The Adelaide Dental Study of Nursing Homes

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ADA
AUSTRALIAN DENTAL ASSOCIATION
South Australian Branch Incorporated

One-year Follow-up 1999

JM Chalmers, KD Carter
CP Hodge, JM Fuss, AJ Spencer

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DSRU Staff:

Director:	Professor A John Spencer
Deputy Director:	Dr Kaye F Roberts-Thomson
Senior Research Fellow:	Dr David S Brennan
Research Fellow:	Dr Jane M Chalmers
Research Officers:	Mr Jason M Armfield
	Mr Knute D Carter
	Ms Kendall L Goldsmith
	Ms Liana Luzzi
	Mrs Judy F Stewart
	Ms Dana N Teusner
Research Associate:	Ms Kelly Jones
General Staff:	Mrs Leonie F Jeffery
	Mrs Lorna Lucas
	Mrs D Ruth Wass
Consultants:	Dr Peter Arrow *(Adelaide University)*
	Dr Mike Morgan *(University of Melbourne)*
	Dr Gary D Slade *(University of North Carolina)*

Any comments or information relevant to the subject matter of this report would be welcome. Correspondence should be directed to:

Dr Jane Chalmers
Research Fellow
AIHW Dental Statistics and Research Unit
Dental School
Adelaide University
SOUTH AUSTRALIA   5005

Tel: (08) 8303 4051
Fax: (08) 8303 4858
E-mail: aihw.dsru@adelaide.edu.au
Website: http://www.adelaide.edu.au/socprev-dent/dsru

Australian Institute of Health and Welfare

Board Chair
Professor Janice Reid

Director
Dr Richard Madden

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Dr Jane Chalmers

Research Fellow
AIHW Dental Statistics and Research Unit
Adelaide University

Mr Knute Carter

Research Officer
AIHW Dental Statistics and Research Unit
Adelaide University

Dr Chris Hodge

Australian Dental Association
South Australian Branch Incorporated

Dr Janet Fuss

Senior Lecturer
Dental School
Adelaide University

Professor A John Spencer

Director
AIHW Dental Statistics and Research Unit
Adelaide University

Suggested citation

Table of contents

List of tables

Acknowledgements

Explanatory note

At the commencement of this study in 1997, participants were sampled from aged care nursing homes. Residents in aged care hostels were not included. In 1997–98, nursing homes were amalgamated with aged care hostels and they are now known as 'aged care homes'.

1 Introduction

1.1 Background

Cross-sectional studies have shown Australian nursing home residents' oral health to be poor, with high levels of coronal and root caries, plaque accumulation and denture-related problems evident (Vowles et al. 1979; Walker 1984; Crack et al. 1980; Stockwell 1987; Homan et al. 1988; Chalmers et al. 1999). The majority of this cross-sectional research was conducted at a time when most residents were edentulous, and few had any natural teeth remaining. In the studies conducted during the 1970s and 1980s, edentulism rates ranged from 80–90% of residents (Vowles et al. 1979; Walker 1984). By the late 1990s, this had dropped to 66% (Chalmers 1999). Very little is known about the onset of oral diseases and how they progress in these medically compromised, functionally dependent, and cognitively impaired older adults. There has been no information published concerning the incidence of oral diseases in Australian nursing home residents. Furthermore, there has been little Australian and international research published concerning the relationship between residents' oral health status and their medical, cognitive, and functional health characteristics. Importantly, the dental profession has not had access to information concerning the oral health status of newly admitted residents, or resident turnover in nursing homes.

The Adelaide Dental Study of Nursing Homes was instigated by the Australian Dental Association (ADA) (SA Branch) and the AIHW Dental Statistics and Research Unit in 1997 to provide comprehensive information concerning the prevalence and incidence of oral diseases in those older South Australians who reside in nursing homes. There are nearly 7,000 nursing home residents in South Australia, with approximately 5,000 located in Adelaide (AIHW 1998). With the substantial changes to the Australian aged care system in recent years, the need to update and expand the information obtained in two previous cross-sectional investigations of South Australian nursing home residents was apparent (Vowles et al. 1979; Walker 1984). To improve the comprehensiveness and usefulness of the information available, the Adelaide Dental Study of Nursing Homes collected data, at baseline and one-year, concerning residents' medical, functional, cognitive, weight, chewing, social and financial status, as well as their general demographic and oral health data. Comprehensive background information concerning the Adelaide Dental Study of Nursing Homes was presented in the Baseline Data Collection Report (Chalmers et al. 1999). Data collected at one-year for the Adelaide Dental Study of Nursing Homes is presented in this report.

1.2 Aims of the study

The purpose of this longitudinal study, the Adelaide Dental Study of Nursing Homes, was to investigate the oral health status of a randomly selected sample of institutionalised older adults residing in nursing homes in Adelaide, South Australia.

The one-year study aimed to:

1. compare dental history characteristics, oral hygiene characteristics, demographic characteristics, cognitive status, medical status, functional status, nutritional status, dentate status, oral disease prevalence and experience, normative dental needs and perceived dental needs, of existing nursing home residents with residents who were new to the nursing home since the baseline dental inspections;

2. determine the one-year incidence and increments of coronal and root caries in existing residents of Adelaide nursing homes who participated in the baseline dental inspections;

3. identify medical status, functional status, cognitive status, nutritional status, and dental history characteristics that were associated with the one-year coronal and root caries increments in existing Adelaide nursing home residents.

1.3 Study components

This report presents the study methods, results and discussion for the one-year data collection for the Adelaide Dental Study of Nursing Homes, in which clinical dental inspections were conducted for:

*   existing residents who participated at baseline and were still residing at the same nursing home;

*   new residents who were admitted to the nursing home since the baseline dental inspections were conducted.

Conclusions are presented at the end of the report.

2 Methods

2.1 Ethical implications of the dental inspections

Approval for the study was obtained annually from The University of Adelaide Human Ethics Committee. An information summary of the study was given to all nursing home residents/guardians, and a consent form was completed and signed for each participant before the collection of questionnaire information, interview and dental inspection. Confidentiality was maintained in the field, and all paper and electronic documents securely stored using a 4-digit identification number for each participant. Where appropriate, carers deemed the 'person responsible' or 'guardian' for the participant signed the consent form. The Office of the Public Advocate of South A provided advice concerning the procedures to be followed to obtain consent from a third party.

To ensure that confidentiality was maintained for all nursing home residents, the Directors of Nursing of all nursing homes were contacted and approval was sought for participation of the nursing home in the one-year data collection before any personal contacts with residents and guardians were initiated. All initial contacts with residents/guardians were coordinated with assistance from the nursing and administration staff of each nursing home. Residents' personal information was only given to the researchers after the resident/guardian had agreed to the resident participating in the study.

The risks involved in the study's dental inspection were no greater than those associated with a standard dental examination. High quality equipment and procedures for oral inspections and cross-infection control were used in the study. Medical risks involved with periodontal probing were fully assessed and no probing was undertaken for at-risk participants. Written reports of the findings from the dental inspection were given to nursing home staff for placement into residents' records, and staff were advised of any treatment needs or problems. Any participant with a life-threatening or serious disorder was referred to the ADA-nominated dentist or the South Australian Dental Service for urgent management of their disorder. Other participants were assisted with referral to the most appropriate public dental clinic or to the ADA-nominated private dentist for any treatment required.

2.2 Timeline, study design, sample size and sampling

The Adelaide Dental Study of Nursing Homes was a longitudinal study with baseline data collected during 1998 and one-year follow-up data collected during 1999. Interviews, questionnaires and dental inspections were completed for participants at both baseline and one-year, using a staggered approach over an eight-month period among the participating nursing homes. After consent was obtained, interviewers conducted nursing home record audits and held discussions with nursing home staff, family members and residents to complete the questionnaires. The dental inspections were then conducted by a dentist and recorder. For the collection of one-year follow-up data in 1999, all participating baseline nursing homes were approached, and

all residents seen at baseline were again invited to participate. For ethical reasons, any residents new to the nursing home were also offered a dental inspection. Information was collected concerning any baseline participants who were no longer resident at the nursing home in 1999.

The study used a random sample of Adelaide nursing homes from the list provided by the Aged Care Division of the Commonwealth Department of Health and Family Services. The 114 Adelaide nursing homes listed with the Commonwealth were grouped by the number of beds (small–medium and large), and seven nursing facilities (five small–medium and two large) were randomly selected for participation in the study. The first seven nursing homes approached all agreed to participate in the one-year follow-up data collection for the study. The time and labour intensive approach needed for the study limited the number of nursing homes selected. All current residents of the seven nursing facilities were asked to participate in the one-year follow-up study.

The sampling strategy was based on previous studies conducted in Australia (Vowles et al. 1979; Walker 1984; Stockwell 1987), New Zealand (Thomson et al. 1992a, 1992b) and the US (Weyant et al. 1993). Sample size calculations also took into account the changing pattern of edentulism in older Australians (Carter 1997). Details of the sampling strategy were published in the Baseline Data Collection Report (Chalmers et al. 1999).

2.3 Measurement of variables, instruments of measurement and collection of data

To ensure that confidentiality was maintained for all nursing home residents, the Directors of Nursing of all participating nursing homes were contacted and approval was sought before any contacts with residents/guardians were initiated. All initial contacts with guardians were coordinated with the assistance of each nursing home, using a primary approach letter. One follow-up 'reminder' mailing was sent and/or a telephone call was made by the interviewer two weeks after the initial mailing. Each resident's personal information was only given to the researchers after the resident/guardian had agreed for the resident to participate in the study.

All questionnaire information was obtained from an audit of nursing home records, and from interviews held with the nursing home staff, family members and residents, prior to the dental inspection. The questionnaire used close-ended questions to collect information concerning the resident's oral hygiene practices and assistance required with oral hygiene, problems encountered providing oral care for the resident, time since, reason for, and treatment provided at last dental visit, location of the last dental visit, smoking and alcohol consumption, medical history, current prescription and over-the-counter medications, chewing abilities, and educational and economic status. Many of these interview questions were used in the South Australian Dental Longitudinal Study (SADLS) of older adults and all were used during the baseline data collection for this study. Assessment of functional status was conducted using the Katz (1963) Index of Activities of Daily Living (ADL) and the Lawton and Brody (1969) Instrumental Activities of Daily Living (IADL) scales. The ADL scale assesses the ability of residents to complete the following activities: bathing, dressing, toileting, transfer, continence and feeding. The IADL scale assesses residents' abilities to complete another set of more independent activities: use of the telephone, shopping,

transportation, medication responsibility, management of finances, and for females only, food preparation, housekeeping and laundry.

The National Institute for Dental Research (NIDR) (1987) protocol was used for the dental inspections in the study. The calibrated dentists examined subjects under standardised lighting conditions and used visual and tactile criteria to assess tooth status, coronal and root caries experience, tooth attrition, accumulation of debris/plaque, presence of gingivitis, loss of periodontal attachment (recession and probing depths), oral mucosal lesions and dental treatment needs. Tooth status was categorised as one of the following: present, sound, missing (replaced with fixed/removable appliance), missing (no space), missing (not replaced), crown, retained root (sound), or retained root (decayed). A retained root had only one-quarter or less of the crown remaining. Coronal caries data were recorded for five surfaces for molars and premolars, and four surfaces for canines and incisors. Four root surfaces were coded for each tooth. Surfaces of tooth crowns and roots were categorised as: sound, decayed, recurrent decay, filled, or filled unsatisfactory. For root surfaces, an additional category of 'not exposed' was available for surfaces with no gingival recession apical to the cemento-enamel junction (CEJ). For a root surface to be scored as sound, the root surface must have been visible. When a crown or root surface could not be physically or visually accessed, an 'excluded' category was scored. When a crown or root surface could not be accessed because of abundant deposits of debris, calculus and/or plaque, a 'plaque' category was scored.

If both the coronal and root surfaces were affected by caries or a restoration, it was necessary to determine the lesion's origin. If more than half of the lesion was above the CEJ, it was regarded as a coronal lesion only; if more than half of the lesion was below the CEJ it was regarded as a root surface lesion only. When scoring multiple surfaces on crowns or roots, the 'one-third rule' was used for restorations or carious lesions that were continuous over one or more of the mesial, buccal, distal or lingual surfaces. The restoration or lesion must have extended across at least one-third of the circumference of the surface. If a restoration or lesion extended across less than one-third of the circumference of both surfaces, the surface with the majority of the circumferential distance was selected. For restorations or lesions which extended beyond the occlusal surface (i.e. over the marginal ridge), the other surface(s) were always included. The normatively assessed tooth treatment needed was scored: number of surfaces (1–5, crown) requiring restoration, need for preventive treatment, extraction due to caries, extraction due to periodontal disease, or extraction for prosthetic reasons.

Tooth attrition was scored as one of four categories: *no attrition; enamel,* when the occlusal or incisal enamel was worn so that dentine was exposed; *dentine,* when the entire occlusal or incisal enamel was obliterated, leaving an enamel ring surrounding a central core of dentine; or *severe,* when the tooth had worn to the gingival margin (i.e. one-third of crown was present). The World Health Organization (WHO) (1987) 'Oral Health Surveys: Basic Methods' was used to assess oral mucosal lesions. Presence, condition and need for replacement of prosthetic appliances were assessed using the criteria developed by Rise (1979).

Presence or absence of plaque was scored using Silness and Loe (1964) criteria:

Score	Plaque Index Criteria
0	No plaque
1	A film of plaque adhering to the free gingival margin and adjacent area of the tooth. The plaque may be seen *in situ* only after application of disclosing solution or by using the probe on the tooth surface.
2	Moderate accumulation of soft deposits within the gingival pocket, or on the tooth and gingival margin which can be seen with the naked eye.
3	Abundance of soft matter within the gingival pocket and/or on the tooth and gingival margin.

Six buccal surfaces were assessed: the buccal surface of the most anterior molar in each quadrant; the buccal surface of 11; and the buccal surface of 31. Hence, the first molar was used or, in its absence, the second molar, or in the absence of both, the third molar. However, there was no substitution for either of the incisors. When an index tooth was not available (missing), the appropriate sextant was scored as 'X'.

Periodontal disease was assessed at three sites per tooth: mesiobuccal, buccal and distolingual. At each site, recession, probing depth, presence of calculus, and presence of bleeding after probing were scored, using an NIDR periodontal probe with colored graduations every 2 mm.

No radiographs were taken and no dental treatment was provided for participants. Residents were advised in writing that they should have a regular dental check-up in addition to the dental inspection provided by the study. The dental inspections were conducted by the calibrated dentists within two weeks of the interview. Duplicate dental inspections were conducted on 10% of the participants during the study to check for examiner reliability. The dental inspections were conducted over several weeks at each nursing home, so that specialised dental inspection procedures could be used. For participants with dementia and behaviourally 'difficult' residents, these procedures allowed for individual variation (Chalmers, 2000):

- dental inspections for an individual participant could be conducted over several sessions if required;

- dental inspections were conducted at times of the day suitable to the resident, any guardians wishing to attend and the nursing home staff;

- the presence of a caregiver was sought at clinical inspections to assist with communication;

- 'task-breakdown' strategies were used when conducting the inspections;

- specialised behavioural and communication strategies developed for adults with dementia were used (such as bridging, distraction, chaining, rescuing and hand-over-hand techniques); and

- the interview or inspection was attempted on three separate occasions for each resident, if the resident was absent or involved in another activity at the time when the clinical inspection/interview was to be conducted.

