P < 0.01$) χ^2 test

Patients aged 25–44 years

The sex of patient, insurance status and reason for visit by time of study for patients aged 25–44 years are shown in Table 14. At each time of the study approximately 57.0% of patients were female. The percentage of 25–44-year-olds with dental insurance decreased between 1993–94 and 1998–99, before increasing again to peak by 2003–04. The highest percentage of 25–44-year-old patients visited for check-ups at each time of the study, with decreased percentages of patients visiting for relief of pain and increased percentages of patients visiting for other dental problems.

Table 14: Sex of patient, insurance status and reason for visit by time of study (%) – patients aged 25–44 years

	Time of study		
	1993–94	1998–99	2003–04
Sex of patient			
Male	42.3	43.0	42.2
Female	57.7	57.0	57.8
Insurance status**			
Insured	51.3	41.4	55.4
Uninsured	48.7	58.6	44.6
Reason for visit**			
Check-up	45.8	40.0	43.7
Relief of pain	36.8	32.1	28.0
Other dental problem	17.4	28.0	28.3

**($P < 0.01$) χ^2 test

At each time of the study the highest percentages of patients aged 25–44 years visited for coronal caries and recall/maintenance care (Table 15). The distribution of main diagnoses varied by time of study, with increased percentages of patients visiting for recall/maintenance care and decreased percentages of patients visiting for denture problems and periodontal disease.

Table 15: Dentate status and main diagnosis by time of study (%) – patients aged 25–44 years

	Time of study		
	1993–94	1998–99	2003–04
Dentate status**			
Dentate	99.2	99.7	99.9
Edentulous	0.8	0.3	0.1
Main diagnosis**			
Aesthetic problem	4.5	4.7	2.6
Cuspal fracture	6.7	4.9	5.3
Coronal caries	28.9	29.2	30.6
Root caries	1.0	0.8	1.1
Denture problems	2.7	1.2	0.8
Dentinal sensitivity	2.1	1.1	1.4
Failed restoration	9.7	10.4	9.0
Occlusal problem	2.0	1.6	2.0
Periodontal disease	6.4	5.8	4.0
Pulpal infection	12.2	13.3	10.8
Recall/maintenance	19.3	22.9	24.7
Trauma	1.2	0.7	1.2
Other	3.4	3.4	6.5

**($P < 0.01$) χ^2 test

Patients aged 45–64 years

The sex of patient, insurance status and reason for visit by time of study for patients aged 45–64 years are shown in Table 16. At each time of the study just over half of the patients were female. The percentage of 45–64-year-olds with dental insurance decreased between 1993–94 and 1998–99, before increasing again to peak by 2003–04. The percentage of patients visiting for other dental problems not involving relief of pain increased over time.

Table 16: Sex of patient, insurance status and reason for visit by time of study (%) – patients aged 45–64 years

	Time of study		
	1993–94	1998–99	2003–04
Sex of patient			
Male	46.5	47.7	45.0
Female	53.5	52.3	55.0
Insurance status**			
Insured	61.7	55.0	63.8
Uninsured	38.3	45.1	36.2
Reason for visit**			
Check-up	42.3	35.2	35.7
Relief of pain	35.3	30.5	28.4
Other dental problem	22.4	34.3	36.0

**($P < 0.01$) χ^2 test

At each time of the study the highest percentages of patients aged 45–64 years visited for coronal caries, recall/maintenance care, pulpal infection and denture problems (Table 17). However, the percentage of patients visiting for denture problems decreased steadily over time while the percentage of patients visiting for recall/maintenance care increased between 1993–94 and 1998–99.

Table 17: Dentate status and main diagnosis by time of study (%) – patients aged 45–64 years

	Time of study		
	1993–94	1998–99	2003–04
Dentate status**			
Dentate	96.9	98.5	98.6
Edentulous	3.1	1.6	1.5
Main diagnosis**			
Aesthetic problem	4.0	4.4	2.5
Cuspal fracture	8.5	9.0	10.8
Coronal caries	20.7	18.9	19.9
Root caries	1.3	1.8	1.5
Denture problems	10.8	8.3	5.7
Dentinal sensitivity	1.7	2.1	1.0
Failed restoration	12.2	14.0	12.8
Occlusal problem	2.3	2.0	1.8
Periodontal disease	8.2	6.1	6.6
Pulpal infection	11.3	10.8	10.7
Recall/maintenance	15.8	19.1	18.7
Trauma	0.3	0.6	0.9
Other	3.1	3.0	7.1

**($P < 0.01$) χ^2 test

Patients aged 65+ years

The sex of patient, insurance status and reason for visit by time of study for patients aged 65 years or more are shown in Table 18. At each time of the study approximately half of the patients were female. The percentage of patients aged 65 years or more with dental insurance cover increased over time. The highest percentage of patients aged 65 years or more visited for a check-up at each time of the study. While there was variation over time in the percentages of patients visiting for relief of pain and other dental problems, no consistent trends were evident.

Table 18: Sex of patient, insurance status and reason for visit by time of study (%) - patients aged 65+ years

	Time of study		
	1993-94	1998-99	2003-04
Sex of patient			
Male	49.6	48.6	45.3
Female	50.4	51.4	54.7
Insurance status**			
Insured	53.1	54.7	66.5
Uninsured	46.9	45.3	33.5
Reason for visit**			
Check-up	37.7	37.2	36.1
Relief of pain	32.2	23.6	29.0
Other dental problem	30.1	39.3	34.8

**($P < 0.01$) χ^2 test

At each time of the study the highest percentages of patients aged 65 years or more visited for denture problems, recall/maintenance care, coronal caries and failed restorations (Table 19). However, the percentage of patients visiting for denture problems decreased steadily over time while the percentage of patients visiting for recall/maintenance care increased between 1993-94 and 1998-99.

Table 19: Dentate status and main diagnosis by time of study (%) - patients aged 65+ years

	Time of study		
	1993-94	1998-99	2003-04
Dentate status**			
Dentate	84.4	91.3	95.3
Edentulous	15.6	8.7	4.7
Main diagnosis**			
Aesthetic problem	2.1	3.1	1.7
Cuspal fracture	6.3	5.2	8.2
Coronal caries	15.8	16.4	15.5
Root caries	1.8	3.9	4.8
Denture problems	30.3	20.9	15.8
Dentinal sensitivity	1.5	0.6	1.7
Failed restoration	10.0	8.5	11.1
Occlusal problem	2.1	1.5	1.4
Periodontal disease	8.2	5.1	5.9
Pulpal infection	6.9	8.8	6.8
Recall/maintenance	11.4	20.7	20.9
Trauma	2.0	0.8	0.6
Other	1.5	4.5	5.7

**($P < 0.01$) χ^2 test

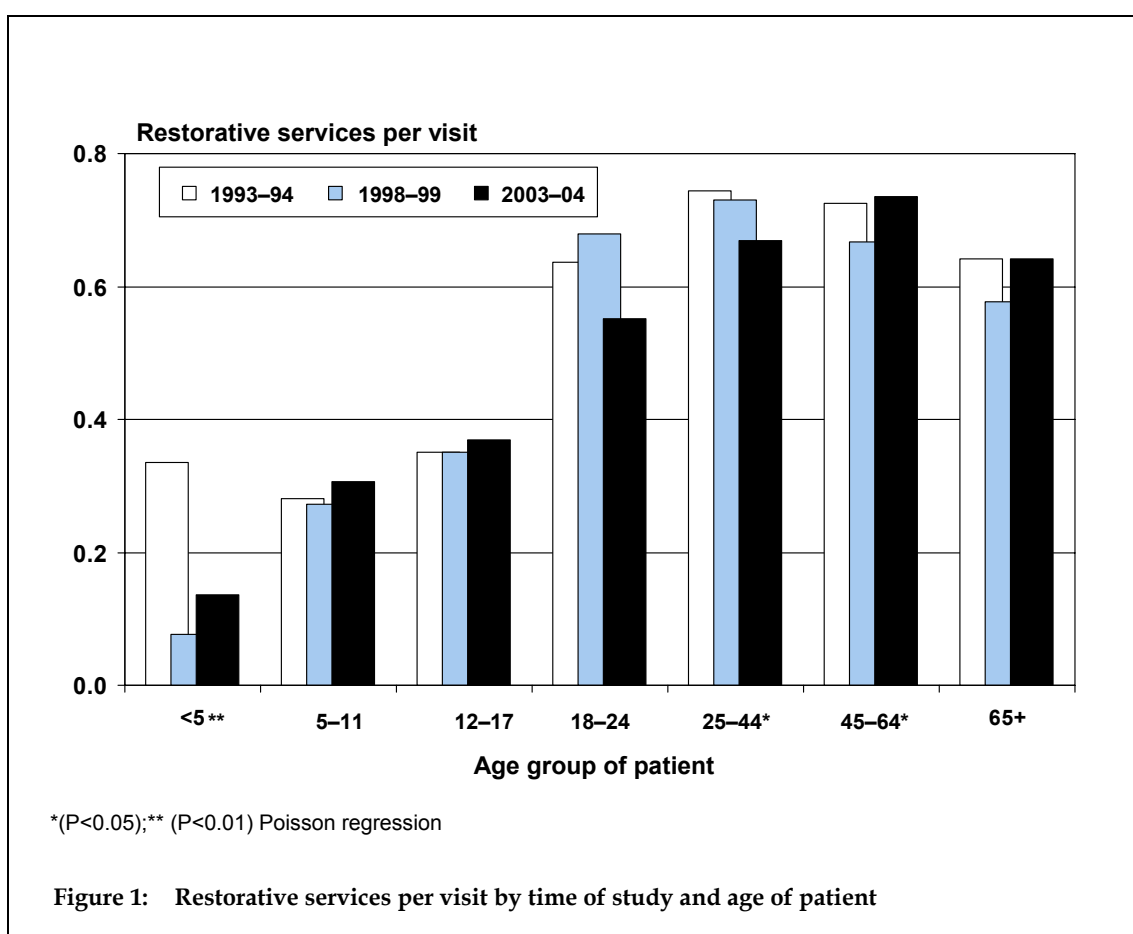
5 Services provided by time of study and age of patient

Services provided per visit are presented in this section by time of study and age of patient for main areas of service and for the total number of services provided per visit.

5.1 Main areas of service

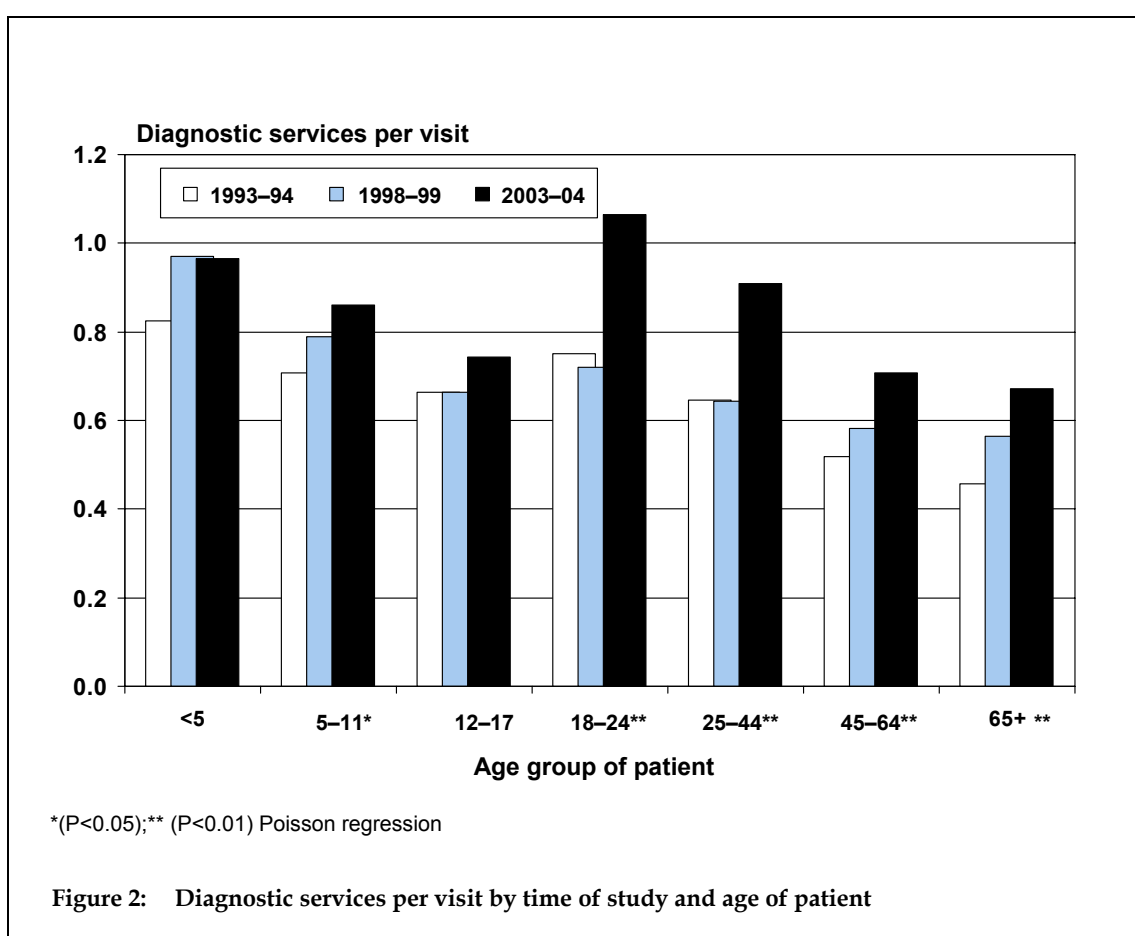
Restorative services

Restorative services were provided at higher rates to adult patients compared to children and adolescents (Figure 1). Restorative services mainly include fillings of various types as well as other restorative services such as veneers. Significant changes over time in the provision of restorative services were observed for patients aged less than 5, 25–44 and 45–64 years. However, the only consistent trend was the decline in the rate of restorative services per visit over time among 25–44-year-old patients.



