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The oral health of older adults with dementia

JM Chalmers, KD Carter, AJ Spencer

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

The Director
AIHW Dental Statistics and Research Unit
ARCPOH, Dental School
The University of Adelaide
SOUTH AUSTRALIA 5005

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

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The oral health of older adults with dementia

Dr Jane M Chalmers
Senior Research Fellow
Australian Research Centre for Population Oral Health
The University of Adelaide

Mr Knute D Carter
Research Officer
Australian Research Centre for Population Oral Health
The University of Adelaide

Professor A John Spencer
Director
Australian Research Centre for Population Oral Health
The University of Adelaide

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Executive summary

The emergence of dementia as a key issue in Australian aged care has been acknowledged with the ongoing restructuring of aged care services in Australia. Several international geriatric dental studies have documented the complex oral health problems of older adults with dementia living in both the community and institutional long-term aged care. From previously conducted, mainly cross-sectional, geriatric dental investigations of older adults with dementia, it appeared that the specific diagnosis of dementia did not seem to be as influential on oral health as was the severity of dementia. However, there have been no international or Australian dental longitudinal studies following the movement of a large number of community-dwelling older adults with dementia over time into residential care.

To build upon the research conducted to date and to better understand the onset and progression of oral diseases in people with dementia, more comprehensive longitudinal data are needed to identify those cognitively impaired older adults at highest risk. People with dementia need to be followed as their dementia progresses and many of them move from their community-dwelling into residential care. The life characteristics of older adults with dementia need to be more comprehensively investigated. These include general health characteristics such as co-morbid medical conditions, medications, functional status, cognitive status, affective functioning, nutrition, swallowing, eating abilities and sociodemographic characteristics. Social support and communication characteristics also need to be investigated, including residential location and type, financial support, social support, carer involvement, carer burden, communication abilities and behavioural problems. Dental and oral hygiene characteristics such as preventive daily oral hygiene care, fluoride exposures, uses of antimicrobials, xerostomia and salivary gland hypofunction, bacterial plaque colonisation, and normative versus perceived dental needs must also be assessed.

Therefore, to investigate these questions, a longitudinal study of community-dwelling older adults with and without dementia was designed. The study's hypotheses were that:

1. at baseline and one-year, coronal and root caries experience, presence of retained roots, and plaque accumulation are higher in participants with moderate to severe dementia, but not participants with mild dementia, when compared to participants without dementia;

2. coronal and root caries increments are higher in participants with dementia compared to participants without dementia;

3. caries experience is related to dementia severity and not to specific dementia diagnoses; and

4. coronal and root caries experience and increments in those with dementia are related to their demographic, medical, medication, functional, cognitive, nutritional, swallowing, dental history and oral hygiene care characteristics, and their residential location.

The purpose of the longitudinal study was to investigate and compare the oral health status of randomly selected samples of community-dwelling dentate older adults with and without dementia in Adelaide, South Australia. Baseline data collection commenced during late 1998 and one-year follow-up data collection commenced in late 1999. Two-year follow-up data collection commenced in late 2000. Approval for the study was obtained annually from The University of Adelaide Human Ethics Committee.

The participants without dementia were randomly selected from those residing in Adelaide in The South Australian Dental Longitudinal Study (SADLS), a study of community-dwelling older adults coordinated by the same research team. In-scope non-dementia participant selection precluded any dentate SADLS participants who had: (1) required a home visit because of their functional, cognitive and/or medical problems; or (2) had a medical diagnosis of dementia or cognitive testing score indicative of dementia. Dementia participants were recruited from The Alzheimer's Association of South Australia, who provided a list of carers that had contacted the Association. All initial contacts with randomly selected dementia participants were coordinated with the Association's assistance. In-scope dementia participants were those who were dentate and community-dwelling and had a formally diagnosed dementia. Confirmation of dementia diagnosis was obtained from the diagnosing doctor on the telephone or in writing. The sex and age of the person with dementia was also recorded to coordinate as closely as possible with the sampling availability of comparison non-dementia participants.

Dementia participants were categorised into one of four groups by their sex (male/female) and their age (<79 years and 80+ years), to enable sex/age group matching with comparison community-dwelling non-dementia participants. The sampling strategy for dementia participants was based on previous studies conducted in the United States. Sample size requirements were based on the numbers of available SADLS comparison participants and on estimates of coronal and root caries increments reported in these US studies, as there were no available comparable Australian data. Interviews and dental inspections were conducted at baseline over an 11-month period, and again at one-year and two-years, using a staggered approach among the dementia and non-dementia participants. The National Institute of Dental Research (NIDR) (1987) protocol was used by calibrated dentists for the dental inspections in the study and inter-examiner reliability was analysed using intra-class correlation.