Following the completion of the dental inspection, a Mini Mental State Exam (MMSE) (Folstein et al. 1975) was conducted. If the subject had completed an MMSE test recently, those results were accepted. The dentist or recorder, having been trained by Dr Chalmers to administer the test, conducted the MMSE. The MMSE scores were categorised using the system developed by Mungas (1991). Those participants scoring 26 or higher (out of 30) were categorised as being within normal cognitive range, those scoring from 21 to 25 had mild dementia, those scoring from 11 to 20 had moderate dementia and those scoring 10 or less had severe dementia. In addition, an interviewer-based assessment of cognitive status was completed using the Global Deterioration Scale (GDS) (Reisberg et al. 1982). The GDS uses seven categories to characterise cognitive status, ranging from normal to late dementia.

2.4 Database maintenance and analysis of data

Maintenance of the participant database, epidemiological data collection and entry, and statistical analyses were conducted using SPSS for Windows (Versions 6.1 & 8.0). Univariate statistics were computed to describe:

- residents' participation rates;
- participants' demographic, medical and dental history characteristics, as well as their dentate status, cognitive status (MMSE and GDS scores), and functional status (IADL and ADL scores);
- participants' normative and perceived dental needs; and
- prevalence and experience of oral diseases and conditions (denture status, oral mucosal lesions, and attrition).

Where appropriate, tests of significance (Pearson's chi-square statistic or ANOVA with a post hoc Scheffe's test) were used to investigate differences in characteristics between those baseline participants who did and those who did not participate at one-year (including those deceased).

Where appropriate, tests of significance (Pearson's chi-square statistic, t-test, or ANOVA with a post hoc Scheffe's test) were used to investigate differences between existing and new residents in terms of their dentate status, cognitive status, functional status, demographic characteristics, medical status, weight change, diet type, chewing ability, dental history, and oral hygiene care characteristics.

In order to provide population estimates for the experience of oral diseases and conditions (tooth status, coronal and root caries, plaque accumulation, and loss of periodontal attachment), the data were weighted by size of nursing home.

Tests of significance were used to investigate differences in experience and increments of these weighted oral diseases and conditions in relation to existing and new residents' demographic characteristics, medical status, cognitive status (MMSE score), functional status (ADL score), weight change, diet type, and chewing ability. Analyses used weighted least squares regression, with a Tukey HSD post hoc test.

The incidence and increments of coronal and root caries (new decayed/filled surfaces—see Tables 39 and 40 for more detail) was analysed, using weighted data, for the dentate baseline participants who again participated at one-year. The crude caries

increment (CCI) was determined for each individual by calculating the number of surfaces with a caries increment, and then calculating the individual and group means. The net caries increment (NCI) was determined for each individual by subtracting the number of examiner reversals from the crude caries increment, and then calculating the individual and group means. The adjusted caries increment (ACI) was determined for each individual by multiplying the CCI by the complement of the number of examiner reversals divided by the baseline caries frequency (Beck et al. 1995). The formula for the ACI is as follows (Beck et al. 1995) (see Tables 39 and 40 for more detail):

ACI = CCI (1 − (Rev / (Rev + x)))

where x =   Decayed/Recurrent/Filled/Filled unsatisfactory (baseline) to Decayed/Recurrent/Filled/Filled unsatisfactory/Root sound (one-year)

Inter-examiner reliability was assessed throughout the study using the Kappa statistic and intra-class correlation analyses. All data collected remain the joint possession of the ADA (SA Branch) and the AIHW DSRU, and databases are securely stored, to maintain confidentiality for all subjects, by Dr Chalmers at the AIHW DSRU.

3   Participation rates

The seven nursing homes participating at baseline again agreed to participate in the one-year follow-up study. Table 1 presents the participation rates for the seven individual nursing homes. Participation varied between nursing homes for both existing residents examined at baseline and new residents.

For existing residents, the participation rates were very high (over 80%) in all but two nursing homes. These two nursing homes included the largest nursing home with over 140 residents, and one small nursing home with fewer than 35 residents. In these two nursing homes, the great majority of residents not participating at one-year had changed consent type from self-consent (at baseline) to guardian consent (at one-year). The guardians for these residents either did not respond to the consent mailout or replied that they did not want the resident to participate because of their age or advancing dementia. As was evident at baseline, the participation rates varied greatly across nursing homes, ranging from 48% to 86%. Again, the largest nursing home had one of the lowest participation rates.

Many of the existing and new residents who had consented to participate died before the scheduled dental inspections were completed at one-year. The percentage of baseline participants who had died before the one-year data collection ranged from 17% to 43% across the nursing homes. Even with new residents, up to one-quarter had died between the time consent was obtained and completion of the dental inspections. Overall, 154 existing residents/guardians and 124 new residents/guardians were approached to participate at one-year, and dental inspections were completed for 111 existing and 75 new residents (total dental inspections = 186). When the distribution of sex and consent characteristics of new participants was compared with that of the new non-participants, no significant differences were found.

Table 1: Participation rates for existing and new residents of individual nursing homes

	Nursing home							Total
	1	**2**	**3**	**4**	**5**	**6**	**7**	**Total**
Number of residents								
Existing	34	21	18	90	21	28	13	225
New	18	13	4	69	21	19	9	153
Not included (deceased, ill, hospitalised)								
Existing	8	7	3	31	9	7	5	70
New	5	1	1	8	5	5	2	27
Not included (discharged before dental inspection)								
Existing	0	0	0	0	0	1	0	1
New	0	0	0	2	0	0	0	2
Total included								
Existing	**26**	**14**	**15**	**59**	**12**	**20**	**8**	**154**
New	**13**	**12**	**3**	**59**	**16**	**14**	**7**	**124**
No response								
Existing	1	0	1	17	2	0	0	21
New	1	2	1	11	4	1	1	21
Non-participants								
Existing	4	1	0	12	3	1	1	22
New	2	2	0	20	2	2	0	28
Participants								
Existing	21	13	14	30	7	19	7	111
New	10	8	2	28	10	11	6	75
Participation rate %								
Existing	**81**	**93**	**93**	**51**	**58**	**95**	**88**	**72**
New	**77**	**67**	**67**	**48**	**63**	**79**	**86**	**61**

Table 2 presents a comparison of the baseline participants' characteristics by their participation status at one-year. There were few significant differences between those baseline participants who were deceased, those who did not participate, and those who did participate. However, analyses did reveal that those baseline participants who did not participate at one-year had significantly lower MMSE scores (mean=5.9) compared with those who did participate (mean=11.4), and those who had died (mean=7.5) (sig. p<0.05). Very few of the baseline participants who did not participate at one-year had normal cognitive testing scores on the MMSE; a significantly higher percentage had scores in the severe impairment range. By comparison, approximately one-eighth of baseline participants who again participated at one-year had MMSE in the normal range (sig. p<0.05). Those dentate baseline participants who did not participate at one-year had significantly higher Plaque Index scores than did those who again participated at one-year. Those dentate baseline participants who did not participate at one-year took significantly fewer medications than did those who were deceased at one-year. Similar percentages of residents gave self-consent and required guardian consent across all three baseline groups.

Table 2: Characteristics of baseline participants by their participation status at one-year (n=224)

| | Baseline participants—participation at one-year | | | |
| | Deceased | No | Yes | All |
Characteristics of baseline participants	n=70	n=43	n=111	n=224
Female (%)	62.9	61.9	73.2	67.9
Age (mean)	82.3	83.1	83.6	83.2
Number of chronic medical conditions (mean)	5.1	4.9	5.0	5.0
Total number of medications (mean)*	8.2	6.5	7.3	7.4
ADL score (number dependent activities) (mean, max=6)	5.0	5.0	5.0	5.0
Time since last dental visit (months) (mean)	70.1	71.3	63.6	66.9
Number of food types can eat (mean, max=5)	2.2	2.2	2.5	2.3
Number of reported problems with oral hygiene (mean)	1.8	1.0	1.6	1.5
MMSE score (mean)**	7.5	5.9	11.4	9.1
MMSE score (%) #				
≤10 (severe dementia)	65.6	71.1	49.5	58.7
26–30 (normal)	9.4	2.6	12.1	9.5
Plaque Index score (mean)*** (n=63 dentate)	1.9	2.4	1.7	1.8
Edentulous rate (%)	72.9	64.3	62.5	66.1
Consent type (%)				
Guardian	67.1	69.0	67.0	67.4
Self	32.9	31.0	33.0	32.6
Private health insurance (%)	28.6	14.3	26.8	25.0
Card type (%)				
Pension	74.3	88.1	73.2	76.3
Department of Veterans' Affairs	11.4	9.5	15.2	12.9

* ANOVA sig. p<0.05 (Scheffe's test: deceased and no categories different)
** ANOVA sig. p<0.05 (Scheffe's test: yes and deceased/no categories different)
*** ANOVA sig. p<0.05 (Scheffe's test: yes and no categories different)
\# chi-square test sig. p<0.05

4 Results

4.1 Comparison of existing and new nursing home residents

Dentate status and related characteristics

Tables 3–5 present existing and new participants' dentate status—maxilla by mandible. In Table 3 it can be seen that 64% of existing participants were edentulous in both the maxilla and the mandible. Fifteen per cent of existing residents were edentulous in one arch only and dentate in the other arch. More were edentulous in the maxilla (78.4%) than in the mandible (64.9%). Twenty-one per cent were dentate in both arches.

Table 3: Dentate status of existing residents—maxilla by mandible (n=111)

	Dentate status mandible (%)		
	Dentate	Edentulous	Total
Dentate status maxilla			
Dentate	20.7	0.9	21.6
Edentulous	14.4	64.0	78.4
Total	**35.1**	**64.9**	**100.0**

In Table 4 it can be seen that 63% of new participants were edentulous in both the maxilla and the mandible. Nineteen per cent of new residents were edentulous in one arch only and dentate in the other arch. More were edentulous in the maxilla (80.1%) than in the mandible (64.0%). Nineteen per cent were dentate in both arches.

Table 4: Dentate status of new residents—maxilla by mandible (n=75)

	Dentate status mandible (%)		
	Dentate	Edentulous	Total
Dentate status maxilla			
Dentate	18.7	1.3	20.0
Edentulous	17.3	62.7	80.1
Total	**36.0**	**64.0**	**100.0**

Table 5 presents results for all one-year participants. Sixty-three per cent of all participants were edentulous in both the maxilla and the mandible. Seventeen per cent of all residents were edentulous in one arch only and dentate in the other arch. More were edentulous in the maxilla (79.0%) than in the mandible (64.5%). Twenty per cent were dentate in both arches.

Table 5: Dentate status of all residents—maxilla by mandible (n=186)

	Dentate status mandible (%)		
	Dentate	Edentulous	Total
Dentate status maxilla			
Dentate	19.9	1.1	21.0
Edentulous	15.6	63.4	79.0
Total	**35.5**	**64.5**	**100.0**

Tables 6–9 present various resident characteristics by dentate status. In Table 6, existing and new residents' demographic and medical characteristics are presented by dentate status. The majority of nursing home residents were females: 62% of dentate and 68.7% of edentulous participants were female. However, among new dentate residents, there was a higher percentage of males, with 50% of new dentate residents being male. The age distribution of residents who participated was similar for both dentate and edentulous residents, with the majority aged 75–94 years (mean=83.2 years, SE=0.7). Existing residents were significantly older (mean=84.9, SE=0.8) than new residents (mean=80.7, SE=1.1) (t-test, sig. $p<0.01$). Newer dentate residents were significantly younger than existing dentate residents; 30% were aged ≤74 years, compared with 10% of existing dentate residents (chi-square test, sig. $p<0.05$).

The great majority of participants in this study were medically compromised, with over 90% having three or more chronic medical conditions and over 95% taking three or more medications. The distribution of number of chronic medical conditions was similar for both dentate and edentulous participants, with approximately 50–60% having 5–8 chronic medical conditions (mean=5.8 chronic medical conditions, SE=0.2). There were no significant differences between existing and new residents' number of chronic medical conditions. The distribution of number of medications taken was again similar for both dentate and edentulous groups, with more than 80% taking 5+ medications (mean=8.6 medications, SE=0.3). Existing residents took a significantly higher number of medications (mean=9.1, SE=0.4) than did new residents (mean=7.9, SE=0.4) (t-test, sig. $p<0.01$). All medications, both prescription and over-the-counter (OTC) types, were entered into the nursing home medication records by a medical practitioner. A breakdown of medication types indicated that most required a prescription.

A very high percentage of residents participating in this study were cognitively impaired. From residents' medical histories in the nursing home records, just over 65% had a diagnosed dementia. Use of the Mini Mental State Exam (MMSE) further revealed that 77% of participants had an MMSE score indicative of moderate–severe dementia and another 15% had scores indicative of mild dementia. Mean MMSE score was 10.6 (SE=0.8). The distribution of MMSE scores did not significantly differ by dentate status, nor did it differ between existing and new residents. Mean MMSE score for existing participants was 10.7 (SE=1.1), and mean MMSE score for new participants was 10.4 (SE=1.3). Only 14.7% of dentate and 8.1% of edentulous participants had MMSE scores in the normal cognitive range of 26–30. Cognitive status was also assessed at one-year by the examiner using the Global Deterioration Scale (GDS) (Reisberg et al. 1982). The distribution of GDS scores did not significantly differ between existing and new, or between dentate and edentulous participants. The percentages of residents with GDS scores indicative of severe dementia (categories 6 and 7) were similar to those with MMSE scores in the severe category (≤10).

The functional status of participants was assessed using the Instrumental Activities of Daily Living (IADL) (Lawton & Brody 1969) and Activities of Daily Living (ADL) (Katz et al. 1963) scales. The IADL scale scores the number of activities that a resident can perform independently. All but 1.7% of edentulous and 2.8% of dentate participants were only able to perform 0 or 1 independent activities. These percentages did not differ significantly between existing and new residents. No residents scored 4–8 IADL activities. The ADL scale scores the number of activities that the resident is dependent upon others for. There was a range of ADL scores among participants, with 50% dependent for all 6 ADLs and less than 3% being dependent for only 0–2 ADLs.

The remaining residents were dependent for 3–5 ADLs (mean=5.2 ADLs, SE=0.1). The pattern of ADL scores did not vary significantly by dentate status, nor for existing compared with new residents. As nearly all participants were able to perform only one or no IADLs, the ADL scores were used as the functional status measure in further analyses.

When the prevalence of individual chronic medical conditions was analysed, dementia was the most prevalent (65%), followed by stroke (35%) and arthritis (30%). Other prevalent medical conditions included high blood pressure, heart disease, depression, cancer, osteoporosis, hip fracture, Parkinson's disease, and diabetes. The only chronic medical conditions that were significantly more prevalent in dentate existing versus dentate new residents, were arthritis and osteoporosis (chi-square test, sig. p<0.05). The only chronic medical condition that was significantly more frequent in edentulous existing versus edentulous new residents, was cancer (chi-square test, sig. p<0.05).