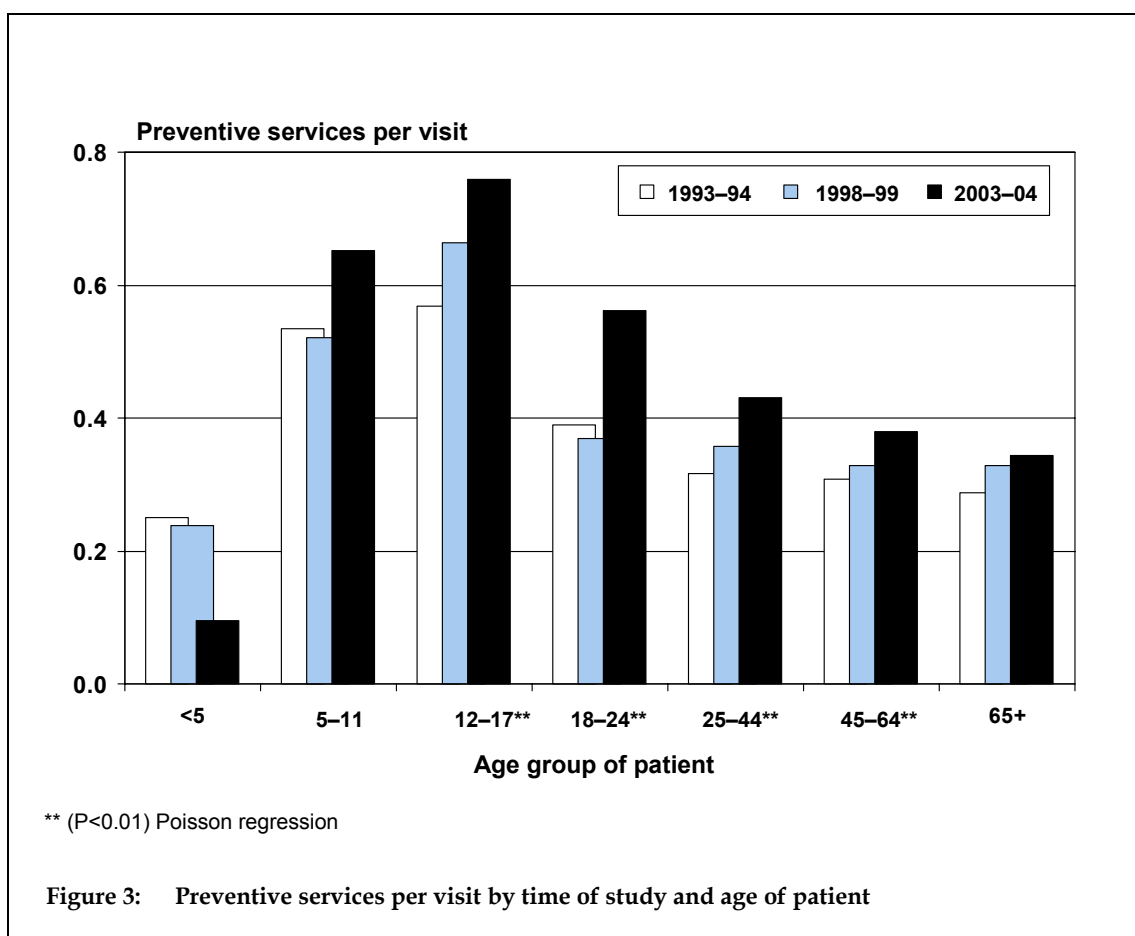
Diagnostic services

The rate of diagnostic services per visit by time of study and age of patient is presented in Figure 2. Diagnostic services are comprised mainly of services such as examinations and radiographs. Patients in the age groups 18 years and older showed a significant increase in the rate of diagnostic services per visit over time, as did patients aged 5–11 years. While patients aged 5–11, 45–64 and 65+ years all showed consistent increases in the rate of diagnostic services per visit at each time of the study, patients aged 18–24 and 25–44 years showed large increases in diagnostic services between 1998–99 and 2003–04. As a result of the increase over time in diagnostic services occurring mainly among adult patients, the distribution of diagnostic services by age of patient was less skewed towards higher rates among children in 2003–04 than it had been in 1993–94, with diagnostic rates peaking instead among 18–24-year-old patients.



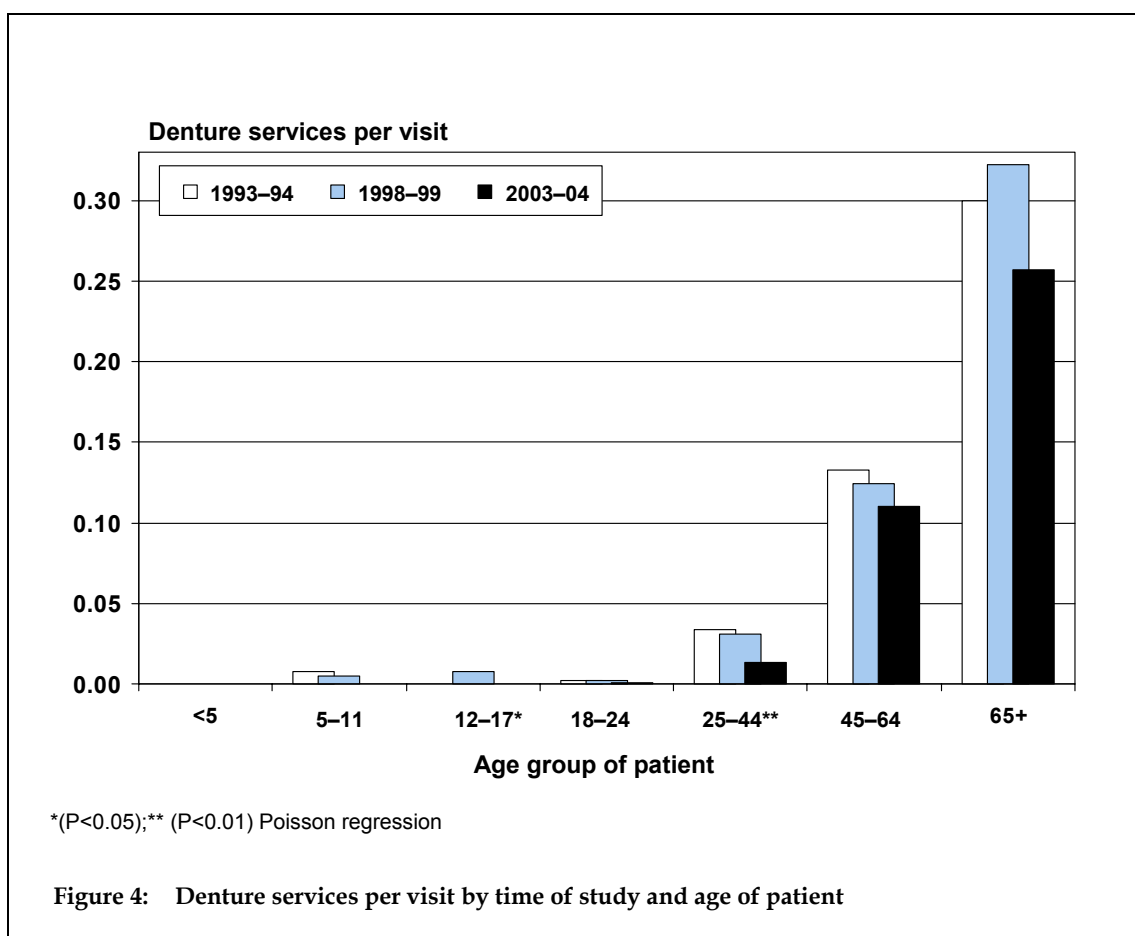
Preventive services

The rate of preventive services per visit by time of study and age of patient is presented in Figure 3. Preventive services are comprised mainly of services such as scale and clean and topical fluoride, as well as other preventive services such as oral hygiene instruction. Patients in the age groups ranging between 12–17 and 45–64 years all showed a significant increase in preventive services per visit between 1993–94 and 2003–04. However, despite these increases in preventive services per visit among adult patients the highest rates of preventive services were observed among 5–11- and 12–17-year-old patients at each time of the study.



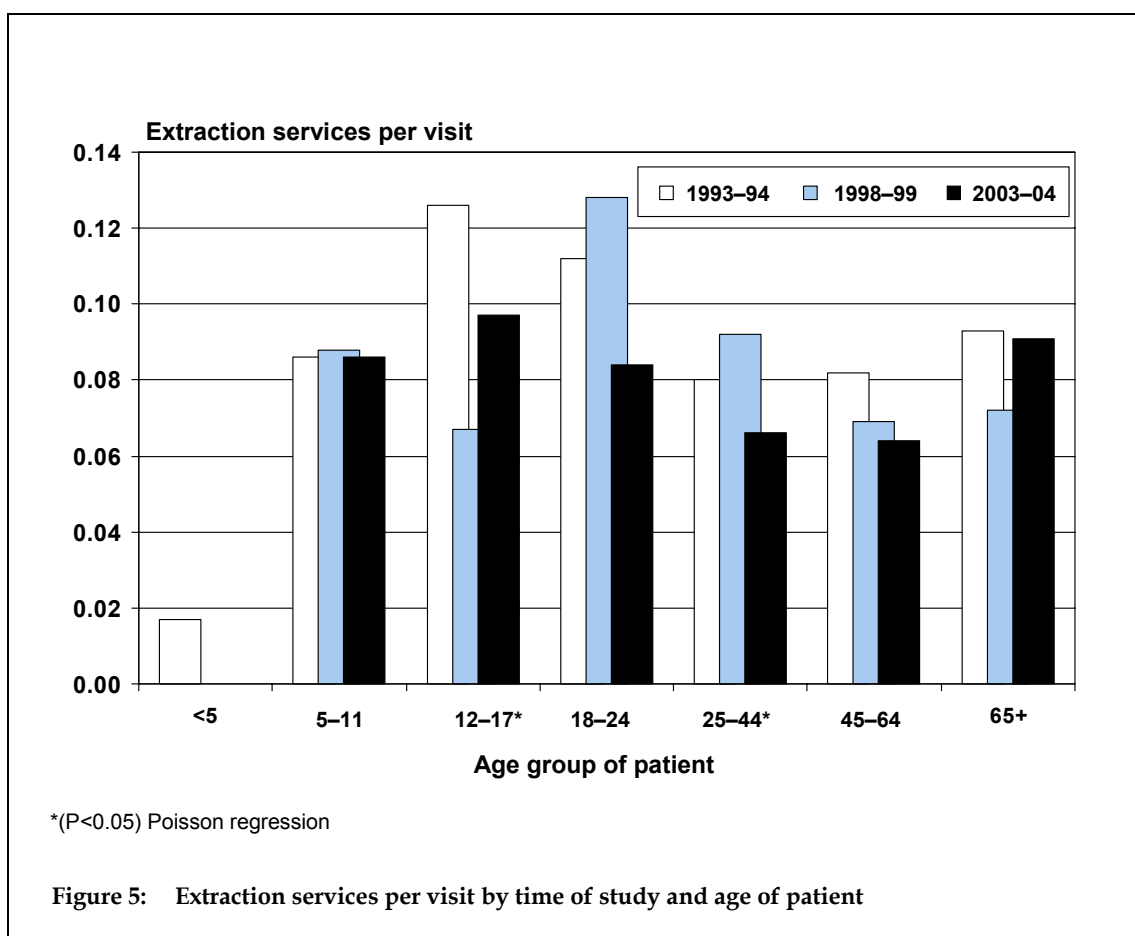
Denture services

The rate of denture services per visit by time of study and age of patient is presented in Figure 4. Rates of denture services increased across older age groups of patients, with the highest rates of denture services observed among patients aged 65 years or more at each time of the study. While patients in the age groups 45–64 years and 65 years or more showed a trend towards lower rates of denture services per visit between 1993–94 and 2003–04, this was not statistically significant. The only significant difference in denture service rates was a decrease in denture services per visit among patients aged 25–44 years.



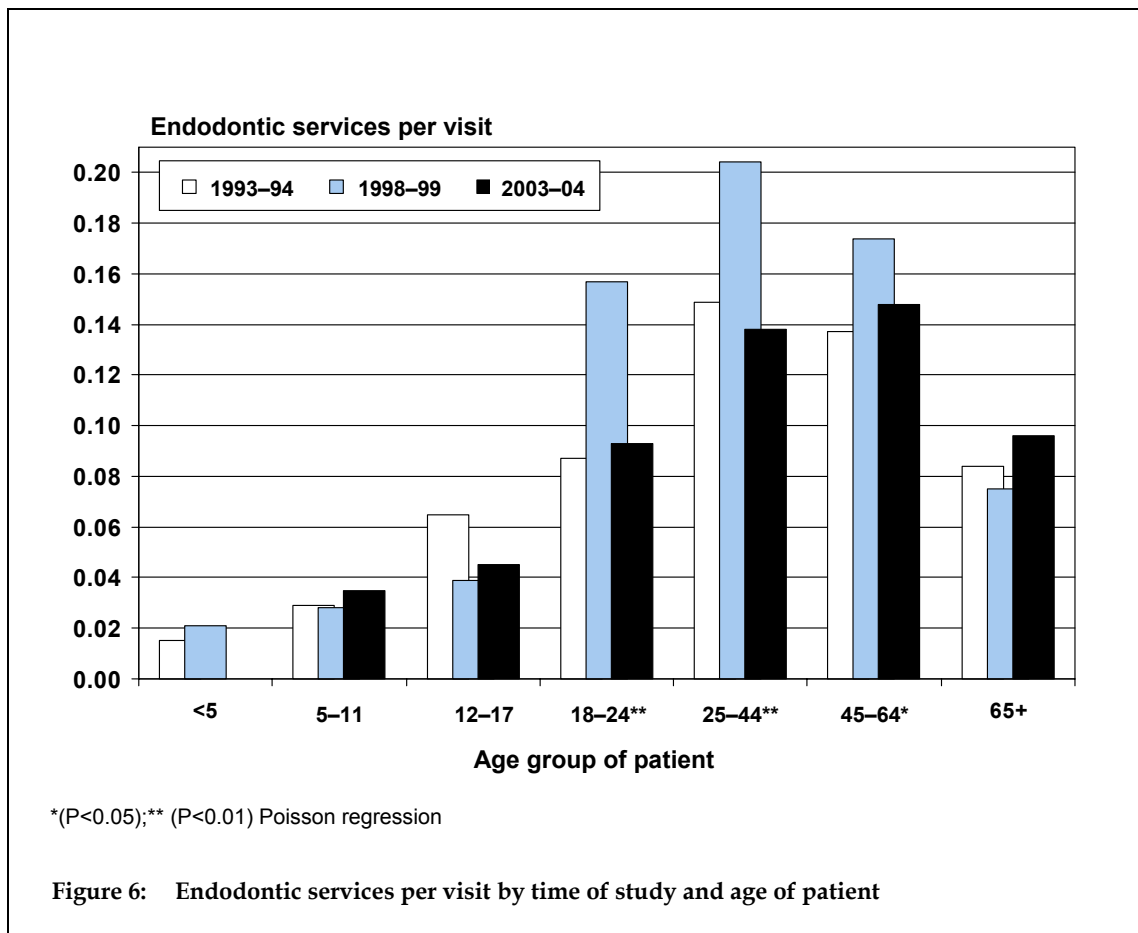
Extraction services

The rate of extraction services per visit by time of study and age of patient is presented in Figure 5. The rate of extraction services per visit showed no clear patterns by age of patient. The highest rates observed in 1993–94 were among patients aged 12–17 years, while in 1998–99 the highest rates were observed among patients aged 18–24 years, and in 2003–04 there was little variation by age for patients aged over 5 years. The only statistically significant differences by time of study were observed among patients aged 12–17 years and 25–44 years, but no clear trend over time was evident in either case.