A questionnaire with close-ended questions was used to collect information concerning: sex, age, country of birth, marital status, government-card-holder status, private health insurance status, smoking and alcohol consumption, medical history, current prescription and over-the-counter medications, chewing abilities (from a list of five food types and at one-year diet type), educational background, oral hygiene care frequency and assistance required with oral hygiene care for both dentures and natural teeth, use of oral hygiene products, problems encountered by carers when providing oral hygiene care, any current dental pain or discomfort, any perceived need for dental treatment, dental attendance type (check-up or for a problem), avoidance of dental care because of cost, time since last dental visit, reason for last dental visit, treatment provided at last dental visit and location of last dental visit. For dementia participants, additional questions were asked such as the relationship of the carer to the person with dementia, where the carer lived, the specific dementia diagnosis from a medical practitioner, and the number of years since dementia diagnosis. Many of these interview questions had been developed and used in the SADLS of older adults.

The instruments used to assess functional status, affective functioning and cognitive status are all valid and reliable instruments widely used in research with functionally

dependent older adults (AIHW 1994). Assessment of functional status was conducted using the Lawton & Brody (1969) Instrumental Activities of Daily Living scale (IADL) and the Katz et al. (1963) Index of Activities of Daily Living scale (ADL).

The cognitive testing instruments used were the Mini-Mental State Exam (MMSE) (Folstein et al. 1975), the Global Deterioration Scale (GDS) (Reisberg et al. 1982) and the Clock-drawing test (Tuokko et al. 1992). An MMSE and GDS were conducted for all dementia and non-dementia participants. If the subject had completed an MMSE test recently, those results were accepted. A trained dentist or interviewer conducted the MMSE, GDS and clock-drawing test. The MMSE scores were categorised using the system developed by Mungas (1991). Those participants scoring 26 or greater (out of 30) were categorised as 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. The MMSE could not be completed for participants who were deaf or blind, or who could not talk. The GDS required the administrator to categorise the participant into one of seven categories from normal cognition to very severe cognitive decline. The GDS could be completed for all participants. The clock-drawing test instructed the participant to imagine that a pre-drawn circle was the face of a clock, and required them to place the numbers on the clock and then the hands on to indicate the time twenty minutes to three. If participants were unable to write, a clock-drawing test was not completed.

At the one-year data collection round, additional data were collected concerning carer burden, participants' swallowing problems, their sources of fluoride and date of admission to residential care facility. These data were not collected at baseline. Participants and, if necessary, their carers were asked to rate the severity of any swallowing problems they had from normal to severe. Carer burden was assessed using the Zarit Burden Scale, in which carers rated the frequency of their feelings of burden from never to nearly always (Zarit et al. 1980, 1986). Carers were able to complete this 22-item questionnaire during the dental appointment visit or were able to mail the completed questionnaire in a reply-paid envelope. Only carers of community-dwelling dementia participants were given the burden questionnaire. Participants' swallowing problems were assessed using a standardised four-point scale (Newton et al. 1994). Sources of fluoride from toothpaste, other dental products and water were noted. If the participant had moved into residential care, their date of admission into the facility was noted.

The study results highlighted that the oral health of participants with dementia was significantly worse than that of their comparison participants without dementia:

- Dementia participants' general health and other characteristics declined from baseline to one-year. Dementia participants' profile became more complex; they became more functionally dependent (ADL and IADL scores), more cognitively impaired (GDS, MMSE scores), more medically compromised and more nutritionally compromised. Dementia participants could eat fewer food types at one-year, 12.6% were eating a soft diet and one-quarter had swallowing problems. Just under one-third of dementia participants were institutionalised between baseline and one-year.
- At one-year higher percentages were taking antidepressant, neuroleptic and sedative/anxiolytic medications; and fewer participants were taking anticholinesterase inhibitor medication. The great majority of those taking neuroleptics were taking traditional neuroleptics with high anticholinergic adverse effects.
- Dental history characteristics did not dramatically change from baseline to one-year for dementia participants, with similar distributions for participants' perceived dental

needs and dental attendance pattern. However, significantly fewer dementia participants had attended the dentist in the previous 12 months at both baseline and one-year.