The percentage of residents who were currently smoking was low, and did not vary by dentate status, nor between existing and new residents. Alcohol consumption was significantly lower for new dentate and edentulous residents (chi-square test, sig. p<0.05).

Time since the resident was admitted to the nursing home was calculated in months, using the date of admission and the date of the dental inspection. There were no significant differences in time since admission between dentate and edentulous existing residents, nor between dentate and edentulous new residents. All new residents were admitted between 1 and 13 months before the one-year dental inspections (mean=7.3 months, SE=0.4). Just under 15% of dentate and edentulous existing residents were admitted less than 24 months prior to the dental inspection. Another approximately 34% were admitted between 24 and 48 months and the remaining 52% more than four years prior to the dental inspection.

Information concerning residents' highest level of education was not available for 40% of participants. This information was not routinely collected in the nursing home records. Few residents had attended trade school or university.

Government card holder status was obtained from nursing home records. Approximately three-quarters of both dentate and edentulous residents held a Pensioner Concession Card. Approximately 10% of new and 17% of existing residents held a Department of Veterans' Affairs Card. Nursing home records also supplied information concerning residents' private health insurance status. General health insurance status only was available; no information was available concerning 'extras' health insurance cover, which often includes dental care. More dentate residents held private health insurance (36%) than did edentulous residents (20%). Health insurance status did not differ significantly between existing and new residents.

Table 6: Demographic and medical characteristics by dentate status for existing, new and all residents (%)

	Dentate			Edentulous		
	Existing *n=41*	**New** *n=30*	**All** *n=71*	**Existing** *n=70*	**New** *n=45*	**All** *n=115*
Sex						
Male	29.3	50.0	38.0	27.1	37.8	31.3
Female	70.7	50.0	62.0	72.9	62.2	68.7
Age group						
≤64 years	4.9	*13.3	8.5	1.4	2.2	1.7
65–74 years	4.9	16.7	9.9	8.6	6.7	7.8
75–84 years	34.1	46.7	39.4	34.3	42.2	37.4
85–94 years	48.8	23.3	38.0	48.6	46.7	47.8
95+ years	7.3	0.0	4.2	7.1	2.2	5.2
Number of chronic medical conditions						
1–2	2.4	10.0	5.6	2.9	6.7	4.3
3–4	31.7	36.7	33.8	24.3	13.3	20.0
5–6	31.7	33.3	32.4	38.6	33.3	36.5
7–8	19.5	10.0	15.5	20.0	22.2	20.9
9+	14.6	10.0	12.7	14.3	24.4	18.3
Total number of medications						
1–2	4.9	6.7	5.6	1.4	4.4	2.6
3–4	2.4	10.0	5.6	11.4	2.2	7.8
5–6	19.5	20.0	19.7	15.7	24.4	19.1
7–8	29.3	23.3	26.8	15.7	28.9	20.9
9–12	34.1	36.7	35.2	31.4	22.2	27.8
13+	9.8	3.3	7.0	24.3	17.8	21.7
MMSE score						
≤10 (severe dementia)	57.9	53.3	55.9	46.8	56.8	50.5
11–20 (moderate dementia)	18.4	26.7	22.1	29.0	24.3	27.3
21–25 (mild dementia)	10.5	3.3	7.4	16.1	10.8	14.1
26–30 (normal)	13.2	16.7	14.7	8.1	8.1	8.1
GDS score						
1 (normal)	12.2	16.7	14.1	14.3	15.6	14.8
2	4.9	3.3	4.2	1.4	6.7	9.6
3	2.4	6.7	4.2	4.3	2.2	3.5
4	7.3	10.0	8.5	1.4	6.7	3.5
5	14.6	13.3	14.1	17.1	11.1	14.8
6	17.1	13.3	15.5	20.0	31.1	24.3
7 (very severe dementia)	41.5	36.7	39.4	31.4	26.7	29.6
IADL score (number of independent activities)						
0	85.4	90.0	87.3	81.4	84.4	82.6
1	9.8	10.0	9.9	15.7	15.6	15.7
2	2.4	0.0	1.4	2.9	0.0	1.7
3	2.4	0.0	1.4	0.0	0.0	0.0
4–8	0.0	0.0	0.0	0.0	0.0	0.0
ADL score (number of dependent activities)						
0–2	2.4	0.0	1.4	4.3	0.0	2.6
3	7.3	13.3	9.9	4.3	13.3	7.8
4	4.9	10.0	7.0	7.1	8.9	7.8
5	29.3	36.7	32.4	35.7	24.4	31.3
6	56.1	40.0	49.3	48.6	53.3	50.4

* chi-square test sig. p<0.05 between existing and new participants *(continued)*

Table 6 (continued): Demographic and medical characteristics by dentate status for existing, new and all residents (%)

	Dentate status and resident type					
	Dentate			Edentulous		
	Existing *n=41*	**New** *n=30*	**All** *n=71*	**Existing** *n=70*	**New** *n=45*	**All** *n=115*
A diagnosed dementia	63.4	66.7	64.8	65.7	71.1	67.8
A diagnosed depression	19.5	30.0	23.9	24.3	22.2	23.5
Diagnosed Parkinson's disease	9.8	20.0	14.1	4.3	6.7	5.2
History of stroke	39.0	26.7	33.8	48.6	31.1	41.7
History of high blood pressure	29.3	33.3	31.0	27.1	24.4	26.1
History of heart condition/s	36.6	23.3	31.0	41.4	46.7	43.5
History of diabetes	12.2	6.7	9.9	14.3	11.1	13.0
History of arthritis	43.9	*10.0	29.6	38.6	35.6	37.4
History of osteoporosis	24.4	*6.7	16.9	8.6	13.3	10.4
History of hip fracture	19.5	10.0	15.5	17.1	15.6	16.5
History of cancer	19.5	10.0	15.5	12.9	*28.9	19.1
Currently smoking	4.9	0.0	2.8	5.7	0.0	3.5
Currently drink alcohol	29.3	*6.7	19.7	14.3	*2.2	9.6
Time since admitted						
<12 months	0.0	56.7	23.9	0.0	66.7	26.1
13–24 months	14.6	43.3	25.4	14.3	33.3	20.0
25–36 months	17.1	0.0	11.3	32.9	0.0	20.0
37–48 months	17.1	0.0	9.9	17.1	0.0	10.4
49–60 months	14.6	0.0	8.5	11.4	0.0	7.8
61–120 months	26.8	0.0	15.5	21.4	0.0	13.9
121+ months	9.8	0.0	5.6	2.9	0.0	1.7
Highest educational level						
Primary school	22.0	26.7	23.9	48.6	33.3	42.6
High school	26.8	30.0	28.2	18.6	8.9	14.8
Trade school	4.9	3.3	4.2	4.3	2.2	3.5
University	7.3	0.0	4.2	1.4	0.0	0.9
Don't know	39.0	40.0	39.4	29.1	55.6	38.3
Card status						
Pensioner Concession Card	75.6	63.3	70.4	75.7	88.9	80.0
Veterans' Affairs Card	17.1	10.0	14.1	17.1	11.1	14.8
No cards	7.3	23.3	14.1	5.7	0.0	3.5
Private Health Insurance	36.6	36.7	36.6	21.4	17.8	20.0

* chi-square test sig. p<0.05 between existing and new participants

Table 7 presents existing and new residents' weight change and chewing ability by dentate status. Weight change was measured as the percentage of body weight change per month. Edentulous residents lost more percentage body weight than did dentate residents. The majority of existing and new, dentate and edentulous residents could chew 2–3 of the foods asked about—boiled vegetables, hamburger, meat, carrot, apple (mean=2.5 foods, SE=0.9). Edentulous residents could chew fewer foods than could dentate residents. Most dentate and edentulous residents were able to chew boiled vegetables and hamburger. However, very few edentulous participants could chew harder foods (carrot, apple). An additional question was added at one-year concerning the resident's type of diet. Approximately 50% of edentulous and dentate residents ate a soft/vitamised diet. There were no significant differences for type of diet between existing and new residents.

Table 7: Weight change and chewing ability by dentate status for existing, new and all residents (%)

	Dentate status and resident type					
	Dentate			**Edentulous**		
	Existing	**New**	**All**	**Existing**	**New**	**All**
	n=41	*n=30*	*n=71*	*n=70*	*n=45*	*n=115*
Weight change (% body weight change per month)[†]						
Loss of more than 0.5%	18.4	29.6	23.1	18.2	48.7	29.5
Loss of up to 0.5%	36.8	18.5	29.2	37.9	15.4	29.5
Gain of 0.0–0.5%	21.1	18.5	20.0	30.3	15.4	24.8
Gain of more than 0.5%	23.7	33.3	27.7	13.6	20.5	16.2
Able to chew						
Boiled vegetables	97.6	96.7	97.2	91.4	93.3	92.2
Hamburger	92.7	96.7	94.4	82.9	84.4	83.5
Firm meat	43.9	56.7	49.3	31.4	42.2	35.7
Piece of fresh carrot	22.0	13.3	18.3	12.9	6.7	10.4
Piece of fresh apple	22.0	16.7	19.7	8.6	6.7	7.8
Number of foods can chew						
0	2.4	3.3	2.8	8.6	6.7	7.8
1	4.9	0.0	2.8	7.1	6.7	7.0
2	46.3	36.7	42.3	52.9	42.2	48.7
3	22.0	40.0	29.6	18.6	40.0	27.0
4	7.3	13.3	9.9	5.7	0.0	3.5
5	17.1	6.7	12.7	7.1	4.4	6.1
Have a soft/vitamised diet	56.1	40.0	49.3	55.7	48.9	53.0

†   Subjects who could not be weighed or who were new admissions and only had one weight recorded are not included in this table.

Note: chi-square test; no significant differences between existing and new participants.

Table 8 presents existing and new residents' dental history by dentate status. To obtain information concerning residents' dental history, residents and their nursing home carers were interviewed and nursing records were consulted. Thirteen per cent of dentate and 21% of edentulous residents had dental pain or discomfort at the time of the dental inspection. Perceived dental pain or discomfort did not significantly differ between existing and new residents. Perceived need for dental treatment was low: 16% of dentate and 17% of edentulous participants indicated a need for dental treatment. Perceived treatment need did not significantly differ between existing and new residents. Participants were attending the dentist mainly for a dental problem rather than for a regular check-up. More edentulous participants attended for a problem (87.8%) than did dentate participants (67.6%). There were no significant differences between existing and new, or between dentate and edentulous participants in terms of the above aspects of dental history.

Reason for and location of last dental visit was determined primarily from nursing home records, but was also discussed with residents and nursing home carers. For approximately one-third of residents, there was no notation in their records of a dental visit. Often carers could not remember a dental visit occurring since the resident had been admitted to the nursing home. Dentate residents had visited the dentist more recently than had edentulous residents; 60.9% of dentate and 43.7% of edentulous participants had visited within the 12 months prior to the dental inspection. Another 13% of dentate and edentulous participants had visited 1–2 years prior to the dental inspection; 15% of edentulous participants had last visited a dentist more than 10 years previously. In addition to those residents with no record of a dental visit, there was no record of treatment provided at the last visit for up to another third of residents.

For those residents who had visited in the previous 12 months, edentulous residents last attended for new dentures and denture adjustments. Dentate residents last attended for a range of procedures. The highest percentage attended for a check-up and approximately 10% for each of the following: cleaning, an extraction, a denture adjustment or new dentures. There were no significant differences in the reason for last visit between existing and new residents. The majority of last dental visits for both dentate and edentulous residents took place at the nursing home rather than at a dental clinic for those who had visited in the previous 12 months. The exception was new dentate residents: equal numbers of those had visited a dental clinic (chi-square test, sig. $p < 0.05$).

For those residents who had visited more than 12 months ago, edentulous residents last attended for new dentures and denture adjustments. Dentate residents last attended for a range of procedures. The highest percentage attended for a check-up, new dentures or extractions. There were no significant differences in the reason for last visit between existing and new residents. The majority of last dental visits for both dentate and edentulous residents were at a dental clinic rather than at the nursing home in the case of those who had visited more than 12 months ago. Although many existing residents had visited a dental clinic, significantly more new edentulous residents had visited a dental clinic than had existing edentulous residents (chi-square test, sig. $p < 0.05$).

Table 8: Dental history by dentate status for existing, new and all residents (%)

	Dentate			Edentulous		
	Existing n=41	**New** n=30	**All** n=71	**Existing** n=70	**New** n=45	**All** n=115
Any dental pain or discomfort currently						
Yes	17.1	6.7	12.7	21.4	20.0	20.9
No	73.2	83.3	77.5	78.6	71.1	75.7
Don't know	9.8	10.0	9.9	0.0	8.9	3.5
Need dental treatment at present						
Yes	17.1	13.3	15.5	15.7	20.0	17.4
No	73.2	66.7	70.4	82.9	73.3	79.1
Don't know	9.8	20.0	14.1	1.4	6.7	3.5
Attend dentist						
For check-ups	22.0	33.3	26.8	10.0	4.4	7.8
For a dental problem	73.2	60.0	67.6	87.1	88.9	87.8
Don't know	4.9	6.7	5.6	2.9	6.7	4.3
Time since last dental visit	*n=31*	*n=15*	*n=46*	*n=48*	*n=19*	*n=67*
<12 months	51.6	80.0	60.9	40.4	52.6	43.7
13–24 months	16.1	6.7	13.0	15.4	10.5	14.1
25–36 months	9.7	0.0	6.5	19.2	5.3	15.5
37–48 months	6.5	6.7	6.5	1.9	0.0	1.4
49–60 months	0.0	0.0	0.0	3.8	5.3	4.2
61–120 months	3.2	6.7	4.3	7.7	5.3	7.0
121+ months	12.9	0.0	8.7	11.5	21.1	14.1
Reason for last visit (visit <12 months)	*n=16*	*n=12*		*n=17*	*n=10*	
Check-up	37.5	50.0		20.0	40.0	
Cleaning	25.0	8.3		0.0	0.0	
Filling(s)	0.0	8.3		0.0	0.0	
Extraction	6.3	8.3		0.0	0.0	
Denture adjustment	12.5	8.3		50.0	30.0	
New dentures	12.6	0.0		30.0	30.0	
Don't know	0.0	16.7		0.0	0.0	
Location of last dental visit (visit <12 months)	*n=16*	*n=12*		*n=17*	*n=10*	
Dental surgery/clinic	0.0	*41.7		15.0	30.0	
Nursing home	100.0	41.7		85.0	70.0	
Don't know	0.0	16.7		0.0	0.0	
Reason for last visit (visit >12 months)	*n=15*	*n=3*		*n=31*	*n=9*	
Check-up	13.3	33.3		6.5	11.1	
Cleaning	6.7	0.0		0.0	0.0	
Filling(s)	0.0	0.0		0.0	0.0	
Extraction	6.7	33.3		6.5	0.0	
Denture adjustment	13.3	0.0		9.7	22.2	
New dentures	20.0	33.3		45.2	44.4	
Don't know	40.0	0.0		32.3	22.2	
Location of last dental visit (visit >12 months)	*n=15*	*n=3*		*n=31*	*n=9*	
Dental surgery/clinic	26.7	100.0		41.9	*88.9	
Nursing home	26.7	0.0		29.0	11.1	
Don't know	46.7	0.0		29.0	0.0	

*   chi-square test sig. p<0.05 between existing and new participants

Table 9 presents new and existing residents' oral hygiene care provision by dentate status. There were no significant differences in oral hygiene care provision between existing and new residents. Frequency of denture cleaning was reported by residents and/or nursing home carers. Of dentate participants who wore dentures, 85% had their dentures cleaned once daily. Of existing and new edentulous participants who wore dentures, 86% had their dentures cleaned once daily. Nearly all residents, dentate and edentulous, required assistance to clean their dentures. Some assistance was required by 10% of dentate and 21% of edentulous residents. Total assistance was required by 85% of dentate and 77% of edentulous residents.