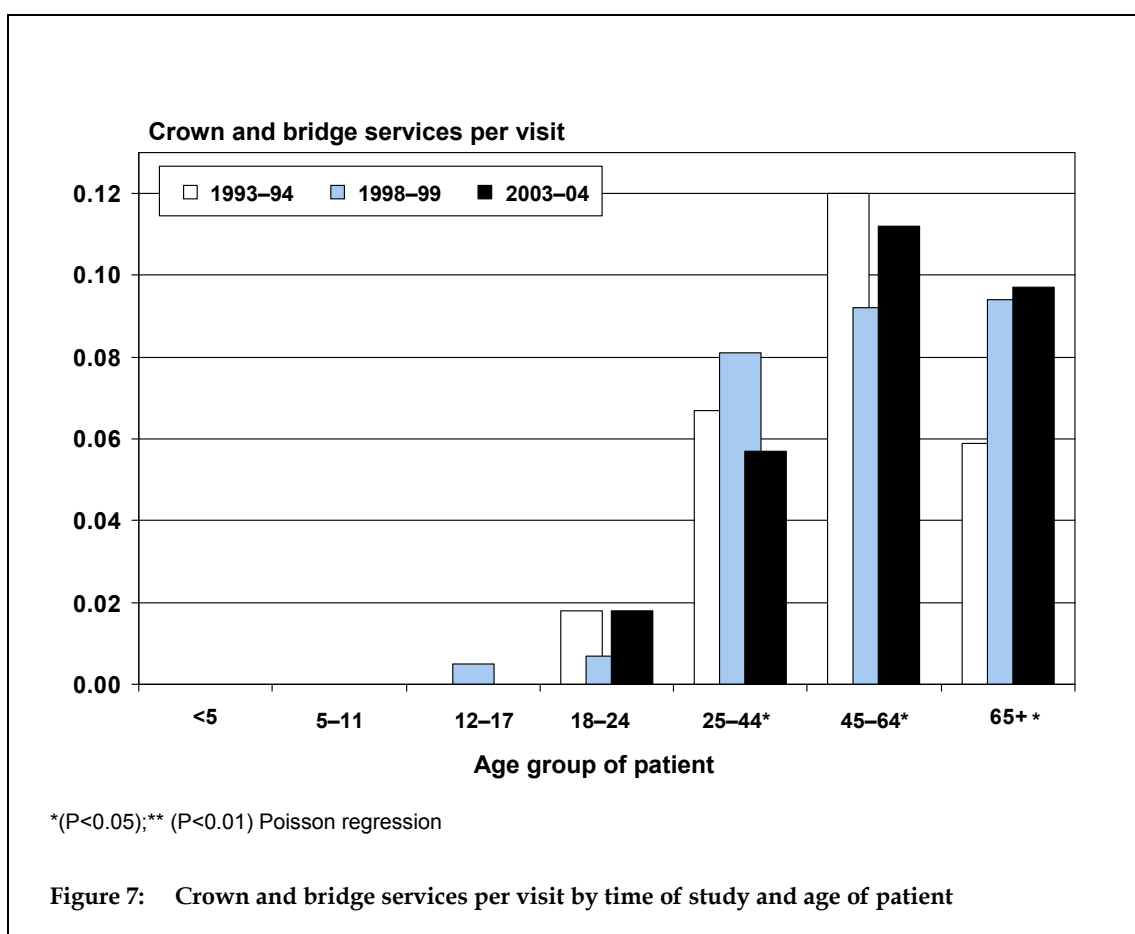
Endodontic services

The rate of endodontic services per visit by time of study and age of patient is presented in Figure 6. Endodontic or root canal services are primarily directed at treating pulpal infections of the tooth. The distribution of endodontic services peaked among patients aged 25–44 years and 45–64 years at each time of the study. Significant differences over time in the rate of endodontic services were observed among patients aged between 18–24 and 45–64 years, with the same pattern of change occurring in each of these age groups involving an increase between 1993–94 and 1998–99 followed by a decrease in 2003–04.



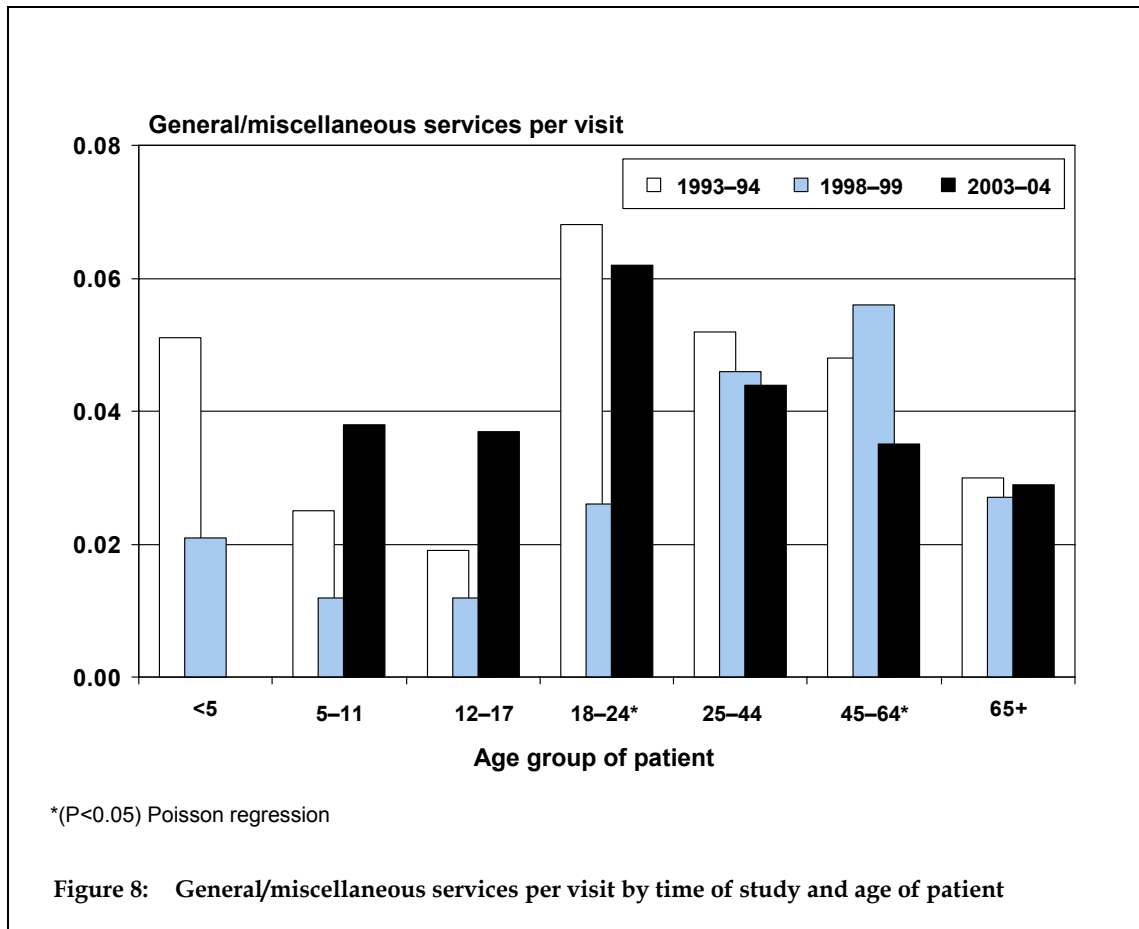
Crown and bridge services

The rate of crown and bridge services per visit by time of study and age of patient is presented in Figure 7. In 1993–94 crown and bridge services increased across successively older age groups of patients to peak among 45–64-year-olds before declining among patients aged 65 years or more. However, the increase in crown and bridge services among patients aged 65 years or more, mainly between 1993–94 and 1998–99, resulted in crown and bridge services peaking among patients aged 65 years or more in 1998–99 and crown and bridge rates among patients aged 65 years or more being ranked second-highest in 2003–04. Significant differences in crown and bridge rates were also observed among 25–44- and 45–64-year-old patients, and while the trends over time were not consistent the result was that crown and bridge rates were lower in 2003–04 than they were in 1993–94 for both age groups of patients.



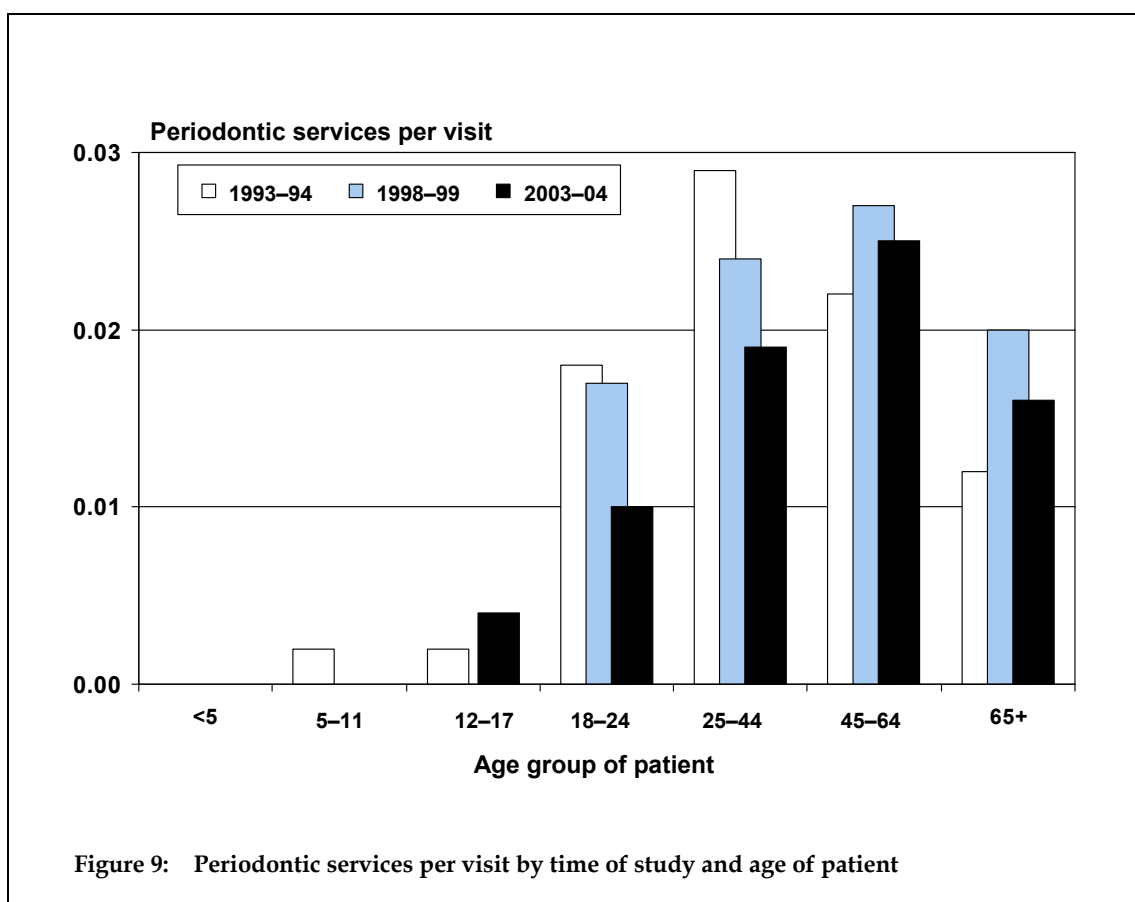
General/miscellaneous services

The rate of general/ miscellaneous services per visit by time of study and age of patient is presented in Figure 8. Services in the general/ miscellaneous category comprise services such as drug therapy, sedation, occlusal splints and post-operative care. The only significant changes over time in the provision of general/ miscellaneous services were observed among 18-24- and 45-64-year-old patients. However, no consistent trends over time in the provision of general/ miscellaneous services were evident.