- Many more dementia participants required assistance with oral hygiene care by one-year, and more than double the percentages of participants' carers had various difficulties with oral hygiene care; at one-year, one-quarter of dementia participants were forgetting to do their oral hygiene care or needed reminding to do so. Dementia participants' resistive and combative behaviours during oral hygiene care had also increased by one-year, with one-quarter to one-third refusing oral hygiene care and not opening their mouth for oral hygiene care.
- The decreasing fluoride sources among dementia participants was of concern; almost no dementia participants (at either baseline or one-year) were using either a cosmetic or a therapeutic mouthrinse, and at one-year only a little more than half of the dementia participants were using a fluoride toothpaste but not drinking fluoridated water. Many participants were using bottled or rain water.
- Mean number of teeth present was 16.5 for dementia and 15.7 for non-dementia participants.
- There was a marked decrease in the use of dentures over the one-year period in the dementia group. Dementia participants had more than double the prevalence of maxillary denture stomatitis, and many times higher prevalence of angular cheilitis at both baseline and one-year.
- The overall dental treatment need perceived at interview by participants in both dementia and non-dementia groups was low—approximately 20% of participants. Many of the dementia participants with high levels of caries and their carers appeared to be unaware of the severity of their oral problems.
- At one-year the highest mean PI scores were in dementia participants who: had been institutionalised between baseline and one-year (PI=2.0), were dependent for 3–6 ADLs (PI=1.9), had not visited the dentist in the previous 12 months (PI=1.7), needed assistance with oral hygiene care, could eat fewer food types; and whose carer had difficulties with oral hygiene care (PI=1.6). These high plaque levels are of great concern in these dependent and medically compromised individuals, as the accumulation of plaque over time on natural teeth and dentures places them at high risk for developing aspiration pneumonia.
- There was a distinctive caries trend in the older adults with dementia, with the majority of dementia participants having untreated decay during the study period. At baseline coronal and/or root caries was present in just under half of participants in the dementia group, compared with a figure of 15.5% for the non-dementia group. At one-year coronal and/or root caries was present in just under 60% of participants in the dementia group, compared with a figure of 28.3% for the non-dementia group. Dementia participants had significantly higher numbers of decayed teeth and coronal and root surfaces. However, numbers of missing teeth, filled teeth, plaque-covered teeth, retained roots and overall DMFT did not significantly differ between the two groups. At the surface level, again, numbers of filled surfaces and decayed/filled surfaces (DFS) and caries attack rates did not significantly differ between the two groups.

- Coronal and root caries increments were higher in participants with dementia compared to participants without dementia. Caries experience was markedly lower at baseline than at one-year in the dementia group and, together with the incidence and increment data, revealed that the onset of severe dental caries occurred in many of the dementia participants between baseline and one-year in this study. Caries incidence rates indicated that 71.8% of dementia participants developed new coronal caries, and 62.1% of dementia participants developed new root caries. These percentages were significantly higher than those under 50% for non-dementia participants. The distribution of numbers of surfaces with caries increments occurring revealed that non-dementia participants had increments on fewer coronal and root surfaces than did dementia participants.
- At baseline and one-year, coronal and root caries experience was higher in participants with moderate to severe dementia, but not in participants with mild dementia, when compared to participants without dementia. This was supported by bivariate analyses of cross-sectional and longitudinal data.
- Caries experience was related to dementia severity and not to specific dementia diagnoses.
- Coronal and root caries experience was higher in dementia participants with moderate to severe dementia, those who were socioeconomically disadvantaged (government-cardholders, no private health insurance), those who were more functionally dependent, those who were taking neuroleptic medications with high anticholinergic adverse effects, those with eating and swallowing problems, those who were not attending the dentist regularly, those who needed assistance with oral hygiene care, those who were behaviourally difficult for carers during oral hygiene care and those whose carers were burdened. This was supported by bivariate analyses of cross-sectional and longitudinal data.
- There was a distinct subgroup of dementia participants who had retained roots present at baseline (20.4%), who had increased numbers of retained roots present at one-year (8.7%) and who had retained roots extracted between baseline and one-year (5.9%). A small subgroup of non-dementia participants also had retained roots present at baseline (8.8%), had increased numbers of retained roots present at one-year (4.4%), and had retained roots extracted between baseline and one-year (1.8%). Interestingly, tooth loss distribution was similar for both dementia and non-dementia groups, with 18.4% of dementia and 15.0% of non-dementia participants losing one or more teeth between baseline and one-year.

In this study, the oral health of older participants with dementia was significantly worse than that of their comparison participants without dementia, including: coronal and root caries prevalence, experience, incidence and increments; presence of retained tooth roots; use of dentures; denture-related oral mucosal lesions; and plaque accumulation. Caries experience was related to dementia severity and not to specific dementia diagnoses. Dementia participants' worse levels of oral health were related to many of their demographic, medical, medication, functional, cognitive, nutritional, swallowing, dental history and oral hygiene care characteristics.