Only 19.4% of dentate residents had their natural teeth cleaned twice daily or more; 79.1% had their natural teeth cleaned once daily. Fifteen per cent of dentate residents required some assistance with cleaning of their natural teeth, 70% needed total assistance and 15% no assistance. There were no significant differences in oral hygiene care provision between existing and new dentate residents.

Nursing home carers were asked if they had any specific difficulties when providing oral care for each resident. Carers had such difficulties with approximately 60% of dentate and 45% of edentulous residents. More difficulties were noted for dentate residents. Carers had 5 or more difficulties with 23.9% of dentate residents compared with 10.5% of edentulous residents. The difficulties most frequently reported were residents refusing oral hygiene care, residents not opening their mouth, residents not understanding carers' directions, residents using abusive and offensive language and biting the toothbrush or carer. There were no significant differences in carers' frequency or type of difficulties with oral care provision between existing and new residents.

The use of cosmetic mouthrinses in these residents was almost non-existent. In no nursing home records or residents' rooms could any type of therapeutic mouthrinse containing fluoride or chlorhexidine be found.

Table 9: Oral hygiene care by dentate status for existing, new and all residents (%)

	Dentate			Edentulous		
	Existing *n=41*	**New** *n=30*	**All** *n=71*	**Existing** *n=70*	**New** *n=45*	**All** *n=115*
Frequency of denture cleaning	*n=24*	*n=15*	*n=39*			
Twice daily or more	16.7	13.3	15.4	16.4	5.0	11.9
Once daily	83.3	86.7	84.6	83.6	90.0	86.1
Weekly	0.0	0.0	0.0	0.0	2.5	1.0
Hardly ever/Never	0.0	0.0	0.0	0.0	2.5	1.0
Assistance needed cleaning dentures	*n=24*	*n=15*	*n=39*			
Yes—some	8.3	13.3	10.3	21.3	20.0	20.8
Yes—total	83.3	86.7	84.6	77.0	77.5	77.2
No	0.0	0.0	5.1	0.0	2.5	2.0
Frequency of teeth cleaning						
Twice daily or more	23.1	14.3	19.4	. .	. .	. .
Once daily	76.9	82.1	79.1	. .	. .	. .
Weekly	0.0	3.6	1.5	. .	. .	. .
Hardly ever/Never	0.0	0.0	0.0	. .	. .	. .
Assistance needed cleaning teeth						
Yes—some	15.4	14.3	14.9	. .	. .	. .
Yes—total	74.4	64.3	70.1	. .	. .	. .
No	10.3	21.4	14.9	. .	. .	. .
Number of difficulties carers have with oral care						
0	36.6	40.0	38.0	50.7	60.0	54.4
1–2	19.5	16.7	18.3	15.9	20.0	17.5
3–4	14.6	26.7	19.7	20.3	13.3	17.5
5+	29.3	16.7	23.9	13.0	6.7	10.5
Types of difficulties with oral care						
Resident refuses oral hygiene care	39.0	33.3	36.6	24.3	22.2	23.5
Resident does not open their mouth	36.6	26.7	32.4	18.6	17.8	18.3
Resident bites toothbrush/swab/nursing staff	19.5	10.0	15.5	4.3	2.2	3.5
Resident does not understand directions	34.1	30.0	32.4	18.6	13.3	16.5
Resident uses abusive/offensive language	14.6	26.7	19.7	14.3	15.6	14.8
Resident's dentures can't be removed or replaced	0.0	10.0	4.2	14.3	4.4	10.4
Use a mouthrinse (cosmetic, not containing fluoride)						
Yes	7.3	0.0	4.2	1.4	0.0	0.9
No	92.7	100.0	95.8	98.6	100.0	99.1

. . not applicable

Note: chi-square test; no significant differences between existing and new participants.

Prevalence and experience of oral diseases and conditions among existing and new residents

Dentures

Dentate status by denture status (maxilla or mandible) of existing and new residents is presented in Tables 10–15.

Of existing participants who were edentulous in the maxilla, 83.9% wore a full denture, 13.8% owned a full denture but did not wear it and 2.3% did not have a denture to replace the missing upper teeth (Table 10). In the mandible, there were higher percentages of existing participants who owned but did not wear their full lower denture (23.6%) and who did not have a denture (4.2%) (Table 11). Seventy-two per cent of residents wore a mandibular full denture. Of the existing participants who were dentate in the maxilla, 33.4% wore a partial denture, while 20.8% owned a partial denture but did not wear it. The percentage of existing participants who were dentate in the mandible and wore a partial denture (20.5%) was lower than for the maxilla. However, a higher percentage (25.6%) owned a mandibular partial denture but did not wear it.

Table 10: Dentate status by denture status—maxilla, for existing residents

	Denture status (%)			
	Full denture	Partial denture	Denture owned but not worn	No denture
Dentate status				
Dentate *(n=24)*	. .	33.4	20.8	45.8
Edentulous *(n=87)*	83.9	. .	13.8	2.3

. .   not applicable

Table 11: Dentate status by denture status—mandible, for existing residents

	Denture status (%)			
	Full denture	Partial denture	Denture owned but not worn	No denture
Dentate status				
Dentate *(n=39)*	. .	20.5	25.6	53.8
Edentulous *(n=72)*	72.2	. .	23.6	4.2

. .   not applicable

Of new participants who were edentulous in the maxilla, 85.0% wore a full denture, 11.7% owned a full denture but did not wear it and 3.3% did not have a denture to replace the missing upper teeth (Table 12). In the mandible, there were higher percentages of new participants who owned but did not wear their full lower denture (18.8%) and who did not have a denture to replace the missing lower teeth (6.3%) (Table 13). Of the new participants who were dentate in the maxilla, 13.3% wore a partial denture and another 13.3% owned a partial denture but did not wear it. The percentage of new participants who were dentate in the mandible and owned a partial denture (18.5%) was lower than for the maxilla (26.6%).

Table 12: Dentate status by denture status—maxilla, for new residents

	Denture status (%)			
	Full denture	Partial denture	Denture owned but not worn	No denture
Dentate status				
Dentate *(n=15)*	. .	13.3	13.3	73.3
Edentulous *(n=60)*	85.0	. .	11.7	3.3

. . not applicable

Table 13: Dentate status by denture status—mandible, for new residents

	Denture status (%)			
	Full denture	Partial denture	Denture owned but not worn	No denture
Dentate status				
Dentate *(n=27)*	. .	18.5	0.0	81.5
Edentulous *(n=48)*	75.0	. .	18.8	6.3

. . not applicable

For all participants who were edentulous in the maxilla, 84.4% wore a full denture, 12.9% owned a full denture but did not wear it and 2.7% did not have a denture to replace the missing upper teeth (Table 14). In the mandible, higher percentages of all edentulous participants owned but did not wear their full lower denture (21.7%) and did not have a denture to replace the missing lower teeth (5.0%) (Table 15). Of all participants who were dentate in the maxilla, 25.7% wore a partial denture and another 17.9% owned a partial denture but did not wear it. The percentage of all participants who were dentate in the mandible and wore a partial denture (19.7%) was lower than for the maxilla. A lower percentage (15.2%) owned a mandibular partial denture but did not wear it.

Table 14: Dentate status by denture status—maxilla, for all residents

	Denture status (%)			
	Full denture	Partial denture	Denture owned but not worn	No denture
Dentate status				
Dentate *(n=39)*	. .	25.7	17.9	56.4
Edentulous *(n=147)*	84.4	. .	12.9	2.7

. . not applicable

Table 15: Dentate status by denture status—mandible, for all residents

	Denture status (%)			
	Full denture	Partial denture	Denture owned but not worn	No denture
Dentate status				
Dentate *(n=66)*	. .	19.7	15.2	65.2
Edentulous *(n=120)*	73.3	. .	21.7	5.0

. . not applicable

Table 16: Types of dentures worn by existing, new and all residents (%)

| | | Resident type | | |
| | | Existing | New | All |
Denture type		n=111	n=75	n=186
Upper denture	**Lower denture**			
Full	Full	45.0	48.0	46.2
Full	Not worn	9.9	4.0	7.5
Full	No denture	8.1	12.0	9.7
Full	Partial	2.7	4.0	3.2
Partial	Full	0.9	1.3	0.5
Partial	Partial	3.6	1.3	2.7
No denture	Partial	0.9	0.0	1.1
Partial	No denture	0.9	1.3	1.1
Partial	Not worn	0.9	0.0	0.5
Not worn	Not worn	14.4	8.0	11.8
Not worn	No denture	1.8	4.0	2.7
No denture	No denture	10.8	16.0	12.9

Note: chi-square test; no significant differences between existing and new participants.

Tables 10–15 present existing and new participants' dentate status by denture status for individual arches. Table 16 presents the combinations of upper and lower dentures worn by existing and new participants.

Seventy-three per cent of existing residents owned a denture for one or both arches. Forty-five per cent of existing residents wore full upper and lower dentures. Another 9.9% wore their full upper denture only and did not wear their full lower denture, and 8.1% wore a full upper denture and no lower denture. Approximately 10% of existing residents wore a partial denture in one or both arches. Fourteen per cent of existing residents owned both upper and lower dentures but did not wear them, and only 10.8% wore no dentures.

Seventy-two per cent of new residents owned a denture for one or both arches. Forty-eight per cent of new residents wore full upper and lower dentures. Another 4% wore their full upper denture only and did not wear their full lower denture, and 12% wore a full upper denture and no lower denture. Approximately 8% of new residents wore a partial denture in one or both arches. Eight per cent of new residents owned both upper and lower dentures but did not wear them, and only 16% wore no dentures.

Seventy-two per cent of all residents owned a denture for one or both arches. Forty-six per cent of all residents wore full upper and lower dentures. Another 7.5% wore their full upper denture only and did not wear their full lower denture, and 9.7% wore a full upper denture and no lower denture. Approximately 9% of all residents wore a partial denture in one or both arches. Twelve per cent of all residents owned both upper and lower dentures but did not wear them, and only 13% wore no dentures.

There were no significant differences for denture types between existing and new residents.

Table 17: Denture wearers—denture problems by dentate status for existing, new and all residents (%)

| | Dentate status and resident type (%) | | | | | |
| | Dentate | | | Edentulous | | |
	Existing	New	All	Existing	New	All
Upper denture	*n=23*	*n=13*	*n=36*	*n=58*	*n=40*	*n=98*
Retention unsatisfactory	30.4	38.5	33.3	17.2	30.0	22.4
Stability unsatisfactory	30.4	38.5	33.3	15.5	32.5	22.4
Occlusion unsatisfactory	8.7	7.7	8.3	6.9	5.0	6.1
Material inadequacies						
Lining	0.0	0.0	0.0	0.0	0.0	0.0
Porosity	0.0	0.0	0.0	0.0	0.0	0.0
Staining	21.7	7.7	16.7	13.8	15.0	14.3
Defects						
Small	17.4	7.7	13.9	8.6	2.5	6.1
Large	0.0	0.0	0.0	0.0	0.0	0.0
Multiple	0.0	0.0	0.0	0.0	0.0	0.0
Lower denture	*n=9*	*n=5*	*n=14*	*n=51*	*n=36*	*n=87*
Retention unsatisfactory	22.2	60.0	35.7	49.0	61.1	54.0
Stability unsatisfactory	11.1	60.0	28.6	33.3	47.2	39.1
Occlusion unsatisfactory	0.0	20.0	7.1	7.8	5.6	6.9
Material inadequacies						
Lining	0.0	0.0	0.0	0.0	0.0	0.0
Porosity	0.0	0.0	0.0	0.0	0.0	0.0
Staining	22.2	0.0	14.3	11.8	8.3	10.3
Defects						
Small	0.0	0.0	0.0	3.9	2.8	3.4
Large	0.0	0.0	0.0	0.0	0.0	0.0
Multiple	0.0	0.0	0.0	0.0	0.0	0.0

Note: chi-square test; no significant differences between existing and new participants.

Table 17 presents denture problems by dentate status for existing and new residents who wore dentures. Among denture wearers, the highest percentages of denture problems occurred in relation to dentate participants' upper dentures and edentulous participants' lower dentures. Inadequate retention (33.3%) and stability (33.3%) were the main problems with dentate participants' upper dentures. Inadequate retention (54%) and stability (39.1%) were the main problems with edentulous participants' lower dentures. Staining on the denture surface was the most frequent material inadequacy in upper and lower dentures, being found in up to 15% of residents. Dentate participants' upper dentures had the highest number of defects, such as broken or missing teeth or fractured denture material. There were no significant differences in denture problems between existing and new residents.

Oral mucosal lesions and conditions

Table 18 presents the prevalence of oral mucosal lesions/conditions among existing and new participants. The prevalence of denture-related lesions/conditions was low in denture wearers: 6% of residents had angular cheilitis and 7% had denture stomatitis in the maxilla. The prevalence of other oral mucosal lesions/conditions was low. Actinic keratosis was observed in 6% of participants. There were no significant differences for oral mucosal lesions and conditions between existing and new residents.

Table 18: Prevalence of oral mucosal lesions/conditions in existing, new and all residents (%)

Oral mucosal lesion/condition	Resident type		
	Existing	New	All
Denture-related lesions/conditions in denture wearers	*n=82*	*n=54*	*n=136*
Angular cheilitis	3.7	9.3	5.9
Denture stomatitis—maxilla	4.9	9.3	6.6
Hyperplasia	2.4	3.7	2.9
Ulceration—mandible	1.2	3.7	2.2
Ulceration—maxilla	1.2	0.0	0.7
Denture stomatitis—mandible	1.2	1.9	0.7
Other lesions/conditions	*n=111*	*n=75*	*n=186*
Actinic keratosis	8.1	2.7	5.9
Ulcer, non-specific	0.9	0.0	0.5
Candidiasis—Pseudomembranous	1.8	0.0	1.1
Candidiasis—Erythematous	0.0	1.3	0.5
Cheek/lip biting	0.9	1.3	1.1
Amalgam tattoo	1.8	1.3	1.6
Gingival hyperplasia	0.0	0.0	0.0
Herpes labialis	0.0	0.0	0.0
Leukoplakia	0.0	0.0	0.0
Mucocele	1.8	0.0	1.1
Geographic tongue	0.0	2.7	1.1
Hairy tongue	0.9	1.3	1.1

Note: chi-square test; no significant differences between existing and new participants.