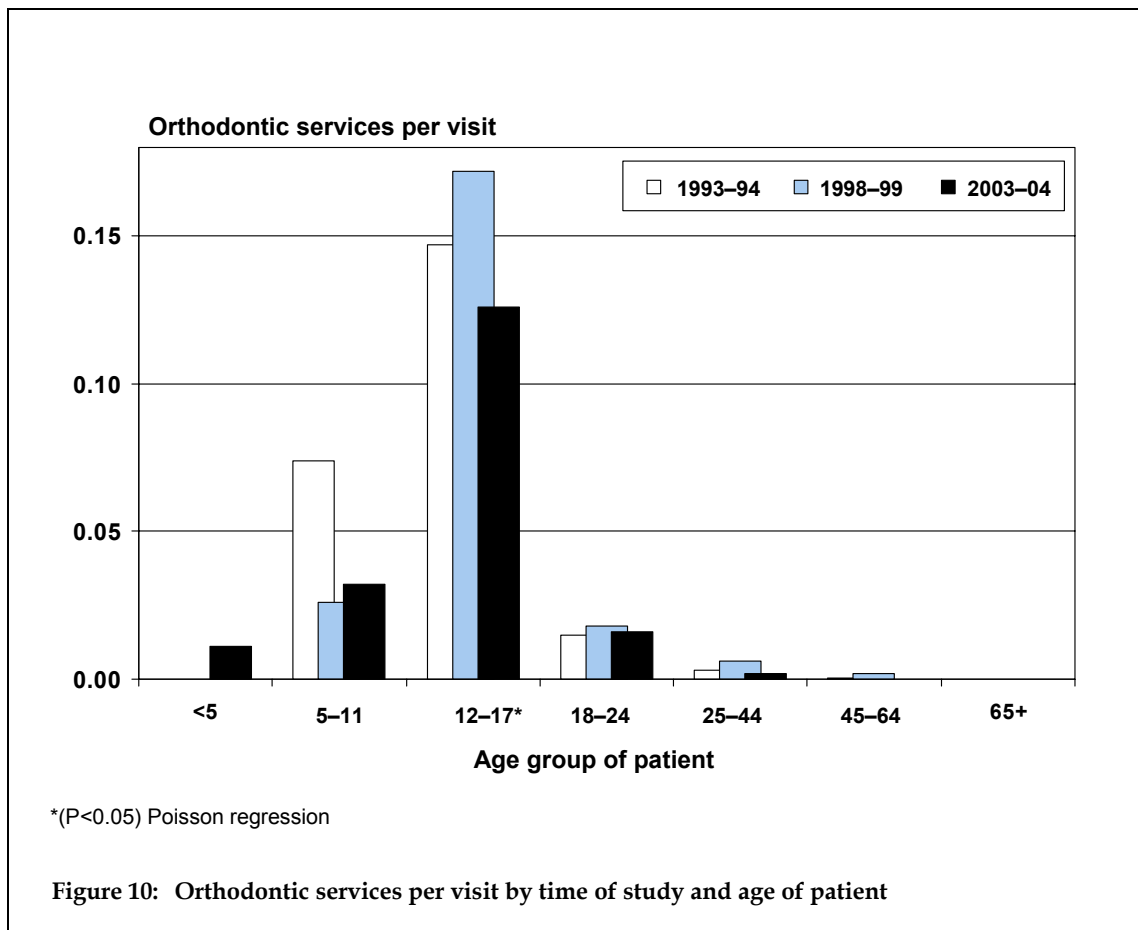
Periodontic services

The rate of periodontic services per visit by time of study and age of patient is presented in Figure 9. Periodontic services are provided to treat gum disease, and comprise services such as root planing. At each time of the study periodontic services peaked among patients aged 25–44 and 45–64 years old. No statistically significant differences in rates of periodontic services over time were observed in any age group of patients.



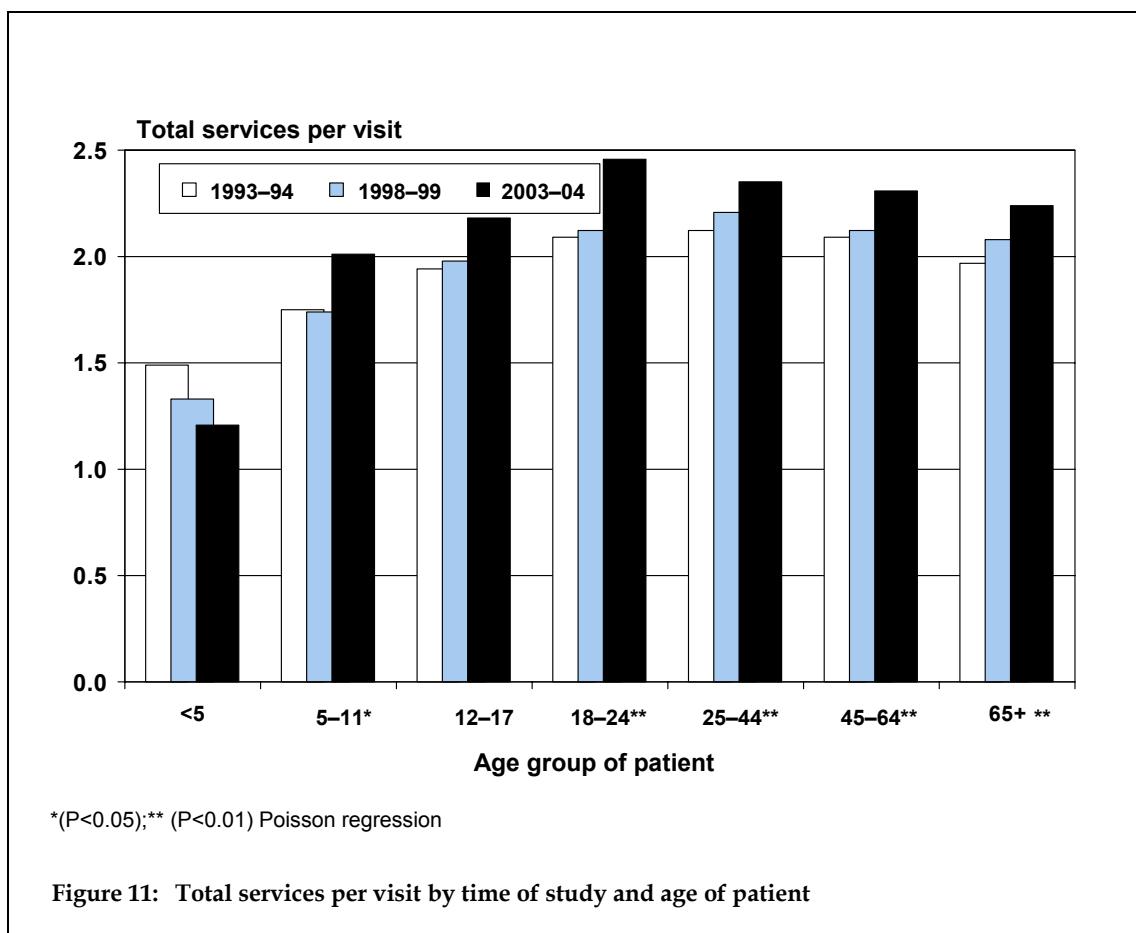
Orthodontic services

The rate of orthodontic services per visit by time of study and age of patient is presented in Figure 10. Orthodontic services comprise services such as removable appliances for treating malocclusion. The distribution of orthodontic services by age of patient showed a peak among 12-17-year-old patients. The only statistically significant change over time in the rate of orthodontic services was observed among patients aged 12-17 years old, but no clear trend over time was evident.



5.2 Total services per visit

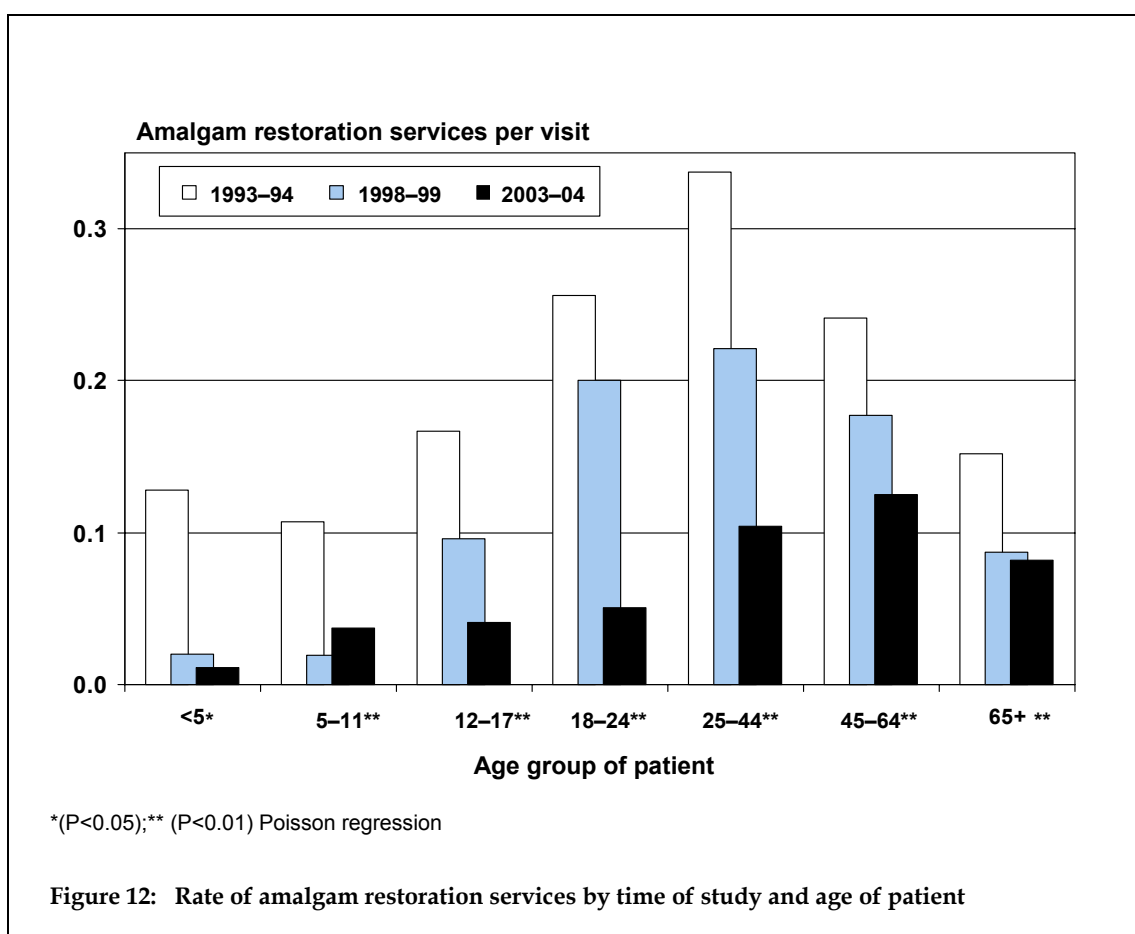
The rate of total services per visit for all main areas of service combined by time of study and age of patient is presented in Figure 11. The rate of total services per visit increased across successively older age groups of patients to peak around the 18–24 and 25–44 years age groups. Increases over time in the rate of total services per visit were observed among patients aged 5–11 years and 18–24 years and older.



5.3 Restorative services

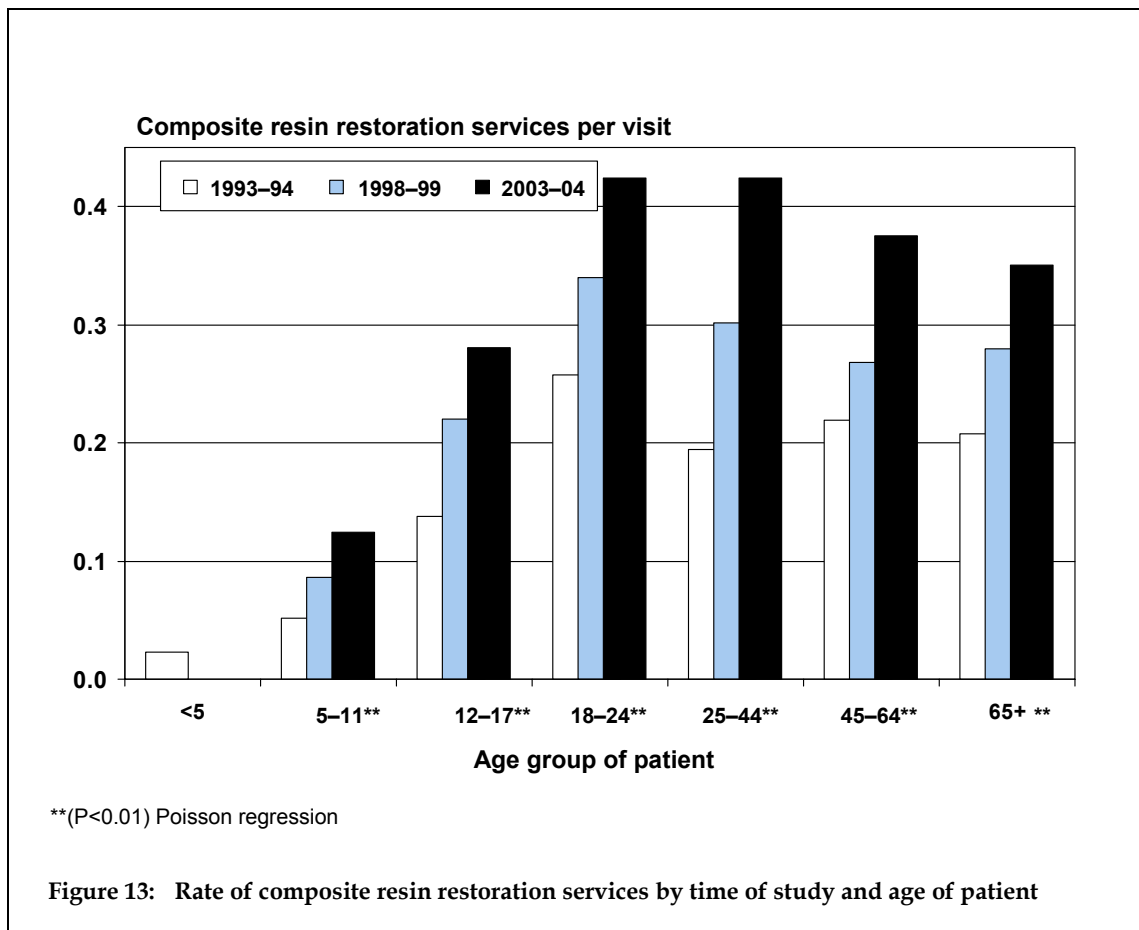
Amalgam restorations

The rate of amalgam restoration services per visit by time of study and age of patient is presented in Figure 12. Rates of amalgam restoration services tended to increase across successively older age groups of patients to peak around patients aged 25–44 years in 1993–94 and 1998–99, and patients aged 45–64 years in 2003–04. Significant differences were observed over time for all groups of patients, involving a decrease in the rate of amalgam restorations per visit between 1993–94 and 2003–04.