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1 Introduction

1.1 Background

Dementia is a leading individual cause of disease and injury burden in both males (5.3%) and females (8.9%) aged 65+ years and is the leading neurological cause of disease and injury burden in older Australians aged 65+ years (AIHW 2000). Dementia is the sixth leading cause of disease burden in the Australian population, and accounts for 3.5% of the total burden (AIHW 2000). The actual prevalence and incidence of dementia in Australia are unknown. Estimates derived from the 1998 ABS Survey of Disability, Ageing and Carers showed that 4.3% of the population aged 65 years and over and 21.9% of those aged 85 years and over reported dementia. These estimates are considerably lower than those for most OECD countries because the ABS survey relied on self or carer reporting and some people with mild or even moderate dementia might not have reported the condition. Estimates based on an average of prevalence rates in OECD countries indicate that the number of Australians with dementia would be about 167,000 in 2002 (AIHW 2004). Henderson et al. (1994) used these age-specific rates and calculated the estimated number of Australians with dementia to be 130,000. By 2006 the number of Australians with dementia is estimated to be more than 200,000, and by 2041 more than 450,000 (Department of Health and Family Services 1996; Henderson et al. 1998). Using Australian Bureau of Statistics 1996 population projections, Henderson et al. (1998) have projected that, Australia-wide, the 'percentage increase in dementia cases is projected to be much greater than the increase in either the total population or the elderly population'. The expected survival of people with dementia, from the point of medical detection, is 93% at 1 year, 49% at 5 years and 16% at 10 years (Henderson et al. 1998). The emergence of dementia as a key issue in Australian aged care was acknowledged with the ongoing restructuring of aged care services in Australia in 1997–98, under the National Aged Care Strategy (AIHW 1999).

Why is maintaining good dental health important for adults with dementia? Adequate oral health is important to maintain these people's quality of life so that they can: talk comfortably and confidently, enjoy eating comfortably, maintain confidence in their appearance, stay pain free, maintain habits/standards of oral health they have had during their life, and stay as healthy as possible. It is important for medical reasons: to minimise sources of micro-organisms from the mouth that may later involve other parts of the body (e.g. bacteraemias, aspiration into the lungs), to manage medication side-effects (e.g. dry mouth, gingival overgrowth, excessive movement of the mouth (tardive dyskinesia)), to detect dental pain that may be masked by analgesic and sedative medications, to manage medical condition side-effects (e.g. swallowing, speech problems), to assist with nutritional intake, to prevent aspiration of loose teeth, to prevent dental emergencies or need for general anaesthesia and to minimise the risk of unnecessary tooth extractions. Good dental health also helps to minimise behavioural problems in people with dementia due to dental pain (e.g. disinterest in or avoidance of food, pulling at the mouth or face, chewing of the lip or tongue, excessive grinding of teeth or dentures, aggression, withdrawal) (Chalmers et al. 1997).

In addition, although not yet fully elucidated, there is growing interest in the relationships between oral health morbidity and general health morbidity, and vice-versa. Relationships being investigated include the two main causes of death in older Australians, circulatory and respiratory conditions (AIHW 2000; Loesche & Lopatin 1998).

Evidence is growing to support the link between oropharyngeal secretions, respiratory pathogen colonisation of dental plaque and aspiration pneumonia; as well as the links between periodontal diseases and cardiovascular conditions (Loesche & Lopatin 1998).

Several international geriatric dental studies have documented the complex oral health problems of older adults with dementia living in both the community and institutional long-term aged care (Dolan & Atchison 1993; Jones et al. 1993; Ship 1992; Ship & Puckett 1994; Warren et al. 1997). However, there have been no international or Australian dental longitudinal studies following the movement of a large number of community-dwelling older adults with dementia over-time into residential care (Dolan & Atchison 1993a). Indeed, in many of the Australian and overseas dental studies investigating the oral health of older adults, both in the community and in nursing homes, there have been exclusion criteria in place restricting participation of older adults with cognitive impairment (Chalmers 2000b). From previously conducted geriatric dental investigations of older adults with dementia, it appeared that the specific diagnosis of dementia did not seem to be as influential on oral health as was the severity of dementia (Chalmers 2000b).

To build upon the research conducted to date and to better understand the onset and progression of oral diseases in people with dementia, more comprehensive longitudinal data are needed to identify those cognitively impaired older adults at highest risk. People with dementia need to be followed as their dementia progresses and many of them move from their community-dwellings into residential care. The life characteristics of older adults with dementia need to be more comprehensively investigated. These include general health characteristics such as co-morbid medical conditions, medications, functional status, cognitive status, affective functioning, nutrition, swallowing, eating abilities and sociodemographic characteristics. Social support and communication characteristics to be investigated include residential location and type, financial support, social support, carer involvement, carer burden, communication abilities and behavioural problems. Dental and oral hygiene characteristics such as preventive daily oral hygiene care, fluoride exposures, uses of antimicrobials, xerostomia and salivary gland hypofunction, bacterial plaque colonisation, and normative versus perceived dental needs must be investigated. Social impacts from oral health problems will be more difficult to investigate in a cognitively impaired population with communication difficulties.