Tooth status (weighted)

Tables 19–22 present dentate residents' tooth status for existing, new and all residents, including mean number of teeth (and standard deviation) that were decayed, missing or filled (DMFT), and retained roots. Teeth that were present but could not be scored because they were covered in plaque, calculus or other debris were scored as 'plaque'. Table 19 shows that existing residents had a mean number of 20.0 missing teeth, 1.3 retained roots and 0.4 teeth that could not be scored because of 'plaque'. Males had more retained roots (p<0.05). Existing residents had a mean number of 1.2 decayed teeth and 2.8 filled teeth. There were no significant differences in numbers of missing, decayed or filled teeth between sex or age groups. Overall, the mean DMFT was 24.0. Residents aged ≤74 years had a significantly lower DMFT (p<0.05).

Table 19: Tooth status for existing residents (n=41)

	Number of decayed crowns		Number of missing teeth		Number of filled/crowned crowns		DMFT		Number of retained roots		Plaque[†]	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Sex												
Male	1.9	(1.6)	19.8	(8.9)	2.1	(3.6)	23.8	(7.5)	*3.5	(6.0)	0.3	(0.5)
Female	1.1	(1.7)	20.0	(6.3)	3.0	(2.9)	24.1	(4.0)	0.8	(1.0)	0.4	(1.4)
Age												
≤74 years	1.9	(1.6)	15.8	(7.3)	1.6	(3.8)	*19.4	(6.2)	*4.6	(7.6)	0.0	(0.0)
75–84 years	1.1	(1.6)	19.2	(6.2)	3.1	(3.3)	23.5	(4.5)	0.8	(1.0)	0.4	(0.6)
85–89 years	0.4	(1.3)	23.9	(4.5)	2.0	(2.3)	26.3	(3.5)	0.6	(1.3)	0.0	(0.2)
90+ years	2.0	(1.9)	19.0	(7.9)	3.9	(2.8)	24.8	(4.5)	1.1	(1.0)	1.0	(2.2)
Total	**1.2**	**(1.7)**	**20.0**	**(6.8)**	**2.8**	**(3.0)**	**24.0**	**(4.8)**	**1.3**	**(3.0)**	**0.4**	**(1.2)**

* sig. p<0.05 weighted least squares regression (first category different from remaining categories—Tukey HSD test)
† Teeth were present but could not be scored because they were covered in plaque, calculus or other debris.

Table 20 presents new dentate residents' tooth status. New residents had a mean number of 18.5 missing teeth, 0.3 retained roots and 0.2 teeth that could not be scored because of 'plaque'. Males had more retained roots (p<0.05). New residents had a mean number of 0.8 decayed teeth and 5.7 filled teeth. There were no significant differences in numbers of missing, decayed or filled teeth between sex or age groups. Overall, the mean DMFT was 24.9.

Table 20: Tooth status for new residents (n=30)

	Number of decayed crowns		Number of missing teeth		Number of filled/crowned crowns		DMFT		Number of retained roots		Plaque[†]	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Sex												
Male	0.9	(1.3)	17.6	(8.1)	5.8	(5.6)	24.3	(3.7)	*0.6	(0.7)	0.1	(0.4)
Female	0.7	(1.0)	19.2	(8.3)	5.5	(5.8)	25.4	(4.4)	0.1	(0.3)	0.2	(0.6)
Age												
≤74 years	1.1	(1.3)	14.9	(9.6)	8.2	(6.6)	24.2	(5.0)	0.1	(0.4)	0.4	(0.8)
75–84 years	0.8	(1.1)	18.4	(7.2)	5.4	(5.2)	24.6	(4.2)	0.5	(0.7)	0.0	(0.2)
85–89 years	0.2	(0.7)	23.7	(4.8)	2.5	(3.5)	26.4	(1.8)	0.4	(0.5)	0.0	(0.0)
Total	**0.8**	**(1.1)**	**18.5**	**(8.1)**	**5.7**	**(5.6)**	**24.9**	**(4.1)**	**0.3**	**(0.6)**	**0.2**	**(0.5)**

* sig. p<0.05 weighted least squares regression (first category different from remaining categories—Tukey HSD test)
† Teeth were present but could not be scored because they were covered in plaque, calculus or other debris.

Table 21 presents tooth status for all dentate residents. Residents had a mean number of 19.3 missing teeth, 0.9 retained roots and 0.3 teeth that could not be scored because of 'plaque'. Younger residents had a lower number of missing teeth (p<0.05).
All residents had a mean number of 1.0 decayed teeth and 4.1 filled teeth. Younger residents had more decayed teeth (p<0.05). There were no significant differences in numbers of filled teeth between sex or age groups. Overall, the mean DMFT was 24.4.

Table 21: Tooth status for all residents (n=71)

	Number of decayed crowns		Number of missing teeth		Number of filled/crowned crowns		DMFT		Number of retained roots		Plaque[†]	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Sex												
Male	1.2	(1.4)	18.4	(8.3)	4.5	(5.2)	24.1	(5.3)	1.6	(3.8)	0.2	(0.4)
Female	0.9	(1.5)	19.7	(7.0)	3.9	(4.3)	24.6	(4.1)	0.5	(0.9)	0.3	(1.1)
Age												
≤74 years	**1.4	(1.5)	*15.2	(8.7)	6.1	(6.5)	22.7	(5.7)	1.5	(4.6)	0.3	(0.7)
75–84 years	0.9	(1.3)	18.9	(6.6)	4.3	(4.4)	24.1	(4.3)	0.7	(0.9)	0.2	(0.5)
85–89 years	0.3	(1.1)	23.8	(4.5)	2.2	(2.8)	26.3	(2.8)	0.5	(1.0)	0.0	(0.2)
90+ years	2.0	(1.9)	19.0	(7.9)	3.9	(2.8)	24.8	(4.5)	1.1	(1.0)	1.0	(2.2)
Total	**1.0**	**(1.5)**	**19.3**	**(7.4)**	**4.1**	**(4.6)**	**24.4**	**(4.5)**	**0.9**	**(2.3)**	**0.3**	**(1.0)**

* sig. p<0.05 weighted least squares regression (first category different from third category—Tukey HSD test)
** sig. p<0.05 weighted least squares regression (third category different from fourth category—Tukey HSD test)
† Teeth were present but could not be scored because they were covered in plaque, calculus or other debris.

When tooth status data of existing and new residents was compared (Table 22), there were no significant differences evident, with the exception that existing residents had significantly fewer filled teeth (p<0.05).

Table 22: Tooth status—summary table

	Number of decayed crowns		Number of missing teeth		Number of filled/crowned crowns		DMFT		Number of retained roots		Plaque[†]	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Existing residents *(n=41)*	1.2	(1.7)	20.0	(6.8)	*2.8	(3.0)	24.0	(4.8)	1.3	(3.0)	0.4	(1.2)
New residents *(n=30)*	0.8	(1.1)	18.5	(8.1)	5.7	(5.6)	24.9	(4.1)	0.3	(0.6)	0.2	(0.5)
All residents *(n=71)*	1.0	(1.5)	19.3	(7.4)	4.1	(4.6)	24.4	(4.5)	0.9	(2.3)	0.3	(1.0)

* sig. p<0.05 weighted least squares regression (existing residents different from new residents—Tukey HSD test)
† Teeth were present but could not be scored because they were covered in plaque, calculus or other debris.

Coronal caries (weighted)

Tables 23–26 present the mean number of coronal surfaces with caries experience for dentate participants. Table 23 presents data for existing residents. The mean number of decayed coronal surfaces (2.0) was higher than the number of decayed teeth (1.2), indicating that multiple surfaces were affected on some individual teeth. Mean number of filled surfaces for existing residents was 6.4. Mean coronal DFS was 8.4 and coronal caries attack rate was 15.9%. Mean number of 'plaque'-covered coronal surfaces was 1.2. There were no significant differences in numbers of decayed, filled or 'plaque'-covered surfaces between the sex or age categories.

Table 23: Coronal surface caries for existing residents (n=41)

	Decayed surfaces		Filled surfaces		Coronal DFS		Plaque surfaces[†]		Attack rate (%)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Sex										
Male	3.2	(2.4)	4.4	(8.3)	7.7	(8.9)	0.8	(1.7)	19.0	(10.9)
Female	1.7	(3.0)	6.9	(9.8)	8.6	(11.2)	1.3	(3.9)	15.2	(11.9)
Age										
≤74 years	2.4	(2.3)	4.0	(9.3)	6.4	(10.5)	0.5	(0.7)	10.2	(8.3)
75–84 years	2.0	(2.5)	8.1	(12.8)	10.1	(13.7)	0.9	(1.8)	17.0	(13.1)
85–89 years	0.7	(2.4)	3.2	(3.5)	3.9	(4.0)	0.1	(0.4)	12.2	(11.6)
90+ years	3.0	(3.8)	8.5	(8.5)	11.5	(10.4)	3.0	(6.3)	20.2	(10.7)
Total	**2.0**	**(2.9)**	**6.4**	**(9.5)**	**8.4**	**(10.7)**	**1.2**	**(3.5)**	**15.9**	**(11.7)**

† Teeth were present but could not be scored because they were covered in plaque, calculus or other debris.

Note: Weighted least squares regression; no significant differences by sex or age.

Table 24 presents the mean number of coronal surfaces with caries experience for new participants. The mean number of decayed coronal surfaces (1.2) was higher than the number of decayed teeth (0.8), indicating that multiple surfaces were affected on some individual teeth. Mean number of filled surfaces for new residents was 11.9. Mean coronal DFS was 13.2 and coronal caries attack rate was 19.8%. Mean number of 'plaque'-covered coronal surfaces was 0.8. There were no significant differences in numbers of decayed, filled or 'plaque'-covered surfaces between the sex or age categories.

Table 24: Coronal surface caries for new residents (n=30)

	Decayed surfaces		Filled surfaces		Coronal DFS		Plaque surfaces[†]		Attack rate (%)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Sex										
Male	1.8	(2.1)	11.6	(13.4)	13.3	(13.8)	0.6	(1.6)	18.7	(12.7)
Female	0.8	(1.2)	12.2	(13.8)	13.0	(13.4)	0.9	(2.9)	20.7	(10.8)
Age										
≤74 years	1.4	(1.8)	17.7	(16.6)	19.1	(16.4)	2.2	(3.9)	23.3	(13.3)
75–84 years	1.6	(1.8)	10.6	(11.0)	12.2	(10.3)	0.0	(0.2)	19.6	(10.7)
85–89 years	0.3	(1.0)	6.1	(10.8)	6.4	(11.2)	0.1	(0.2)	15.0	(9.6)
Total	**1.2**	**(1.7)**	**11.9**	**(13.4)**	**13.2**	**(13.4)**	**0.8**	**(2.4)**	**19.8**	**(11.5)**

† Teeth were present but could not be scored because they were covered in plaque, calculus or other debris.

Note: Weighted least squares regression; no significant differences by sex or age.

Table 25 presents the mean number of coronal surfaces with caries experience for all participants. The mean number of decayed coronal surfaces (1.7) was higher than the number of decayed teeth (1.0), indicating that multiple surfaces were affected on some individual teeth. Mean number of filled surfaces for all residents was 8.9. Mean coronal DFS was 10.5 and coronal caries attack rate was 17.7%. Mean number of 'plaque'-covered coronal surfaces was 1.0. There were no significant differences in numbers of decayed, filled or 'plaque'-covered surfaces between the sex or age categories.

Table 25: Coronal surface caries for all residents (n=71)

	Decayed surfaces		Filled surfaces		Coronal DFS		Plaque surfaces[†]		Attack rate (%)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Sex										
Male	2.3	(2.3)	8.9	(12.1)	11.2	(12.3)	0.7	(1.6)	18.8	(11.9)
Female	1.4	(2.5)	8.8	(11.6)	10.2	(12.1)	1.2	(3.6)	17.2	(11.8)
Age										
≤74 years	1.8	(2.0)	13.2	(15.7)	15.0	(15.7)	1.6	(3.3)	19.1	(13.2)
75–84 years	1.8	(2.2)	9.4	(11.8)	11.2	(11.9)	0.5	(1.3)	18.3	(11.8)
85–89 years	0.6	(1.9)	4.4	(7.4)	5.0	(7.7)	0.1	(0.3)	13.5	(10.5)
90+ years	3.0	(3.8)	8.5	(8.5)	11.5	(10.4)	3.0	(6.3)	20.2	(10.7)
Total	**1.7**	**(2.5)**	**8.9**	**(11.7)**	**10.5**	**(12.1)**	**1.0**	**(3.1)**	**17.7**	**(11.7)**

† Teeth were present but could not be scored because they were covered in plaque, calculus or other debris.

Note: Weighted least squares regression; no significant differences by sex or age.

When coronal surface caries data was compared between existing and new residents (Table 26), there were no significant differences evident, with the exception that existing residents had significantly fewer filled coronal surfaces (p<0.05).

Table 26: Coronal caries—summary table

	Decayed surfaces		Filled surfaces		Coronal DFS		Plaque surfaces[†]		Attack rate (%)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Existing residents *(n=41)*	2.0	(2.9)	*6.4	(9.5)	8.4	(10.7)	1.2	(3.5)	15.9	(11.7)
New residents *(n=30)*	1.2	(1.7)	11.9	(13.4)	13.2	(13.4)	0.8	(2.4)	19.8	(11.5)
All residents *(n=71)*	1.7	(2.5)	8.9	(11.7)	10.5	(12.1)	1.0	(3.1)	17.7	(11.7)

* sig. p<0.05 weighted least squares regression (existing residents different from new residents—Tukey HSD test)
† Teeth were present but could not be scored because they were covered in plaque, calculus or other debris.

Root caries (weighted)

Tables 27–30 present the mean number of root surfaces with caries experience for dentate residents. Table 27 presents the mean number of root surfaces with caries experience for existing residents. The mean of 1.5 decayed root surfaces for existing residents was similar to the mean of 2.0 decayed coronal surfaces. However, an additional 9.8 root surfaces per resident were scored as being covered in 'plaque'. Residents' mean number of filled root surfaces was 0.8. The root DFS index was 2.3 for existing residents. The mean root caries attack rate (=RCI, Root Caries Index) was 25.1%. Although root DFS was lower than coronal DFS, the attack rate for root caries (25.1%) was higher than that for coronal caries (15.9%).