Composite resin restorations

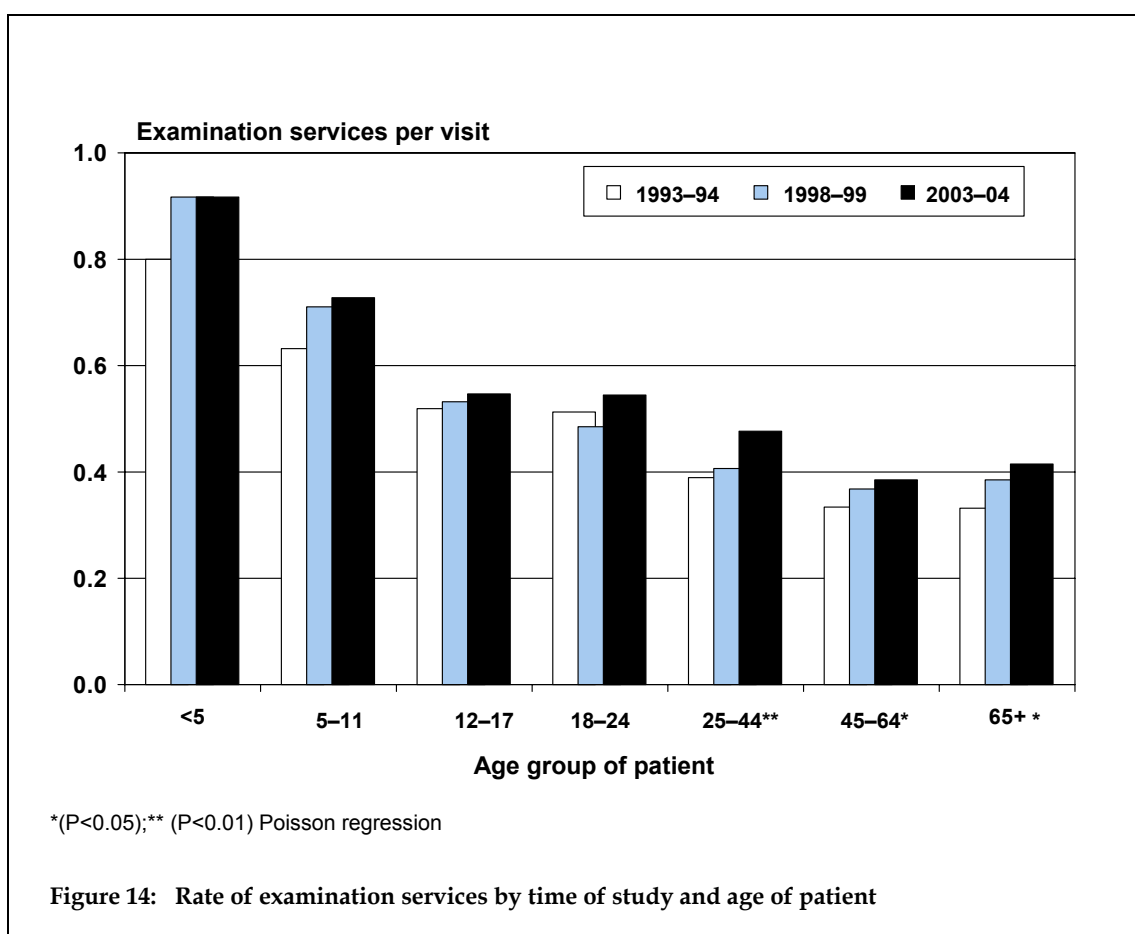
The rate of composite resin restoration services per visit by time of study and age of patient is presented in Figure 13. The rate of composite resin restorations per visit tended to increase across successively older age groups of patients to peak among patients aged 18–24 years. All age groups of patients aged over 5 years exhibited a significant increase in the rate of composite resin restorations at each time of the study.



5.4 Diagnostic services

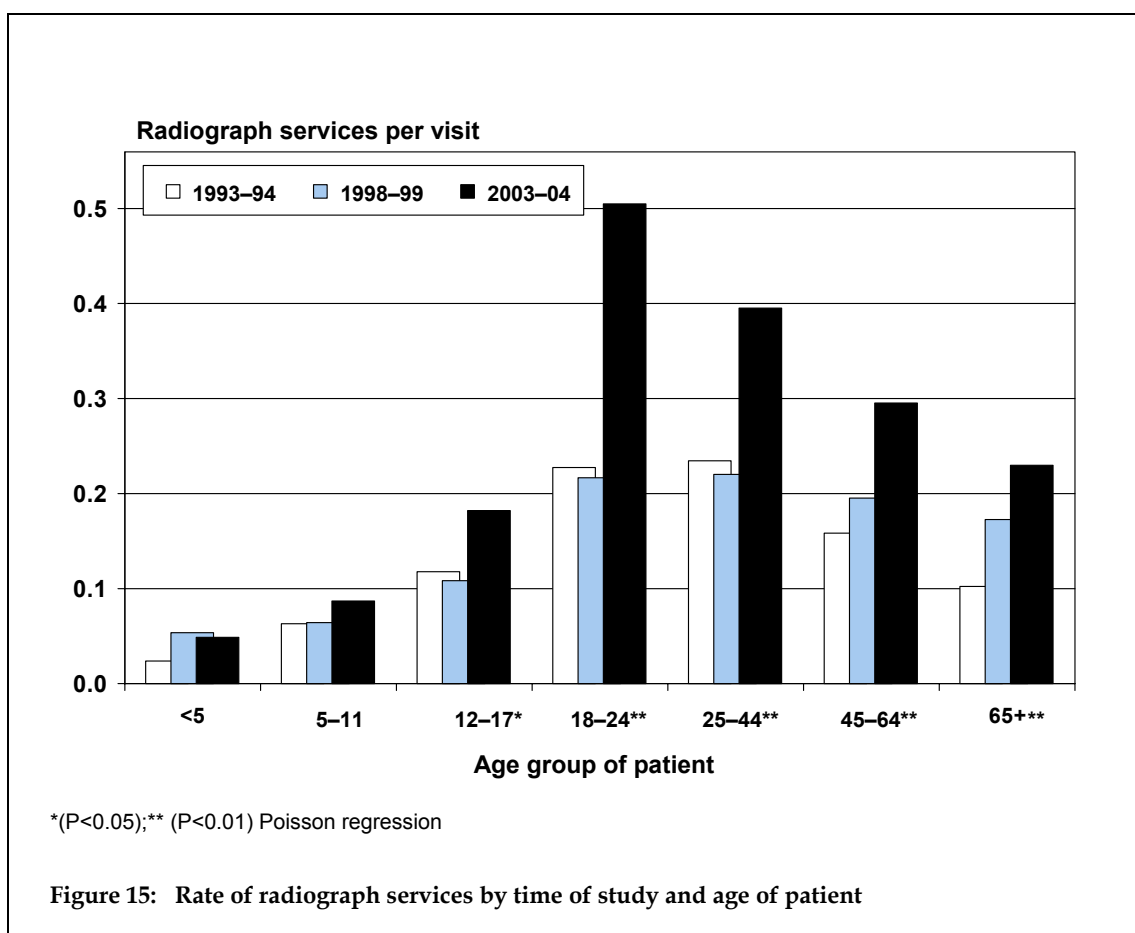
Examinations

The rate of examination services per visit by time of study and age of patient is presented in Figure 14. At each time of the study the rate of dental examinations peaked among patients aged less than 5 years and tended to decrease across successively older age groups of patients. Statistically significant increases in the rate of dental examinations over time were observed among patients aged 25–44 years and older.



Radiographs

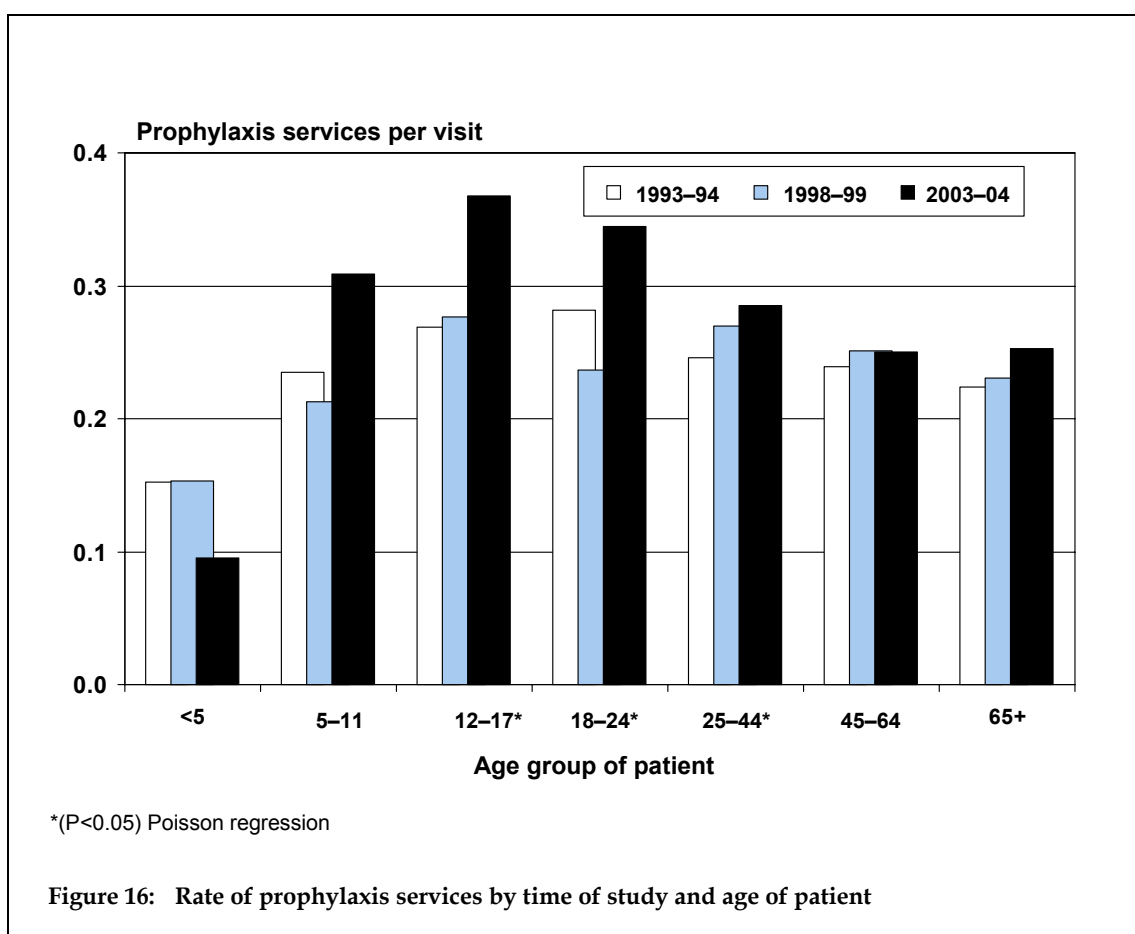
The rate of radiograph services per visit by time of study and age of patient is presented in Figure 15. The provision of radiograph services per visit peaked among patients aged 18–24 and 25–44 years at each time of the study. However, there was a pronounced increase in the rates of radiograph services per visit over time among adult patients aged 18–24 years and older, resulting in an age distribution of radiograph services per visit that had a greater peak among young to middle-aged adults in 2003–04 compared to 1993–94 and 1998–99. This could reflect concerns regarding caries development as well as increased prevalence of pulpal infection among young adults and maintenance of existing restorations leading to increased recall/maintenance care.



5.5 Preventive services

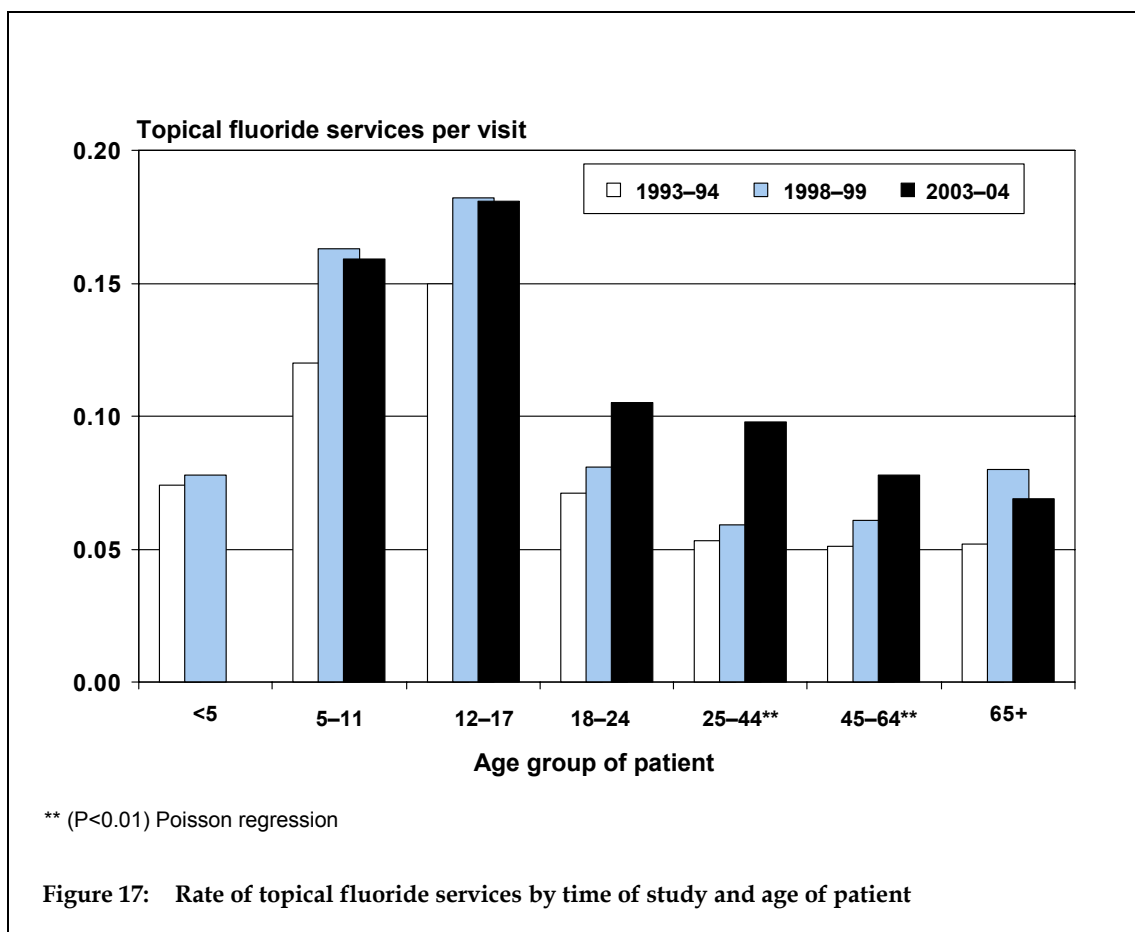
Prophylaxis

The rate of prophylaxis services per visit by time of study and age of patient is presented in Figure 16. Dental prophylaxis services comprise scale and clean services to remove plaque and calculus. Dental prophylaxis rates tended to peak among patients aged 12–17 and 18–24 years at each time of the study. Statistically significant differences in dental prophylaxis rates per visit were observed over time among patients who were aged between 12–17 and 25–44 years.