Table 27: Root surface caries for existing residents (n=41)

	Decayed surfaces		Filled surfaces		Root DFS		Plaque surfaces[†]		RCI (%)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Sex										
Male	3.1	(5.8)	1.3	(3.1)	4.4	(6.7)	8.9	(14.9)	29.1	(29.5)
Female	1.1	(2.0)	0.7	(1.3)	1.8	(2.1)	10.1	(16.0)	24.2	(23.0)
Age										
≤74 years	2.2	(2.8)	1.1	(2.9)	3.3	(3.5)	8.8	(8.4)	17.4	(14.8)
75–84 years	1.4	(4.0)	0.1	(0.4)	1.5	(4.1)	14.8	(23.2)	28.2	(32.9)
85–89 years	1.2	(3.0)	1.1	(1.8)	2.3	(3.2)	3.2	(3.0)	19.9	(14.2)
90+ years	1.6	(2.7)	1.3	(2.1)	3.0	(3.6)	10.1	(11.8)	30.6	(22.3)
Total	**1.5**	**(3.2)**	**0.8**	**(1.8)**	**2.3**	**(3.6)**	**9.8**	**(15.6)**	**25.1**	**(23.9)**

† Teeth were present but could not be scored because they were covered in plaque, calculus or other debris.
Note: Weighted least squares regression; no significant differences by sex or age.

Table 28 presents the mean number of root surfaces with caries experience for new residents. The mean of 1.0 decayed root surfaces for new residents was lower than the mean of 1.2 decayed coronal surfaces. An additional 9.1 root surfaces per resident were scored as being covered in 'plaque'. Residents' mean number of filled root surfaces was 2.0. The root DFS index was 3.0 for new residents. The mean root caries attack rate was 25.4%. Although root DFS was lower than coronal DFS, the attack rate for root caries (25.4%) was higher than that for coronal caries (19.8%).

Table 28: Root surface caries for new residents (n=30)

	Decayed surfaces		Filled surfaces		Root DFS		Plaque surfaces[†]		RCI (%)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Sex										
Male	0.7	(2.2)	2.4	(1.9)	3.1	(3.2)	7.6	(7.6)	31.9	(28.0)
Female	1.2	(4.2)	1.7	(2.4)	2.9	(5.0)	10.3	(16.4)	19.7	(27.6)
Age										
≤74 years	0.5	(2.0)	1.4	(2.1)	1.9	(3.7)	15.5	(18.3)	12.8	(15.3)
75–84 years	1.0	(2.7)	2.0	(2.0)	3.0	(3.9)	6.0	(7.5)	31.9	(34.9)
85–89 years	1.7	(5.9)	2.9	(2.6)	4.6	(5.5)	5.5	(10.2)	29.3	(23.1)
Total	**1.0**	**(3.4)**	**2.0**	**(2.2)**	**3.0**	**(4.2)**	**9.1**	**(13.1)**	**25.4**	**(28.0)**

† Teeth were present but could not be scored because they were covered in plaque, calculus or other debris.
Note: Weighted least squares regression; no significant differences by sex or age.

Table 29 presents the mean number of root surfaces with caries experience for all residents. The mean of 1.3 decayed root surfaces for all residents was lower than the mean of 1.7 decayed coronal surfaces. However, an additional 9.5 root surfaces per resident were scored as being covered in 'plaque'. Residents' mean number of filled root surfaces was 1.4. The root DFS index was 2.6 for all residents. The mean root caries attack rate was 25.2%. Although root DFS was lower than coronal DFS, the attack rate for root caries (25.2%) was higher than that for coronal caries (17.7%).

Table 29: Root surface caries for all residents (n=71)

	Decayed surfaces		Filled surfaces		Root DFS		Plaque surfaces[†]		RCI (%)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Sex										
Male	1.6	(4.0)	2.0	(2.4)	3.6	(4.7)	8.1	(10.6)	31.0	(27.8)
Female	1.1	(3.0)	1.1	(1.8)	2.2	(3.5)	10.1	(16.0)	22.6	(24.6)
Age										
≤74 years	1.1	(2.4)	1.3	(2.3)	2.4	(3.6)	13.3	(15.8)	14.5	(14.8)
75–84 years	1.2	(3.3)	1.1	(1.7)	2.3	(4.0)	10.4	(17.5)	30.1	(33.4)
85–89 years	1.4	(4.3)	1.9	(2.3)	3.3	(4.4)	4.2	(6.9)	24.1	(18.7)
90+ years	1.6	(2.7)	1.3	(2.1)	3.0	(3.6)	10.1	(11.8)	30.6	(22.3)
Total	**1.3**	**(3.3)**	**1.4**	**(2.0)**	**2.6**	**(3.9)**	**9.5**	**(14.5)**	**25.2**	**(25.7)**

† Teeth were present but could not be scored because they were covered in plaque, calculus or other debris.

Note: Weighted least squares regression; no significant differences by sex or age.

When root surface caries data was compared between existing and new residents (Table 30), there were no significant differences evident, with the exception that existing residents had significantly fewer filled root surfaces (p<0.05).

Table 30: Root caries—summary table

	Decayed surfaces		Filled surfaces		Root DFS		Plaque surfaces[†]		RCI (%)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Existing residents *(n=41)*	1.5	(3.2)	*0.8	(1.8)	2.3	(3.6)	9.8	(15.6)	25.1	(23.9)
New residents *(n=30)*	1.0	(3.4)	2.0	(2.2)	3.0	(4.2)	9.1	(13.1)	25.4	(28.0)
All residents *(n=71)*	1.3	(3.3)	1.4	(2.0)	2.6	(3.9)	9.5	(14.5)	25.2	(25.7)

* sig. p<0.05 weighted least squares regression (existing residents different from new residents—Tukey HSD test)
† Teeth were present but could not be scored because they were covered in plaque, calculus or other debris.

Retained roots (weighted)

Table 31 presents types of retained roots (decayed or sound) for existing and new residents. Of the mean 1.3 retained root per existing resident, there was a mean of 0.9 decayed versus 0.5 sound retained roots. Existing male residents had more decayed and sound retained roots (p<0.05) than their female counterparts. There were no significant differences in numbers of retained (decayed or sound) roots by age.

Of the mean 0.3 retained root per new resident, there was a mean of 0.1 decayed versus 0.2 sound retained roots. New male residents had more sound retained roots (p<0.05) than their female counterparts. There were no significant differences in numbers of retained (decayed or sound) roots by age.

Table 31: Retained roots for existing and new residents

	Retained root decayed						Retained root sound					
	Existing n=4		New n=30		All n=71		Existing n=41		New n=30		All n=71	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Sex												
Male	*2.1	(4.1)	0.1	(0.3)	0.8	(2.6)	*1.3	(2.1)	*0.5	(0.7)	*0.8	(1.4)
Female	0.6	(1.0)	0.1	(0.3)	0.4	(0.9)	0.2	(0.4)	0.0	(0.2)	0.2	(0.4)
Age												
≤74 years	3.1	(5.1)	0.1	(0.4)	1.0	(3.1)	1.5	(2.5)	0.0	(0.0)	0.5	(1.5)
75–84 years	0.5	(0.9)	0.1	(0.3)	0.3	(0.7)	0.3	(0.7)	0.4	(0.7)	0.4	(0.7)
85–89 years	0.2	(1.2)	0.1	(0.2)	0.2	(0.9)	0.4	(0.6)	0.3	(0.5)	0.4	(0.5)
90+ years	1.0	(1.0)	n.a.	n.a.	1.0	(1.0)	0.1	(0.5)	n.a.	n.a.	0.1	(0.5)
Total	**0.9**	**(2.1)**	****0.1**	**(0.3)**	**0.5**	**(1.6)**	**0.5**	**(1.1)**	**0.2**	**(0.5)**	**0.4**	**(0.9)**

* sig. p<0.05 weighted least squares regression (first category different from remaining categories—Tukey HSD test)
** sig. p<0.05 weighted least squares regression (existing residents different from new residents—Tukey HSD test)

Attrition

Table 32 presents the attrition status and mean number of teeth for existing, new and all residents. Existing dentate residents had a mean number of 10.8 teeth present. The majority of existing residents' teeth that could be scored showed signs of attrition. Existing dentate residents had a mean of 1.9 teeth with enamel attrition, 5.3 teeth with dentine attrition and 0.1 teeth with severe attrition.

New dentate residents had a mean number of 12.7 teeth present, significantly more teeth than for existing residents (t-test, sig. p<0.01). The majority of new residents' teeth that could be scored showed signs of attrition. New dentate residents had a mean of 1.4 teeth with enamel attrition, 6.8 teeth with dentine attrition and 0.2 teeth with severe attrition.

Overall, dentate residents had a mean number of 11.6 teeth present. The majority of residents' teeth showed signs of attrition. Dentate residents had a mean of 1.7 teeth with enamel attrition, 5.9 teeth with dentine attrition and 0.1 teeth with severe attrition.

Table 32: Dentate residents—attrition status and mean number of teeth for existing, new and all residents (n=76)

	Existing (n=41)		New (n=30)		All (n=71)	
	Mean	SD	Mean	SD	Mean	SD
Attrition status						
No score[a]	3.5	(4.2)	4.3	(6.4)	3.8	(5.2)
Enamel[b]	1.9	(3.2)	1.4	(2.4)	1.7	(2.9)
Dentine[c]	5.3	(4.0)	6.8	(5.0)	5.9	(4.5)
Severe[d]	0.1	(0.2)	0.2	(0.8)	0.1	(0.5)
Total	*10.8	(5.9)	12.7	(8.1)	11.6	(6.9)

*   t-test, sig. p<0.01 for existing versus new residents
(a) No score = no attrition evident or could not be scored because of restoration placed or plaque/debris accumulation.
(b) Enamel = occlusal/incisal enamel was worn so that dentine was exposed.
(c) Dentine = entire occlusal/incisal enamel was obliterated, leaving an enamel ring.
(d) Severe = tooth has worn to the gingival margin (≤1/3 crown is present).

Note: Excludes crowned teeth and retained roots.

Periodontal conditions

Table 33 presents the medical conditions (type and number) that precluded a periodontal inspection for existing and new residents. Approximately 20% of residents had artificial joints or prostheses, 8.5% had a bleeding problem and 8.5% would have required further consultation with medical practitioners and possible modification of their medications. Approximately 35% of dentate residents were precluded from the periodontal inspection because they had one or two of these conditions. Another approximately 60% of residents did not have a periodontal inspection completed mainly because of access difficulties. These access difficulties resulted in the examiners being unable to confidently and accurately read the graduations on the periodontal probe and included: teeth and gingival tissues being grossly covered in plaque, debris or calculus, the residents' head/body being physically difficult to position, repetitive movements and wandering that precluded placement of the periodontal probe, violent behavioural problems, or sensitivity of the resident to probing.

No further periodontal analyses are presented because of the limited number of periodontal inspections completed (n=14).

Table 33: Medical conditions precluding periodontal inspection for existing, new and all dentate residents (%)

	Existing *(n=41)*	New *(n=30)*	All *(n=71)*
Type of medical condition			
Rheumatic fever	2.4	0.0	1.4
Heart or heart valve problems	2.4	0.0	1.4
Artificial joints or prostheses	22.0	16.7	19.7
A bleeding problem	9.8	6.7	8.5
Medications	9.8	6.7	8.5
Number of medical conditions			
No condition	63.4	66.7	64.8
One condition	29.3	33.3	31.0
Two conditions	7.3	0.0	4.2

Plaque accumulation

Table 34 presents mean Plaque Index (PI) scores (weighted) (possible range 0–3) for all existing and new dentate residents. Mean PI score for all dentate residents was moderately high (1.9). There were significant differences in mean PI scores between different age groups and MMSE scores (weighted least squares regression, $p<0.05$). Younger residents had high plaque scores. Residents who had moderate MMSE dementia scores had lower plaque scores. Other non-significant differences in PI scores were present: PI scores were higher for new females, pension card holders, the more functionally dependent, those taking fewer medications and those who could eat fewer foods. Residents on a soft/vitamised diet had similar plaque scores to those on a normal diet.

During the study period, 38.9% of existing dentate participants had no change in their PI scores, 22.2% had a lower PI score at one-year, and 38.9% had an increase in their PI score at one-year.

Table 34: Mean Plaque Index scores (weighted) for existing, new and all dentate residents

	Mean Plaque Index Score		
	Existing *n=41*	New *n=30*	All *n=71*
Sex			
Male	2.2	1.4	1.6
Female	1.9	2.1	2.0
Age group			
≤74 years	2.3	2.2	*2.3
75–84 years	2.2	1.6	1.9
85–89 years	1.5	1.6	1.5
90+ years	1.7		1.7
Number of chronic medical conditions			
1–<3	2.2	1.9	2.0
4–<5	1.9	1.9	1.9
6+	1.9	1.6	1.8
Number of medications			
1–4	2.6	1.8	2.1
5–7	1.4	2.3	1.9
8+	2.0	1.5	1.8
Time since admitted			
<12 months		1.9	1.9
1–<3 years	1.6	1.7	1.7
3–<5 years	2.3		2.3
5+ years	1.8		1.7
Government cards			
Pensioner	2.0	1.8	1.9
Department of Veterans' Affairs	1.8	1.5	1.6
None	1.4	1.8	1.6
ADL score (no. of dependent activities)			
0–4	2.0	2.0	2.0
5	1.6	1.6	1.6
6	2.0	1.9	2.0
MMSE score			
≤10 (severe dementia)	2.0	2.0	**2.0
11–20 (moderate dementia)	1.5	1.1	1.3
21–25 (mild dementia)	2.2	3.0	2.3
26–30 (normal)	2.4	1.9	2.1
Body weight change			
Negative	2.0	1.8	1.9
Positive	1.9	1.8	1.9
Number of foods can eat			
0–1	2.0	3.0	2.3
2–3	2.0	1.7	1.8
4–5	1.6	2.1	1.9
Soft diet			
Yes	2.0	1.7	1.9
No	1.8	1.9	1.9
All residents	**1.9**	**1.8**	**1.9**

*   sig. p<0.05 weighted least squares regression (first category different from remaining categories—Tukey HSD test)
** sig. p<0.01 weighted least squares regression (second category different from remaining categories—Tukey HSD test)

Normative, rational and perceived needs for dental care

Tables 35 and 36 present denture treatment needed and wanted for the upper and lower dentures for existing and new residents. The rational treatment need assessed by dentists in this section of the dental inspection considered all of a participant's modifying factors, such as functional status, cognitive status, medical history, medications, social history, financial history, dental history, ethical issues and the like. In many cases, a normative dental need (assessed purely on dental criteria) was evident, but after the complete rational treatment evaluation, treatment was not advocated. Thus, the rational treatment need was often less than the normative dental need. Rational dental treatment needs were low for both upper and lower dentures in this study, with 39% of existing and 27% of new residents needing denture treatment. Participants' perceived denture treatment needs were even lower again than the rational treatment need. For example, 50–60% of existing residents who were assessed as requiring a new full denture in either the upper or lower arch did not want the new denture. Also, 50% of existing and 40% of new residents assessed as requiring a reline for their upper or lower denture did not want the reline.

Table 35: Denture treatment needed and wanted—upper denture for existing, new and all residents

| | Denture treatment wanted (%) | | | | | |
| | Existing | | | New | | |
	n	Agreed	Disagreed	n	Agreed	Disagreed
Denture treatment needed*						
Adjustment	0			0		
Reline	6	50.0	50.0	5	60.0	40.0
Repair	7	28.6	71.4	1	100.0	0.0
Full denture	6	50.0	50.0	1	100.0	0.0
Partial denture	1	0.0	100.0	0		

* Rational treatment need determined by dentist considered all of a participant's modifying factors, such as functional status, cognitive status, medical history, medications, social history, financial history, dental history, ethical issues, etc.