Topical fluoride

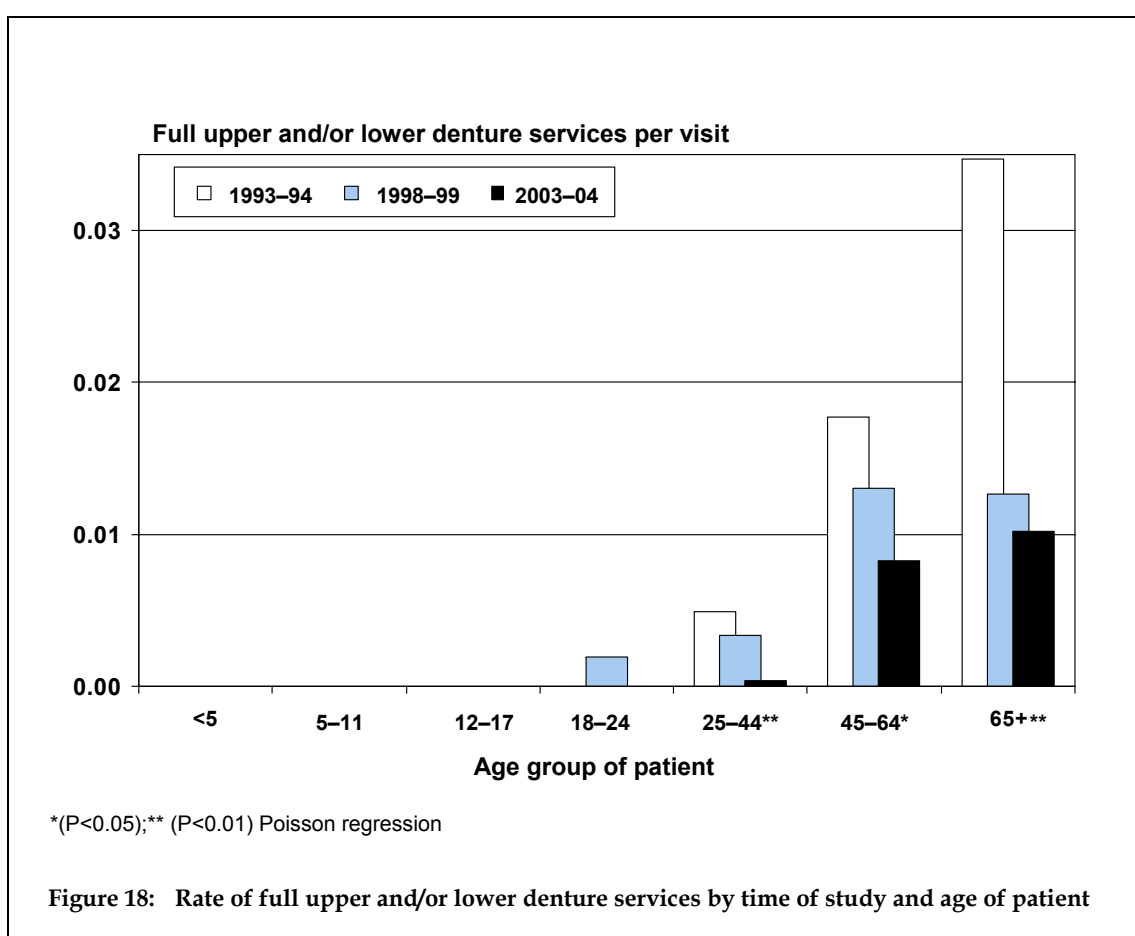
The rate of topical fluoride services per visit by time of study and age of patient is presented in Figure 17. Topical fluoride services comprise the application of fluoride solution or gel to the surfaces of the teeth. At each time of the study the rate of topical fluoride services per visit peaked among patients aged 12–17 years. Increased rates of topical fluoride services were observed among most age groups of patients, but these were only statistically significant among patients aged 25–44 and 45–64 years.



5.6 Denture services

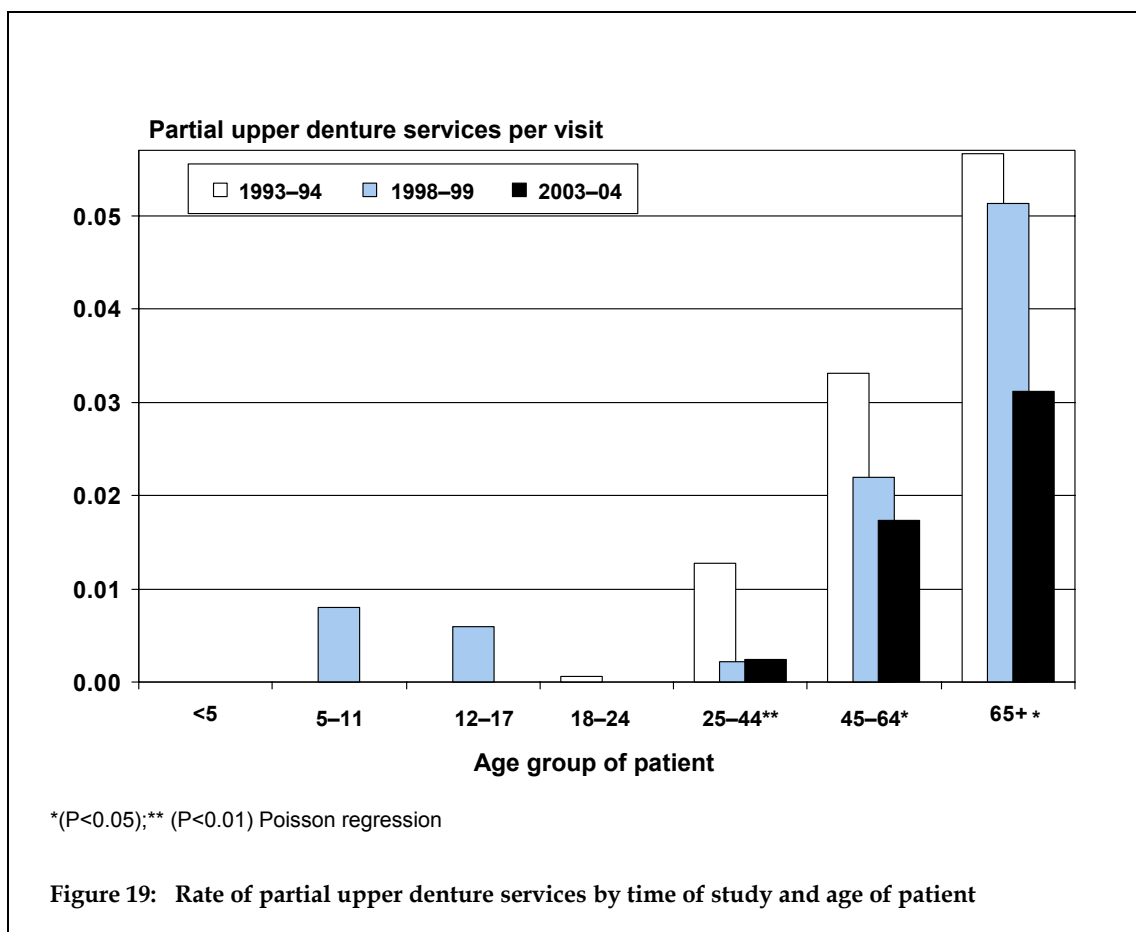
Full dentures

The rate of full upper and/or lower denture services per visit by time of study and age of patient is presented in Figure 18. In 1993–94 provision of full denture services increased across older age groups of patients to peak among those aged 65 years or more. While full denture services were also provided at higher rates among patients aged 45–64 years and 65 years or more in both 1998–99 and 2003–04, the variation by age of patient was less pronounced due to consistent decreases in rates of full denture services over time among patients aged 25–44 years, 45–64 years and 65 years or more.



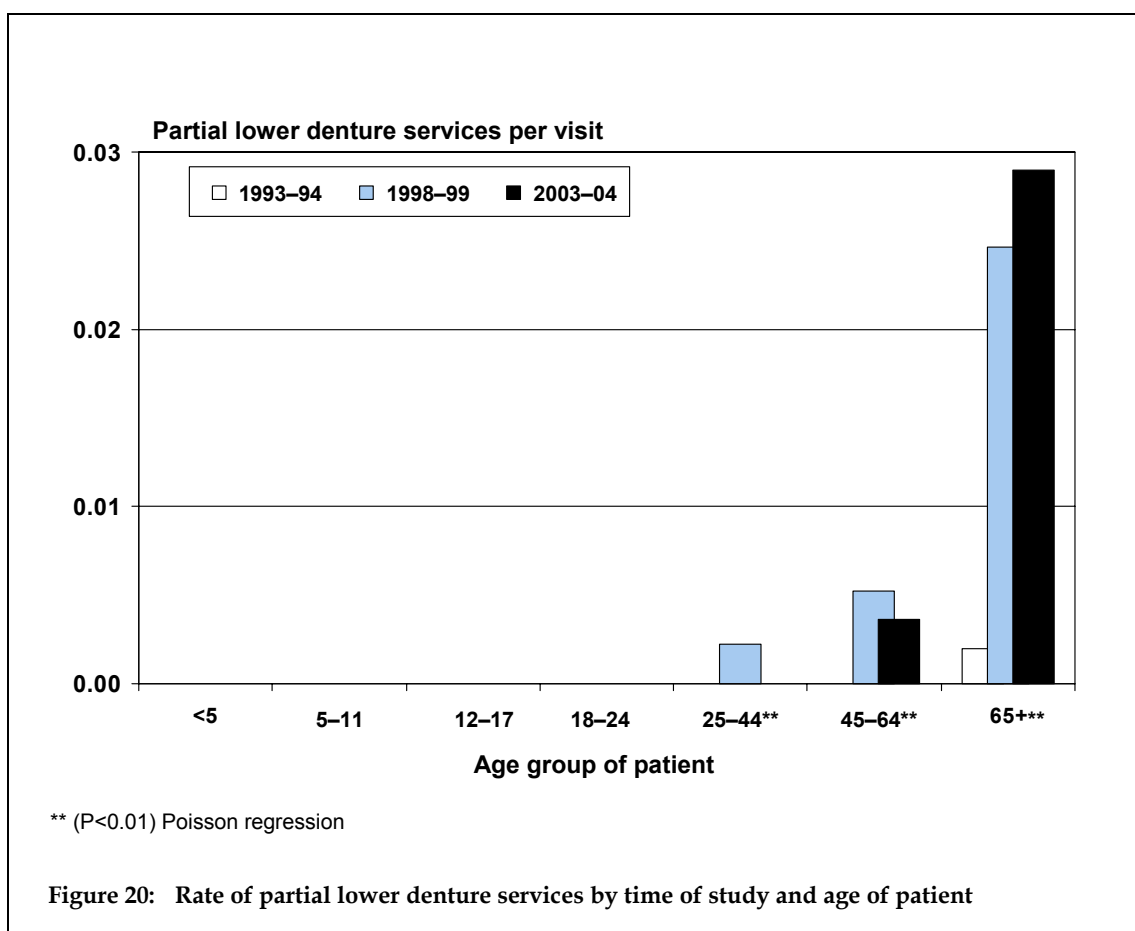
Partial upper dentures

The rate of partial upper denture services per visit by time of study and age of patient is presented in Figure 19. The pattern of provision of partial upper denture services by age of patient and variation over time was similar to that observed for provision of full dentures, with higher provision of partial upper denture services among older age groups of patients and decreases in provision of partial denture services over time observed among patients aged 25–44 years, 45–64 years and 65 years or more.



Partial lower dentures

The rate of partial lower denture services per visit by time of study and age of patient is presented in Figure 20. The provision of partial lower dentures was highest among older patients as observed for provision of full dentures and partial upper dentures. However, the change in provision of partial lower denture services over time among patients aged 65 years or more was in the opposite direction to that observed for provision of full dentures and partial upper dentures, with increased provision of partial lower dentures observed over time. While statistically significant differences were also observed for the provision of partial lower dentures among patients aged 25–44 and 45–64 years, there were no consistent trends over time.



6 Discussion

The background for dental service provision in Australia can be viewed as involving changes in the oral health status of the population, which tend to be improvements but there will also be increases in the pool of teeth at risk of oral disease. Parallel to these changes in oral health are demographic changes, which involve an increased pool of middle-aged to older adults, who through retaining more teeth as the level of edentulism declines will become the focus of dental needs and services.