Table 36: Denture treatment needed and wanted—lower denture for existing, new and all residents

| | Denture treatment wanted (%) | | | | | |
| | Existing | | | New | | |
	n	Agreed	Disagreed	n	Agreed	Disagreed
Denture treatment needed*						
Adjustment	1	100.0	0.0	0		
Reline	2	50.0	50.0	5	60.0	40.0
Repair	5	60.0	40.0	1	100.0	0.0
Full denture	5	40.0	60.0	1	100.0	0.0
Partial denture	1	0.0	100.0	0		

* Rational treatment need determined by dentist considered all of a participant's modifying factors, such as functional status, cognitive status, medical history, medications, social history, financial history, dental history, ethical issues, etc.

Table 37 presents existing and new participants' perceived dental need by dentate status from interview. Perceived need for dental treatment was low; 15.5% of dentate and 17.4% of edentulous residents perceived a need for treatment. Fewer edentulous existing residents had a perceived need than did dentate existing residents. However, a higher percentage of edentulous new residents had a perceived dental need. The low perceived needs of dentate residents were in contrast to their high normative treatment needs.

Table 37: Existing and new participants' perceived dental need by dentate status from interview

| | Participants' perceived need for dental treatment | | | | | | | | |
| | Existing *(n=111)* | | | New *(n=75)* | | | All *(n=186)* | | |
	Yes	No	Don't know	Yes	No	Don't know	Yes	No	Don't know
Dentate status									
Dentate *(n=71)*	17.1	73.2	9.8	13.3	66.7	20.0	15.5	70.4	14.1
Edentulous *(n=115)*	15.7	73.3	6.7	20.0	73.3	6.7	17.4	79.1	3.5

Table 38 presents normative treatment needs for restorations, extractions and preventive care for existing, new and all dentate residents. Dentate residents required restorations for a mean of 2.9 surfaces. When categorised by type of restoration (for 1–4 surfaces), residents required restoration of 1 surface for a mean of 0.7 teeth; restoration of 2 surfaces for 0.4 teeth, restoration of 3 surfaces for 0.2 teeth and restoration of 4 surfaces for 0.2 teeth. Normative need for extractions was high, especially for existing residents—0.6 teeth per resident. Preventive care was determined at tooth level, and was 0.7 teeth per resident.

Table 38: Existing, new and all dentate residents—normative treatment needs

| | Mean number of teeth requiring treatment | | |
Type of treatment	Existing *n=41*	New *n=30*	All *n=71*
Restorations			
For 1 surface	0.7	0.7	0.7
For 2 surfaces	0.4	0.4	0.4
For 3 surfaces	0.2	0.2	0.2
For 4 surfaces	0.2	0.3	0.2
Extractions	1.0	0.2	0.6
Preventive	0.8	0.6	0.7

4.2 Incidence and increments of oral diseases

Coronal and root caries

The incidence and increments of coronal and root caries over the one year period between the baseline and one-year dental inspections was analysed for the 41 dentate baseline participants who again participated at one-year. Tables 39 and 40 provide details of the numbers of coronal (Table 39) and root (Table 40) caries surface increments and reversals, as well as the decision making used to determine caries increments from the baseline and one-year coding of surfaces. A comparison of baseline and one-year surface coding was made for each individual surface. In Table 39 it can be seen that this comparison was made for 6,068 coronal surfaces. In Table 40 it can be seen that this comparison was made for 5,248 root surfaces. Only surface combinations (and numbers of surfaces for each combination) that occurred from baseline to one-year in this dataset have been presented in these tables. Examiner reversals (Rev) were determined to have occurred when coronal or root surfaces coded as decayed/recurrent/filled/filled unsatisfactory at baseline were coded as sound at one-year. Caries increments (CI) were determined for surfaces with new caries, fillings on previously sound surfaces, and new recurrent caries on previously filled surfaces. In this study there were a large number of plaque-covered surfaces at baseline, and any baseline plaque-covered surfaces that were decayed at one-year were also determined to be a caries increment.

Tables 39 and 40 also provide additional information concerning oral diseases. For example, of the coronal surfaces coded as decayed at baseline, only four were filled at one-year and 35 remained decayed. Of the root surfaces coded as decayed at baseline, only one was filled at one-year and 32 remained decayed. Similarly, retained roots were not being extracted; only four of the 124 baseline coronal surfaces coded as not being present as there was a retained root, were missing (extracted) at one-year.

Table 39: Number of coronal caries surface increments and reversals, and decision making from baseline and one-year coding (total surfaces = 6,068)

Baseline coronal surface coding		One-year coronal surface coding										
		Sound (S)	Decayed (D)	Recurrent (R)	Filled (F)	Filled unsatisfactory (U)	Crown (C)	Retained root sound (Rs)	Retained root decayed (Rd)	Plaque covered (P)	Not accessible (X)	Missing (M)
Sound	(S)	1,440 [a]	+30	+1	+33	–	–	20 [a]	+13 *	38 [a]	–	8 [a]
Decayed	(D)	(14)	35 [b]	+1	4 [b]	3 [b]	–	5 [b]	6 [b]	1 [a]	–	7 [a]
Recurrent	(R)	–	–	6 [b]	4 [b]	–	–	–	–	–	–	–
Filled	(F)	(10)	+8 *	+13	220 [b]	2 [b]	–	9 [b]	+4 *	10 [a]	–	6 [a]
Filled unsatisfactory	(U)	–	–	–	–	2 [b]	–	–	+3 *	–	–	–
Crown	(C)	–	–	–	–	–	38 [a]	–	–	–	–	–
Retained root sound	(Rs)	–	–	–	–	–	–	37 [a]	–	–	–	10 [a]
Retained root decayed	(Rd)	–	–	–	–	–	–	12 *	112 [a]	–	–	4 [a]
Plaque covered	(P)	18 [a]	+5 *	–	1 [a]	–	–	1 [a]	–	4 [a]	–	–
Not accessible	(X)	30 [a]	–	–	14 [a]	–	–	–	+1 *	–	–	–
Missing	(M)	–	–	–	–	–	–	–	–	–	–	3,825 [a]

+ = caries increment
( ) = examiner reversal
a = change in codes is acceptable
b = change in codes is acceptable and used in denominator (x) for adjusted caries increment calculations

– Blank cells—these code changes were not present in this dataset.
* Each individual case re-checked and decision made.

Note: Bold figures indicate no change from baseline to one-year.

Table 40: Number of root caries surface increments and reversals, and decision making from baseline and one-year coding (total surfaces = 5,248)

Baseline root surface coding		One-year root surface coding								
		Not exposed (N)	Sound (S)	Decayed (D)	Recurrent (R)	Filled (F)	Filled unsatisfactory (U)	Plaque covered (P)	Not accessible (X)	Missing (M)
Not exposed	(N)	**468** [a]	111 [a]	23 [a]	–	5 [a]	–	165 [a]	–	33 [a]
Sound	(S)	54 [a]	**243** [a]	+19	+2	+7	+1	119 [a]	–	17 [a]
Decayed	(D)	(7)	(6)	**32** [b]	–	1 [b]	–	20 [a]	–	17 [a]
Recurrent	(R)	–	–	1 [b]	–	1 [b]	–	–	–	–
Filled	(F)	(6)	(5)	+3 *	+1	**24** [b]	1 [b]	15 [a]	–	*
Filled unsatisfactory	(U)	–	–	–	+1	–	–		–	*
Plaque covered	(P)	167 [a]	62 [a]	+10 *		8 [a]		**159** [a]	–	5 [a]
Not accessible	(X)	13 [a]	1 [a]	–	–	–	–	3 [a]	–	–
Missing	(M)	–	–	–	–	–	–	–	–	**3,412** [a]

+ = caries increment
( ) = examiner reversal
a = change in codes is acceptable
b = change in codes is acceptable and used in denominator (x) for adjusted caries increment calculations

– Blank cells—these code changes were not present in this dataset.
* Each individual case re-checked and decision made.

Note: Bold figures indicate no change from baseline to one-year.

Table 41 presents the coronal and root caries increments for decayed and filled surfaces (DFS). For coronal caries, the crude caries increment (CCI) was 2.6 surfaces, the net caries increment (NCI) was 2.2 surfaces, and the adjusted caries increment (ACI) was 2.5 surfaces. For root caries, the CCI was 1.1 surfaces, the NCI was 0.8 surfaces, and the ACI was 1.0 surface. The ACI was used in further longitudinal coronal and root surface caries analyses.

Table 41: Coronal and root caries increments (weighted) (n=41)

	Coronal and root caries increments (decayed/filled surfaces)			
	Coronal surfaces		Root surfaces	
	Mean	SD	Mean	SD
Crude caries increment (CCI)	2.6	(3.8)	1.1	(2.5)
Net caries increment (NCI)*	2.2	(3.9)	0.8	(2.5)
Adjusted caries increment (ACI)**	2.5	(3.8)	1.0	(2.4)

*   NCI = CCI – examiner reversals (Rev)
**   ACI = CCI (1 – (Rev / (Rev + x)))   where x =Decayed/Recurrent/Filled/Filled unsatisfactory (baseline) to
                    Decayed/Recurrent/Filled/Filled unsatisfactory/Root sound (one-year)
                    (see Tables 39 and 40 for more details)

Table 42 presents the participants' coronal and root caries incidence rates. Coronal caries occurred in 64% of participants. Root caries occurred in 49% of participants.

Table 42: Coronal and root caries incidence rates (weighted) (n=41)

Coronal and root caries incidence rate (decayed/filled surfaces)	
Coronal surfaces (%)	Root surfaces (%)
64.4	48.5

Tooth loss and retained roots

Tables 43–45 present incidence data for tooth loss and retained roots for the 41 existing dentate participants. These residents had a mean of 19.9 missing teeth at baseline, and only 6.9% lost one or more teeth during the one-year study period; mean number of teeth lost was 0.1 teeth (Table 43). Two existing dentate residents became edentulous during the study period.

Table 43: Mean numbers of teeth and percentage of existing participants losing 1+ teeth during one-year study period* (weighted) (n=41)

	Number missing teeth at baseline	Number missing teeth at one-year	Mean number of teeth lost	% participants losing 1+ teeth
Mean	19.9	20.0	0.1	6.9%
SD	(6.7)	(6.8)	(0.4)	

*   Two participants became edentulous during the study period.

Table 44 presents data concerning retained roots. These residents had a mean of 1.0 retained roots at baseline, and 52.5% of existing dentate residents had one or more retained roots present at baseline. At one-year, these residents had a mean of 1.3 retained roots present, and 63.4% of residents had one or more retained roots. This resulted in an overall increase of 0.3 retained roots per resident during the study period. However, as seen in Table 45, the majority of residents had the same number of retained roots at one-year as at baseline (64.4%). Nearly one-quarter (23.8%) had one more retained root at one-year, and a minority had 2 more retained roots at one-year. Very few residents had any retained roots removed (5.9%).

Table 44: Mean numbers of retained roots present and percentage of participants with 1+ retained roots during one-year study period for existing participants (weighted) (n=41)

	Number retained roots at baseline	% of participants with 1+ retained roots at baseline	Number retained roots at one-year	% of participants with 1+ retained roots at one-year	Change in mean number of retained roots
Mean	1.0	52.5%	1.3	63.4%	0.3
SD	(2.6)		(3.0)		0.7

Table 45: Change in number of retained roots during one-year study period for existing participants (weighted) (n=41)

Change in number of retained roots during study period	% of participants
−1 retained root	5.9
Same number of retained roots (possibly 0)	64.4
+1 retained root	23.8
+2 retained roots	5.9

Residents' characteristics associated with caries increments

Coronal caries (weighted)

Table 46 presents coronal caries increments (ACI) by residents' characteristics. Significant differences in coronal caries increments were found for several of these characteristics. Residents with fewer medical conditions had significantly higher coronal caries increments, as did residents taking fewer medications. Those residents who had lost weight and who could eat fewer foods had significantly higher coronal caries increments. Residents with dementia had higher coronal caries increments, but this difference was not significant.

Table 46: Coronal caries increments (ACI) by residents' characteristics (weighted) (n=41)

	Coronal caries increments		
	n	**Mean**	**SD**
Number of medical conditions*			
1–3	6	7.3	(8.0)
4–5	14	1.7	(2.1)
6+	21	1.9	(2.6)
Number of medications*			
1–4	3	6.3	(8.5)
5–7	12	2.3	(3.0)
8+	26	1.7	(2.2)
Time since admitted			
<3 years	13	1.4	(1.5)
3+ years	28	2.7	(4.2)
Time since last visit			
<12 months	16	2.5	(2.6)
≥12 months	15	2.1	(2.5)
ADL score (no. of dependent activities)			
0–4	6	2.8	(1.8)
5	12	1.3	(2.4)
6	23	3.1	(4.7)
MMSE score			
≤10	22	2.8	(4.7)
11–30	16	1.6	(1.8)
Diagnosed dementia			
Yes	26	3.0	(4.5)
No	15	1.5	(1.8)
Body weight change per month*			
Negative	21	3.7	(4.7)
Positive	17	1.2	(1.4)
Soft diet			
Yes	23	2.8	(4.5)
No	18	2.0	(2.4)
Number of foods can eat*			
0–1	3	6.3	(8.4)
2–3	28	2.2	(2.6)
4–5	10	1.1	(1.8)
Total	**41**	**2.4**	**(3.8)**

* sig. $p < 0.05$ weighted least squares regression (first category different from remaining categories—Tukey HSD test)

Root caries (weighted)

Table 47 presents root caries increments (ACI) by residents' characteristics. No significant differences were found for root caries increments among these characteristics.

Table 47: Root caries increments (ACI) by residents' characteristics (weighted) (n=41)

	Root caries increments		
	n	Mean	SD
Number of medical conditions			
1–3	6	2.4	(6.6)
4–5	14	0.8	(0.7)
6+	21	0.8	(1.4)
Number of medications			
1–4	3	0.3	(0.5)
5–7	12	0.7	(1.0)
8+	26	1.3	(3.0)
Time since admitted			
<3 years	13	1.0	(2.0)
3+ years	28	1.0	(2.5)
Time since last visit			
<12 months	16	1.3	(1.2)
≥12 months	15	1.1	(3.6)
ADL score (no. of dependent activities)			
0–4	6	1.5	(1.6)
5	12	0.5	(0.8)
6	23	1.1	(3.1)
MMSE score			
≤10	22	0.6	(1.1)
11–30	16	1.4	(3.7)
Diagnosed dementia			
Yes	26	0.6	(0.8)
No	15	1.6	(3.9)
Body weight change per month			
Negative	21	1.1	(3.1)
Positive	17	0.9	(1.6)
Soft diet			
Yes	23	0.6	(1.1)
No	18	1.5	(3.5)
Number of foods can eat			
0–1	3	0.3	(0.5)
2–3	28	0.8	(1.2)
4–5	10	1.9	(5.1)
Total	**41**	**1.0**	**(2.4)**

Note: Weighted least squares regression; no significant differences.