6.1 Practice patterns

Previous reports have shown that service patterns are related to the age and sex of the patients (Bailit & Clive 1981; Spencer & Lewis 1988). However, there appear to be fewer gender-specific associations in dentistry compared to medicine, where biological differences operate and some health issues are seen as masculine and some as feminine, providing a source of differentiation (Bensing, Van den Brink-Muinen & De Bakker, 1993). There were few differences observed in service rates by sex of patient in the 1998–99 wave of the Longitudinal Study of Dentists' Practice Activity (Brennan & Spencer 2002). Other reports of dental service patterns in Australia have detected differences by sex of patient, but statistically significant differences have been few in number and less pronounced in size compared to those observed for age of patient (Brennan, Spencer & Szuster 1998).

The Australian population is ageing, with the proportion of older persons increasing and the growth rate of the older population projected to continue to increase into the future (AIHW 2002). In 2003–04 the age group 45–64 years comprised the highest percentage of patients, and increases were also observed for the percentage of patients aged 65 years or more. Changes in population demographics and oral health status associated with increases in the numbers of older dentate adults have been linked to an increased need for adult dental services (Douglass & Furino 1990). Use of services therefore may also increase as tooth loss declines (Shay 2004; Spencer & Lewis 1988), with changing demographics and technological advances leading to higher patient expectations and greater demand for oral health care (Douglass & Sheets 2000). The capacity to supply services will depend on how the prevailing population and disease trends interact with factors such as perceived needs and economic conditions, and the levels of effective demand (Furino & Douglass 1990).

With the shift towards adult patients there is increasing interest in trends among patients in the 45–64 years and 65 years or older age groups. Patients aged 45–64 years and 65 years or more reflected the overall trend towards increased insurance coverage between 1993–94 and 2003–04. The trends in insurance coverage among children and adolescents were mixed, but there were higher percentages of 18–24- and 25–44-year-old patients with insurance in 2003–04 compared to 1993–94. Visit factors related to service patterns include insurance status and reason for visit. Insurance has been positively related to use and mix of services, and to oral health (Bailit, Newhouse, Brook et al. 1985; Manning, Bailit, Benjamin & Newhouse 1985; Mueller & Monheit 1988). Service patterns have also been associated with reason for visit, with a less favourable service-mix in terms of preventive care and tooth retention associated with emergency visits after controlling for insurance status

(Brennan, Spencer & Szuster 1997). Children and adolescents showed no significant change in the percentages visiting for relief of pain. Patients aged 18–24 years showed an increase in the percentage visiting for relief of pain between 1993–94 and 2003–04, while 25–44-year-old patients showed a consistent decrease in the percentage visiting for relief of pain over the study period. For patients in both the 45–64 years and 65 years or more age groups the percentages of emergency visits for relief of pain were lower in 2003–04 compared to 1993–94, although the trend was not consistent for patients aged 65 years or more. Patients aged 65 years or more showed a decline in the percentage of relief of pain visits between 1993–94 and 1998–99, and while the percentage of relief of pain visits increased between 1998–99 and 2003–04 it did not reach the same percentage as that observed in 1993–94.

While the percentage of edentulous patients decreased over time for those who were aged 25–44 years, 45–64 years and 65+ years, this was most marked among patients aged 65 years or more, with 15.6% edentulous in 1993–94 and 4.7% in 2003–04. Reflecting the decline in tooth loss, the percentages of patients visiting for denture problems decreased from 10.8% in 1993–94 to 5.7% in 2003–04 for 45–64-year-olds, and from 30.3% to 15.8% among patients aged 65 years or more. There was a corresponding increase in the percentages of patients attending for recall/maintenance care between 1993–94 and 2003–04, from 15.8% to 18.7% among 45–64-year-olds and from 11.4% to 20.9% among patients aged 65 years or more. Patients aged 25–44 years also showed increased percentages of recall/maintenance care and decreased percentages of denture problems, as well as a decline in periodontal disease. There were few changes in main diagnoses among children and adolescents, but patients aged 18–24 years showed an increase in pulpal infection diagnoses over the study period.

6.2 Service provision trends

The number of diagnostic services per visit increased among patients aged 5–11 years, and 18–24 years through to 65 years or more, reflecting increased rates of examinations among the 25–44, 45–64 and 65 years or more age groups, and increased rates of radiograph services among patients aged 12–17 years and older. There were increased rates of preventive services per visit among patients aged 45–64 years, reflecting increased rates of topical fluoride services. The overall mix of services is expected to continue to shift toward diagnostic and preventive services (Eklund 1999). As oral health has improved with higher rates of tooth retention, the focus of preventive dentistry has widened to increasingly include older adults (Murray & Steele 2003). Rates of crown and bridge services per visit increased among patients aged 65 years or more. The total number of services per visit increased among patients aged 5–11 years and 18–24 years and older.

Changes in service patterns may reflect changes in oral health status translated into need for specific services. Such changes may have an impact upon productivity and could have led to an increase in length of appointment times. Possible explanations include increased numbers of older patients (Shuman, Loupe, Davidson et al. 1994), who may have complex treatment needs which require more services or take longer to complete. Historical records have indicated that average length of appointment time changed little over the period 1960–61 to 1974–75, but there has been an increase since 1974–75 which was quite marked across the 1977–78 to 1982–83 period (Barnard 1977; 1981; 1985; Spencer & Lewis 1986). Cross-infection control procedures may be

another possible source of influence on productivity associated with either increased appointment or changeover times. The operation of such effects on dentist productivity has implications for planning the delivery of dental services.

6.3 Conclusions

There are increasing numbers of older patients who are retaining their teeth, and these patients may have complex treatment needs that require more services and involve longer appointments in order to complete the treatment. These changes in oral health have resulted in decreased visits for dental problems and increased visits for recall/maintenance care among patients aged 45–64 years and 65 years or more. Such changes in oral health, demographics and use of services are expected to have an impact on the practice activity of dentists.

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Appendix A: Data tables

This section provides data tables for the service provision trends presented in Figures 1 to 20.

Table 20: Restorative services per visit by time of study and age of patient – dentate patients

Age of patient	Time of study					
	1993–94		1998–99		2003–04	
	Mean	S.E.	Mean	S.E.	Mean	S.E.
<5**	0.335	0.091	0.077	0.045	0.136	0.078
5–11	0.280	0.025	0.272	0.034	0.307	0.034
12–17	0.351	0.028	0.351	0.048	0.370	0.043
18–24	0.636	0.040	0.679	0.054	0.552	0.049
25–44*	0.744	0.020	0.731	0.027	0.669	0.023
45–64*	0.725	0.026	0.667	0.027	0.735	0.027
65+	0.642	0.040	0.577	0.043	0.641	0.043

*(P<0.05); **(P<0.01) Poisson regression

Table 21: Diagnostic services per visit by time of study and age of patient – dentate patients

Age of patient	Time of study					
	1993–94		1998–99		2003–04	
	Mean	S.E.	Mean	S.E.	Mean	S.E.
<5	0.825	0.041	0.971	0.054	0.966	0.056
5–11*	0.707	0.023	0.789	0.031	0.860	0.033
12–17	0.665	0.028	0.663	0.039	0.744	0.045
18–24**	0.750	0.031	0.721	0.040	1.064	0.058
25–44**	0.645	0.015	0.643	0.018	0.908	0.029
45–64**	0.518	0.016	0.582	0.020	0.708	0.023
65+**	0.458	0.024	0.564	0.034	0.671	0.034

*(P<0.05); **(P<0.01) Poisson regression

Table 22: Preventive services per visit by time of study and age of patient – dentate patients

Age of patient	Time of study					
	1993–94		1998–99		2003–04	
	Mean	S.E.	Mean	S.E.	Mean	S.E.
<5	0.250	0.054	0.239	0.088	0.095	0.046
5–11	0.534	0.038	0.521	0.058	0.652	0.052
12–17**	0.569	0.041	0.663	0.066	0.759	0.058
18–24**	0.389	0.025	0.369	0.040	0.561	0.047
25–44**	0.317	0.011	0.357	0.016	0.431	0.021
45–64**	0.308	0.013	0.328	0.016	0.379	0.021
65+	0.288	0.021	0.328	0.028	0.343	0.024

** (P<0.01) Poisson regression

Table 23: Denture services per visit by time of study and age of patient – dentate patients

Age of patient	Time of study					
	1993–94		1998–99		2003–04	
	Mean	S.E.	Mean	S.E.	Mean	S.E.
<5	—	—	—	—	—	—
5–11	0.008	0.004	0.005	0.004	—	—
12–17	—	—	0.008	0.005	—	—
18–24	0.002	0.002	0.002	0.002	0.001	0.002
25–44**	0.034	0.004	0.031	0.009	0.013	0.004
45–64	0.133	0.014	0.124	0.021	0.110	0.019
65+	0.300	0.035	0.322	0.052	0.257	0.052

**($P < 0.01$) Poisson regression

Table 24: Extraction services per visit by time of study and age of patient – dentate patients

Age of patient	Time of study					
	1993–94		1998–99		2003–04	
	Mean	S.E.	Mean	S.E.	Mean	S.E.
<5	0.017	0.017	—	—	—	—
5–11	0.086	0.015	0.088	0.023	0.086	0.018
12–17*	0.126	0.020	0.067	0.024	0.097	0.022
18–24	0.112	0.015	0.128	0.038	0.084	0.017
25–44*	0.080	0.006	0.092	0.009	0.066	0.007
45–64	0.082	0.008	0.069	0.008	0.064	0.007
65+	0.093	0.016	0.072	0.013	0.091	0.018

*($P < 0.05$) Poisson regression

Table 25: Endodontic services per visit by time of study and age of patient – dentate patients

Age of patient	Time of study					
	1993–94		1998–99		2003–04	
	Mean	S.E.	Mean	S.E.	Mean	S.E.
<5	0.015	0.012	0.021	0.021	—	—
5–11	0.029	0.007	0.028	0.012	0.035	0.010
12–17	0.065	0.019	0.039	0.020	0.045	0.012
18–24**	0.087	0.015	0.157	0.034	0.093	0.020
25–44**	0.149	0.010	0.204	0.017	0.138	0.013
45–64*	0.137	0.011	0.174	0.016	0.148	0.014
65+	0.084	0.014	0.075	0.015	0.096	0.016

*($P < 0.05$); **($P < 0.01$) Poisson regression

Table 26: Crown and bridge services per visit by time of study and age of patient – dentate patients

Age of patient	Time of study					
	1993–94		1998–99		2003–04	
	Mean	S.E.	Mean	S.E.	Mean	S.E.
<5	—	—	—	—	—	—
5–11	—	—	—	—	—	—
12–17	—	—	0.005	0.004	—	—
18–24	0.018	0.007	0.007	0.005	0.018	0.009
25–44*	0.067	0.007	0.081	0.011	0.057	0.007
45–64*	0.120	0.010	0.092	0.012	0.112	0.010
65+*	0.059	0.010	0.094	0.015	0.097	0.017

*(P<0.05) Poisson regression

Table 27: General/miscellaneous services per visit by time of study and age of patient – dentate patients

Age of patient	Time of study					
	1993–94		1998–99		2003–04	
	Mean	S.E.	Mean	S.E.	Mean	S.E.
<5	0.051	0.023	0.021	0.021	—	—
5–11	0.025	0.006	0.012	0.007	0.038	0.011
12–17	0.019	0.006	0.012	0.008	0.037	0.010
18–24*	0.068	0.013	0.026	0.008	0.062	0.017
25–44	0.052	0.004	0.046	0.006	0.044	0.005
45–64*	0.048	0.008	0.056	0.007	0.035	0.005
65+	0.030	0.007	0.027	0.008	0.029	0.007

*(P<0.05) Poisson regression

Table 28: Periodontic services per visit by time of study and age of patient – dentate patients

Age of patient	Time of study					
	1993–94		1998–99		2003–04	
	Mean	S.E.	Mean	S.E.	Mean	S.E.
<5	—	—	—	—	—	—
5–11	0.002	0.002	—	—	—	—
12–17	0.002	0.002	—	—	0.004	0.003
18–24	0.018	0.006	0.017	0.007	0.010	0.005
25–44	0.029	0.004	0.024	0.005	0.019	0.004
45–64	0.022	0.004	0.027	0.005	0.025	0.004
65+	0.012	0.004	0.020	0.007	0.016	0.005

Table 29: Orthodontic services per visit by time of study and age of patient – dentate patients

Age of patient	Time of study					
	1993–94		1998–99		2003–04	
	Mean	S.E.	Mean	S.E.	Mean	S.E.
<5	—	—	—	—	0.011	0.016
5–11**	0.074	0.011	0.026	0.010	0.032	0.013
12–17	0.147	0.014	0.172	0.022	0.126	0.026
18–24	0.015	0.005	0.018	0.009	0.016	0.007
25–44	0.003	0.001	0.006	0.002	0.002	0.001
45–64	—	—	0.002	0.001	—	—
65+	—	—	—	—	—	—

**($P < 0.01$) Poisson regression

Table 30: Total services per visit by time of study and age of patient – dentate patients

Age of patient	Time of study					
	1993–94		1998–99		2003–04	
	Mean	S.E.	Mean	S.E.	Mean	S.E.
<5	1.492	0.095	1.329	0.095	1.208	0.075
5–11	1.745	0.042	1.740	0.063	2.010	0.061
12–17	1.944	0.049	1.979	0.072	2.181	0.071
18–24**	2.095	0.046	2.124	0.074	2.462	0.081
25–44**	2.118	0.022	2.214	0.031	2.347	0.038
45–64**	2.093	0.031	2.121	0.039	2.315	0.040
65+**	1.967	0.051	2.079	0.067	2.240	0.072

**($P < 0.01$) Poisson regression

Restorative services

Table 31: Amalgam services per visit by time of study and age of patient – dentate patients

Age of patient	Time of study					
	1993–94		1998–99		2003–04	
	Mean	S.E.	Mean	S.E.	Mean	S.E.
<5*	0.128	0.045	0.020	0.020	0.011	0.016
5–11**	0.107	0.016	0.019	0.010	0.037	0.012
12–17**	0.167	0.020	0.096	0.024	0.041	0.014
18–24**	0.256	0.022	0.200	0.031	0.051	0.012
25–44**	0.337	0.012	0.221	0.013	0.104	0.009
45–64**	0.241	0.012	0.177	0.013	0.125	0.009
65+**	0.152	0.015	0.087	0.014	0.082	0.013

*(P<0.05); **(P<0.01) Poisson regression

Table 32: Composite resin services per visit by time of study and age of patient – dentate patients

Age of patient	Time of study					
	1993–94		1998–99		2003–04	
	Mean	S.E.	Mean	S.E.	Mean	S.E.
<5	0.023	0.031	—	—	—	—
5–11**	0.052	0.010	0.086	0.022	0.124	0.023
12–17**	0.138	0.017	0.220	0.039	0.281	0.037
18–24**	0.258	0.029	0.340	0.036	0.424	0.045
25–44**	0.194	0.010	0.302	0.018	0.424	0.018
45–64**	0.219	0.014	0.268	0.016	0.375	0.018
65+**	0.208	0.023	0.280	0.029	0.350	0.028

** (P<0.01) Poisson regression

Diagnostic services

Table 33: Examination services per visit by time of study and age of patient – dentate patients

Age of patient	Time of study					
	1993–94		1998–99		2003–04	
	Mean	S.E.	Mean	S.E.	Mean	S.E.
<5	0.801	0.041	0.917	0.041	0.918	0.043
5–11	0.631	0.020	0.711	0.029	0.727	0.025
12–17	0.520	0.020	0.531	0.030	0.547	0.028
18–24	0.512	0.019	0.485	0.027	0.545	0.027
25–44**	0.389	0.009	0.407	0.012	0.477	0.012
45–64*	0.334	0.010	0.369	0.013	0.386	0.012
65+*	0.332	0.017	0.385	0.022	0.415	0.020

*(P<0.05); **(P<0.01) Poisson regression

Table 34: Radiograph services per visit by time of study and age of patient – dentate patients

Age of patient	Time of study					
	1993–94		1998–99		2003–04	
	Mean	S.E.	Mean	S.E.	Mean	S.E.
<5	0.024	0.016	0.054	0.033	0.049	0.034
5–11	0.063	0.010	0.064	0.015	0.087	0.019
12–17*	0.118	0.014	0.109	0.019	0.182	0.032
18–24**	0.228	0.021	0.217	0.024	0.505	0.044
25–44**	0.235	0.009	0.221	0.011	0.395	0.018
45–64**	0.159	0.010	0.196	0.013	0.295	0.016
65+**	0.103	0.012	0.173	0.022	0.230	0.023

*(P<0.05); **(P<0.01) Poisson regression

Preventive services

Table 33: Prophylaxis services per visit by time of study and age of patient – dentate patients

Age of patient	Time of study					
	1993–94		1998–99		2003–04	
	Mean	S.E.	Mean	S.E.	Mean	S.E.
<5	0.152	0.037	0.153	0.053	0.095	0.046
5–11	0.235	0.017	0.212	0.025	0.309	0.025
12–17*	0.269	0.018	0.277	0.027	0.368	0.026
18–24*	0.282	0.017	0.237	0.023	0.345	0.026
25–44*	0.246	0.008	0.270	0.011	0.285	0.011
45–64	0.239	0.009	0.251	0.012	0.250	0.011
65+	0.224	0.016	0.231	0.019	0.253	0.017

*(P<0.05) Poisson regression

Table 34: Topical fluoride services per visit by time of study and age of patient – dentate patients

Age of patient	Time of study					
	1993–94		1998–99		2003–04	
	Mean	S.E.	Mean	S.E.	Mean	S.E.
<5	0.074	0.027	0.078	0.039	—	—
5–11	0.120	0.013	0.163	0.025	0.159	0.020
12–17	0.150	0.014	0.182	0.023	0.181	0.021
18–24	0.071	0.010	0.081	0.015	0.105	0.016
25–44**	0.053	0.004	0.059	0.006	0.098	0.007
45–64**	0.051	0.005	0.061	0.006	0.078	0.006
65+	0.052	0.008	0.080	0.012	0.069	0.010

*(P<0.05); **(P<0.01) Poisson regression

Denture services

Table 35: Full denture services per visit by time of study and age of patient – dentate patients

Age of patient	Time of study					
	1993–94		1998–99		2003–04	
	Mean	S.E.	Mean	S.E.	Mean	S.E.
<5	—	—	—	—	—	—
5–11	—	—	—	—	—	—
12–17	—	—	—	—	—	—
18–24	—	—	0.0019	0.0023	—	—
25–44**	0.0049	0.0016	0.0034	0.0016	0.0003	0.0004
45–64*	0.0177	0.0028	0.0131	0.0030	0.0083	0.0022
65+**	0.0347	0.0071	0.0127	0.0050	0.0102	0.0038

*(P<0.05); **(P<0.01) Poisson regression

Table 36: Partial upper denture services per visit by time of study and age of patient – dentate patients

Age of patient	Time of study					
	1993–94		1998–99		2003–04	
	Mean	S.E.	Mean	S.E.	Mean	S.E.
<5	—	—	—	—	—	—
5–11	0.0080	0.0037	—	—	—	—
12–17	—	—	0.0059	0.0046	—	—
18–24	0.0006	0.0009	—	—	—	—
25–44**	0.0127	0.0021	0.0022	0.0012	0.0024	0.0012
45–64*	0.0332	0.0042	0.0219	0.0041	0.0174	0.0031
65+*	0.0566	0.0095	0.0513	0.0099	0.0312	0.0071

*(P<0.05); **(P<0.01) Poisson regression

Table 37: Partial lower denture services per visit by time of study and age of patient – dentate patients

Age of patient	Time of study					
	1993–94		1998–99		2003–04	
	Mean	S.E.	Mean	S.E.	Mean	S.E.
<5	—	—	—	—	—	—
5–11	—	—	—	—	—	—
12–17	—	—	—	—	—	—
18–24	—	—	—	—	—	—
25–44**	—	—	0.0022	0.0012	—	—
45–64**	—	—	0.0053	0.0019	0.0064	0.0019
65+**	0.0020	0.0016	0.0246	0.0070	0.0290	0.0064

** (P<0.01) Poisson regression

Appendix B: Publications from the Longitudinal Study of Dentists' Practice Activity

Newsletters

AIHW Dental Statistics and Research Unit 1990. Newsletter. Vol. I (1), May 1990.

AIHW Dental Statistics and Research Unit 1991. Newsletter. Vol. II (1), May 1991.

AIHW Dental Statistics and Research Unit 1992. Newsletter. Vol. III (1), February 1992.

AIHW Dental Statistics and Research Unit 1994. Newsletter. Vol. V (1), May 1994.

AIHW Dental Statistics and Research Unit 1995. Newsletter. Vol. VI (1), July 1995.

AIHW Dental Statistics and Research Unit 1996. Newsletter. Vol. VII (1), August 1996.

AIHW Dental Statistics and Research Unit 1998. Newsletter. Vol. IX (1), September 1998.

Reports

Spencer AJ & Lewis JM 1986. Workforce participation and productivity of dentists in Australia. Melbourne: University of Melbourne.

AIHW Dental Statistics and Research Unit 1994. Dental services. In: Australia's health 1994, the fourth biennial report of the Australian Institute of Health and Welfare. Canberra: AGPS, 177-80.

AIHW Dental Statistics and Research Unit 1996. Trends in dental practice. In: Australia's health 1996, the fifth biennial report of the Australian Institute of Health and Welfare. Canberra: AGPS, 144-5.

AIHW Dental Statistics and Research Unit 1998. The Longitudinal Study of Dentists' Practice Activity. In: Australia's oral health and dental services. Adelaide: AIHW Dental Statistics and Research Unit, The University of Adelaide, 80-91.

AIHW Dental Statistics and Research Unit 2002. Trends in dental practice. In: Australia's health 2002: the eighth biennial health report of the Australian Institute of Health and Welfare. Canberra: AIHW, 315-6.

Brennan DS & Spencer AJ 2002. Dentists' practice activity in Australia: 1983-84 to 1998-99. Dental Statistics and Research Series No. 26. Canberra: Australian Institute of Health and Welfare.

Scientific journals

1983–84 wave

Spencer AJ & Lewis JM 1988. The practice of dentistry by male and female dentists. *Community Dentistry and Oral Epidemiology* 16: 202–7.

Spencer AJ & Lewis JM 1989. Service-mix in general dental practice in Australia. *Australian Dental Journal* 34: 69–74.

Spencer AJ & Lewis JM 1989. The provision of periodontal services in general dental practice in Australia. *Community Dental Health* 6: 337–47.

1988–89 wave

Brennan DS, Spencer AJ & Szuster FSP 1992. Differences in time devoted to work by male and female dentists. *British Dental Journal* 172: 348–9.

Spencer AJ, Brennan DS & Szuster FSP 1994. Trends in work effort among private general practitioners. *International Dental Journal* 44: 223–9.

Spencer AJ, Brennan DS & Szuster FSP 1994. Changing provision of restorative services in Australia. *Journal of Dentistry* 22: 136–40.

Spencer AJ, Szuster FSP & Brennan DS 1994. Service-mix provided to patients in Australian private practice. *Australian Dental Journal* 39: 316–20.

Brennan DS, Spencer AJ & Szuster FSP 1996. Dentist service rates and distribution of practice styles over time. *Community Dentistry and Oral Epidemiology* 24: 145–51.

1993–94 wave

Brennan DS, Spencer AJ & Szuster FSP 1996. Productivity among Australian private general dental practitioners across a ten year period. *International Dental Journal* 46: 139–45.

Brennan DS 1996. Geographic location and the provision of dental services in Australia. *Australian Health Review* 19: 138–40.

Brennan DS, Spencer AJ & Szuster FSP 1997. Insurance status and provision of dental services in Australian private general practice. *Community Dentistry and Oral Epidemiology* 25: 423–8.

Brennan DS, Spencer AJ & Szuster FSP 1998. Rates of dental service provision between capital city and non-capital locations. *Australian Journal of Rural Health* 6: 12–7.

Brennan DS, Spencer AJ & Szuster FSP 1998. Service provision trends between 1983–84 and 1993–94 in Australian private general practice. *Australian Dental Journal* 43: 331–6.

Brennan DS, Ryan P, Spencer AJ & Szuster FSP 2000. Dental service rates: age, period and cohort effects. *Community Dental Health* 17: 70–8.

Brennan DS, Spencer AJ & Szuster FSP 2000. Service patterns by main diagnoses and characteristics of patients. *Community Dentistry and Oral Epidemiology* 28: 225–33.

Brennan DS, Spencer AJ & Szuster FSP 2001. Provision of extractions by main diagnoses. *International Dental Journal* 51: 1–6.

1998–99 wave

Brennan DS, Spencer AJ, Kriven S & Szuster FSP 2001. The effect of mailing strategies and use of incentives on response rates to mailed surveys. *Australasian Journal of Market Research* 9: 1–10.

Brennan DS & Spencer AJ 2002. Practice activity trends among Australian private general dental practitioners: 1983–84 to 1998–99. *International Dental Journal* 52: 61–6.

Brennan DS & Spencer AJ 2003. Provision of diagnostic and preventive services in general dental practice. *Community Dental Health* 20: 5–10.

Brennan DS & Spencer AJ 2003. Diagnostic and preventive services trends: 1983–84 to 1998–99. *Australian Dental Journal* 48: 43–9.

Brennan DS & Spencer AJ 2003. Service provision trends among Australian private general dental practitioners: 1983–84 to 1998–99. *International Dental Journal* 53: 449–52.

Brennan DS & Spencer AJ 2003. Restorative service trends in private general practice in Australia: 1983 to 1999. *Journal of Dentistry* 31: 143–51.

Brennan DS & Spencer AJ 2003. Restorative service patterns in Australia: amalgam, composite resin and glass ionomer restorations. *International Dental Journal* 53: 455–63.

Mihailidis S & Spencer AJ. Econometric analysis of the private, general dental sector in Australia 1983–1998. *Australian Dental Journal* (submitted).

AIHW Dental Statistics and Research Series

1. *The Child Dental Health Survey, Australia 1989*
2. *The Child Dental Health Survey, Australia 1990*
3. *Inventory of dental public health data collections in Australia, 1980–1990*
4. *The Child Dental Health Survey, Australia 1991*
5. *The Child Dental Health Survey, Australia 1992*
6. *Dental practitioner statistics, Australia 1992*
7. *The Child Dental Health Survey, Australia 1993*
8. *Dental practitioner statistics, Australia 1993*
9. *The Child Dental Health Survey, Australia 1994*
10. *The Child Dental Health Survey, Australia 1995*
11. *Dental practitioner statistics, Australia 1994*
12. *Dental hygienist labourforce, Australia 1996*
13. *Dental therapist labourforce, Australia 1996*
14. *Population estimates, standard errors and hypothesis tests from the 1987/88 National Oral Health Survey of Australia*
15. *Adult access to dental care – migrants*
16. *Adult access to dental care – Indigenous Australians*
17. *Adult access to dental care – rural and remote dwellers*
18. *Australia's oral health and dental services*
19. *Aging and dental health*
20. *The Child Dental Health Survey, Australia 1996*
21. *The Child Dental Health Survey, Australia 1997*
22. *The Adelaide Dental Study of Nursing Homes 1998*
23. *The Adelaide Dental Study of Nursing Homes One-year Follow-up 1999*
24. *The Child Dental Health Survey, Australia 1998*
25. *Public perceptions of dentistry: stimulus or barrier to better oral health*
26. *Dentists' practice activity in Australia: 1983–84 to 1998–99*
27. *The Child Dental Health Survey, Australia 1999: trends across the 1990s*
28. *Dental labour force, Australia 2000*
29. *The oral health of older adults with dementia*
30. *Oral health trends among adult public dental patients*
31. *Dental health differences between boys and girls: The Child Dental Health Survey, Australia 2000*
32. *Practice activity patterns of dentists in Australia: trends over time by age and patients*
33. *Socioeconomic differences in children's dental health: The Child Dental Health Survey, Australia 2001*

Information on the above reports can be obtained from:

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