5   Discussion

Residents' characteristics in this one-year Adelaide study sample were similar to those reported by the AIHW (1998) for all South Australian nursing home residents. Residents' age, sex, government card status, time since admitted, and dependency levels were all comparable.

Several of the study's limitations have been comprehensively discussed in the baseline report (Chalmers et al. 1999). At one-year, there were several additional methodological limitations and problems encountered:

1. low guardian response rate—this appeared to be specific to the largest nursing home and strategies to address this need to be carefully considered in future studies;

2. baseline participants who had deceased or did not participate at one-year were more cognitively impaired and had higher Plaque Index scores than those who did participate at one-year—although intuitively expected, this may have resulted in an underestimation of oral disease incidence;

3. high rates of death among existing and new participants—this study now provides some estimates of these rates to be used to improve sampling strategies for future studies; and

4. effect of the study on carers' provision of oral hygiene care for residents—the decreased rates of denture-related oral mucosal problems found in the one-year study, may have indicated that carers were now providing better denture care. However, the high prevalence of other oral diseases and high Plaque Index scores indicated that this improved oral hygiene care did not extend to natural teeth. Although a dental in-service education session was offered to all participating nursing homes after the baseline data collection, only 3 nursing homes requested the in-service session, and staff attendance was low (3–8 staff at each session).

The first of the study aims was to compare dental history characteristics, oral hygiene characteristics, demographic characteristics, cognitive status, medical status, functional status, nutritional status, dentate status, oral disease prevalence and experience, normative dental needs and perceived dental needs of existing nursing home residents with residents who were new to the nursing home since the baseline dental inspections. Overall, very few of these characteristics differed significantly between existing and new residents. When compared with previous study results (Vowles et al. 1979; Walker 1984), these baseline and one-year data highlight how dramatically nursing home residents' dental profile has changed in recent years, and provides an indication of the problems and challenges that the future may hold for this increasingly dentate older adult population.

The prevalence of edentulism was slightly lower at one-year (63%) than at baseline (66%) (Chalmers et al. 1999). This was again much lower than the 80–90% edentulism rate reported in previous studies in the 1970s and 1980s (Vowles et al. 1979; Walker 1984), but is still higher than national estimates for similarly aged (85+ years) Australians (Chalmers et al. 1999). The percentage of edentulous residents did not significantly differ between existing and new residents. Mean number of teeth for all

dentate residents examined at one-year (11.6 teeth) was similar to that reported at baseline (11.9 teeth). This was again greater than the mean number of teeth reported in previous studies in the 1970s and 1980s (Vowles et al. 1979; Walker 1984). As may have been expected, new residents had a significantly greater mean number of teeth than did existing residents.

As was found at baseline, the residents participating in the Adelaide Dental Study of Nursing Homes were very functionally dependent, medically compromised, cognitively impaired and behaviourally difficult older adults. Although new residents were significantly younger than existing residents, the mean age of new residents was still over 80 years. Participating residents had a mean number of 6 chronic medical conditions, took a mean number of 9 medications, and were dependent for nearly all activities of daily living. This complex resident profile did not change during the study period.

The baseline and one-year cross-sectional data provided estimates of the nursing home population who were eligible for public-funded dental care, care funded by the Department of Veterans' Affairs, and dental care provided by private dental practitioners. Approximately 70% of dentate and 80% of edentulous residents, both existing and new, were card holders eligible for public-funded dental care. Approximately 13%, of both existing and new, were Department of Veterans' Affairs card holders and thus were eligible for subsidised treatment provided by private dental practitioners registered with the Department of Veterans' Affairs. Up to 15% of existing and new residents were not card holders of any type, and required dental care provided by private dental practitioners, at their own cost unless subsidised by private health insurance. As discussed in the baseline report, both private and public dental sectors play an important role in dental care provision for nursing home residents. However, this study did not quantify or specifically identify the individual resident's dental care providers, whether public or private. It is important that this information be collected in future studies.

The analysis of existing versus new residents' characteristics further reinforced the great impact that dementia has had on the changing oral health status of nursing home residents. As was evident at baseline, the great majority of residents had moderate to severe cognitive impairment, with many of the remaining residents' cognitive testing scores indicative of mild cognitive impairment. New residents were admitted to the nursing homes with similar levels of cognitive impairment as those residents already living at the nursing homes. Dementia, followed by stroke, was by far the most prevalent chronic medical condition reported for these residents.

One of the main influences on the development of oral diseases in older adults is the standard of oral hygiene care. As was found at baseline, carers experienced many problems with oral hygiene care provision for residents with dementia. It would appear that carers experienced more complex problems than they reported, and these need to be further researched. Informal discussions with staff highlighted how these problems frequently negated their attempts and resulted in no oral hygiene care being provided. Cleaning of dentures and teeth in the nursing homes was generally reported to be conducted on a daily basis. However, as discussed in the baseline report, it is doubtful that regular and adequate daily oral hygiene care was provided for behaviourally difficult residents. The high levels of plaque accumulation on residents' natural teeth did not support the carers' reported frequency of oral hygiene care provision. It would seem apparent that the types of behavioural problems carers encountered in relation to oral hygiene practices would have impacted on residents'

eating abilities and type of diet. At least half the residents ate a soft or vitamised diet, and the majority of residents were able to eat only softer food types. The results of this study suggest that dietary type and eating abilities were compromised in residents who wore dentures, as up to one-fifth of residents who owned dentures did not wear them, and more than 40% of residents had unsatisfactory denture retention and stability. The reasons for residents' diet type and the impact of behavioural and dental problems on diet type consitute an important area for future study. Although an assessment of residents' swallowing problems was not conducted in this study, discussions with staff and observations of the residents during the dental inspections did indicate that swallowing problems impacted greatly on residents' diet and on oral hygiene care provision. These discussions and observations revealed that staff were very concerned about residents, especially those with dementia or stroke, not being able to rinse and spit safely, and about them swallowing mouthrinses and toothpaste. An additional reason for concern in these residents was the high accumulation of plaque on dentures and natural teeth. Recent research has identified a causal link between high levels of plaque accumulating over time and the occurrence of aspiration pneumonia (Loesche & Lopatin 1998). The combination of risk factors present in these nursing home residents, including eating and swallowing problems, functional dependency, use of antibiotics, xerostomia and high levels of plaque accumulation, place them at high risk for developing aspiration pneumonia (Loesche & Lopatin 1998).

Although assessments of xerostomia and salivary gland hypofunction were not made in this study, it was noted that residents were taking many medications with adverse effects on saliva. Additionally, many residents were taking antipsychotic medications with adverse oral movement effects such as tardive dyskinesia. Collection of such data is complex and challenging in this population. However, in future studies, investigation is needed of polypharmacy, history of medication dosage and length of time taken, and medications with adverse oral effects.

In contrast to their high levels of oral diseases, both existing and new residents had low levels of perceived dental pain/discomfort and perceived need for dental treatment. As many of the residents had moderate to severe dementia, and many were on several antipsychotic, pain relieving or sedative medications, it seems reasonable to suggest that pain was being masked or they had difficulties communicating any dental pain/discomfort to others. Indeed, their behavioural and communication problems may have complicated carers' attempts to understand any expressions of oral pain/discomfort. Also of concern were the low levels and types of dental treatment being provided for both the existing and new cognitively impaired nursing home residents. Access to denture treatment and tooth extractions appeared to be greater than access to restorative or preventive dental care. Although dental treatment was sometimes conducted at the nursing home, there was little evidence in either the questionnaire or the dental inspection data of much restorative treatment being provided. It is important to note that most residents accessed dental care only when they had a problem rather than regularly for a check-up.

Results from the baseline questionnaires administered to dentists and Directors of Nursing, together with the findings from the longitudinal clinical dental inspections, indicated the urgent need for dental professionals to become more knowledgeable about all aspects of dementia and stroke. They also highlighted the need for the dental profession to look beyond traditional dentistry for solutions to the problems of behaviour management, severe oral diseases, and difficulties in providing oral hygiene care that are abundant in cognitively impaired older adults.

The high experience of coronal and root caries at one-year was similar to the experience at baseline. As reported at baseline, coronal and root caries experience at one-year was again many times greater than found in community-dwelling older adults without dementia. Any residents with caries evident at the dental inspection were referred to a private or public dentist for treatment. However, many of the existing male residents who had high numbers of decayed and sound retained roots present at baseline, still had those roots present at one-year. This indicated that the dentists who were referred patients experienced difficulties providing treatment for these nursing home residents, or made treatment planning decisions not to extract, restore, or preventively treat the retained roots.

There were no significant differences between existing and new residents in terms of their tooth status, coronal caries prevalence and experience, or root caries prevalence and experience, with the exceptions that new residents had significantly more filled coronal and root surfaces, and new residents had significantly fewer decayed retained roots. When comparing caries attack rates, similar rates were found for existing and new residents; rates at one-year were higher than at baseline. Coronal caries attack rates had increased from 17.1% at baseline to 17.7% at one-year; root caries attack rates (=Root Caries Index) had increased from 19.6% to 25.2%. Examiners reported caries on many anterior incisal edges with attrition into the tooth's dentine and pulp. In future studies it would be important to score the worn anterior tooth incisal area separately, rather than scoring it on the adjacent lingual surface.

Large numbers of tooth surfaces were covered in plaque and debris that negated more precise assessment of caries at baseline and one-year, and this highlights two important issues. Firstly, caries experience may have been underestimated. Surface level longitudinal data does support this. Secondly, the ability to remove this debris before conducting an epidemiological dental inspection will be greatly compromised and at most times impossible to achieve in this population. Time spent removing the debris may reduce the residents' cooperative time available to complete the dental inspection. Also, removal of plaque and debris one or more days prior to the dental inspection may be ineffective. These methodological issues need to be considered further in the planning and pilot stages of future studies.

This study was one of the first international longitudinal geriatric dental research investigations of institutionalised older adults. Thus, the longitudinal caries results presented will be useful when researchers are planning future research in dependent older adult populations. The coronal and root caries increments occurring in these nursing home residents were many times greater than that reported from longitudinal studies of generally healthy, community-dwelling older South Australians (Chalmers 1997). Caries increments in this population were greater over one year than were found over 3–5 years in the community-dwelling older adults (Chalmers 1997). Results from longitudinal caries analyses also support concerns about residents' eating abilities and type of diet. Residents who had lost weight and who could eat fewer foods had significantly higher coronal caries increments. Residents with dementia did have higher coronal caries increments, but this difference was not significant. However, this study did not fully elucidate the complex relationships between oral diseases and residents' declining cognitive status, declining functional status, nutritional and eating problems, swallowing problems, salivary dysfunction and use of medications with adverse oral effects.

The longitudinal data presented in the Adelaide Dental Study of Nursing Homes may even have been underestimating oral disease progression. Dental inspection protocol

rules dictated that if both the coronal and root surfaces were affected by caries or a restoration, the lesion's origin had to be determined. If more than half of the lesion was above the cemento-enamel junction (CEJ) it was regarded as a coronal lesion only; if more than half of the lesion was below the CEJ it was regarded as a root surface lesion only. Thus, many of the examiner reversals evident in both the coronal and root caries increment data (presented in Tables 39 and 40) occurred because of the need to determine and score only the origin of the caries/restoration. In many instances, a carious lesion initially scored as coronal had progressed, and so at one-year was scored as a root lesion, resulting in an examiner reversal for the coronal surface. Also, as discussed comprehensively by Beck and colleagues, the problem of missing teeth and the higher rate of tooth loss in older adults often results in the underestimation of caries incidence (Beck et al. 1997).

Thus, from the Adelaide Dental Study of Nursing Homes baseline and one-year data collections, it appeared that new residents were being admitted to nursing homes with a compromised oral health status, or developed severe coronal and root caries within several months of their admission. New residents had a poor oral health status, and oral diseases, especially coronal and root caries, progressed rapidly during residents' stay at the nursing home. The deterioration in the oral health status of these mainly cognitively impaired older adults appeared to be occurring in the moderate to severe stages of dementia. However, to further clarify when the onset of severe oral diseases occurs, additional longitudinal study data is required that provides an assessment of oral health status upon admission to nursing homes, together with longitudinal data from community-dwelling older adults prior to their move into residential care. A concurrent longitudinal study being conducted by the AIHW DSRU, with randomly selected community-dwelling older adults with and without dementia, will greatly assist us to understand the exact timing of and conditions required for the onset and progression of severe oral diseases. Preliminary results from this study have intimated that severe oral disease onset is most likely to occur when the cognitively impaired person's functional limitations, behavioural and communication problems, polypharmacy and salivary dysfunction are high and result in high levels of carer burden, most probably during the year or so prior to institutionalisation.

6 Conclusions

As was found at baseline, the residents participating in the Adelaide Dental Study of Nursing Homes were very functionally dependent, medically compromised, cognitively impaired and behaviourally difficult older adults. Existing and new residents of Adelaide nursing homes had similar dental history characteristics, oral hygiene characteristics, demographic characteristics, cognitive status, medical status, functional status, nutritional status, dentate status, oral disease prevalence and experience, normative dental needs and perceived dental needs.

The percentage of edentulism (63%) did not significantly differ between existing and new residents. New residents had significantly more teeth present than existing residents. The great majority of residents had moderate to severe cognitive impairment. New residents were admitted to the nursing homes with levels of cognitive impairment that were similar to existing residents. Residents with dementia, whether existing or new to the nursing home, gave carers many complex problems in providing oral hygiene care. The great majority of residents (80%+) were eligible for public dental care and/or for care subsidised by the Department of Veterans' Affairs.

There were no significant differences between existing and new residents in terms of their tooth status, coronal caries experience, or root caries experience, with the exceptions that new residents had significantly more filled coronal and root surfaces, and significantly fewer decayed retained roots. The high experience of coronal and root caries at one-year was similar to the caries experience at baseline; coronal and root caries experience at one-year was again many times greater than found in community-dwelling older adults. Similarly, large numbers of tooth surfaces were covered in plaque and debris, which ruled out more precise assessment of caries. In contrast to their high levels of oral diseases, both existing and new residents had low levels of perceived dental pain/discomfort and perceived need for dental treatment.

The coronal and root caries increments occurring in these nursing home residents were high; they were many times greater than that reported from longitudinal studies of community-dwelling older adults. Residents with eating difficulties and dementia were at higher risk for developing oral diseases and posed many challenging oral hygiene care problems to their carers. New residents were being admitted to nursing homes with a compromised oral health status, or developed coronal and root caries within several months of their admission. The oral health status of new residents was poor, and oral diseases, especially coronal and root caries, progressed rapidly during residents' stay at the nursing home. The deterioration in the oral health status of these mainly cognitively impaired older adults appeared to be occurring in the late-moderate to severe stages of dementia.

Results from the baseline questionnaires administered to dentists and Directors of Nursing, together with the findings from the clinical dental inspections, indicated the urgent need for dental professionals to become more knowledgeable about dementia and stroke.

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