1.2 Hypotheses from study

To investigate these questions, a longitudinal study of community-dwelling older adults with and without dementia was designed. The study's hypotheses were that:

1. at baseline and one-year, coronal and root caries experience, presence of retained roots, and plaque accumulation are higher in participants with moderate to severe dementia, but not participants with mild dementia, when compared to participants without dementia;

2. coronal and root caries increments are higher in participants with dementia compared to participants without dementia;

3. caries experience is related to dementia severity and not to specific dementia diagnoses; and

4. coronal and root caries experience and increments in the dementia participants are related to their demographic, medical, medication, functional, cognitive, nutritional, swallowing, dental history and oral hygiene care characteristics, and their residential location.

1.3 Aims

The purpose of the longitudinal study was to investigate and compare the oral health status of randomly selected samples of community-dwelling dentate older adults with and without dementia in Adelaide, South Australia.

For community-dwelling older adults with dementia, the baseline study aimed to:

1. determine and compare the demographic, medical, medication, functional, cognitive, nutritional, dental history and oral hygiene care characteristics of community-dwelling dentate older adults with and without dementia;
2. identify demographic, medical, medication, functional, cognitive, nutritional, dental history and oral hygiene care characteristics of participants with dementia that were associated with increasing cognitive impairment;
3. quantify and compare the experience of oral diseases and conditions (e.g. coronal caries, root caries, plaque accumulation, attrition, oral mucosal lesions and denture problems) in community-dwelling dentate older adults with and without dementia;
4. identify and compare characteristics of demographics, medical status, medication status, functional status, cognitive status, nutritional status, dental history and oral hygiene care problems that were associated with the experience of oral diseases and conditions in community-dwelling dentate older adults with and without dementia; and
5. compare normative and perceived needs for dental treatment among community-dwelling dentate older adults with and without dementia.

For community-dwelling older adults with dementia, the one-year study aimed to:

1. determine and compare at one-year the demographic, medical, medication, functional, cognitive, nutritional, swallowing problems, dental history and oral hygiene care characteristics of community-dwelling dentate older adults with and without dementia;
2. quantify and compare the experience at one-year of oral diseases and conditions (e.g. coronal caries, root caries, plaque accumulation, attrition, oral mucosal lesions, and denture problems) in community-dwelling dentate older adults with and without dementia;
3. quantify and compare one-year coronal and root caries increments, tooth loss and changes in retained roots in community-dwelling dentate older adults with and without dementia;
4. identify and compare characteristics of demographics, medical status, medication status, functional status, cognitive status, nutritional status, swallowing problems, institutionalisation, dental history and oral hygiene care problems that were associated with one-year coronal and root caries increments in community-dwelling dentate older adults with and without dementia; and

5. investigate additional characteristics for dementia participants including stage of dementia, type of dementia, carer characteristics, carer burden, cognitive testing scores and use of medications (e.g. neuroleptics), and their relationship with the coronal and root caries experience and increments, in community-dwelling dentate older adults with dementia.

2 Methods—baseline and one-year data collections

2.1 Ethical implications of the clinical 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 participants and their guardians, and a consent form was completed and signed for each participant before the annual collection of questionnaire information and the dental inspection. Where appropriate, carers deemed the 'person responsible' or 'guardian' of participants signed an annual consent form at each round of data collection. All initial contacts with dementia participants were coordinated with the assistance of The Alzheimer's Association of South Australia, who provided a list of carers that had contacted the Association. To ensure confidentiality was maintained for these carers, they were contacted using a primary approach letter (PAL) from The University of Adelaide, and then approval was sought by telephone from carers before any further personal contacts were made with the participants with dementia. The participants without dementia were obtained from The South Australian Dental Longitudinal Study (SADLS), coordinated by Dr Jane Chalmers, AIHW DSRU. SADLS participants were contacted with an initial primary approach letter and then asked by telephone if they would like to participate in the study. Confidentiality was maintained in the field, and all paper and electronic documents securely stored using a participant identification number.

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. The Central Sterilising Unit (CSU) of the Adelaide Dental Hospital assisted with the sterilising and pre-packaging of dental instruments. 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 participants and their guardians, and they were verbally advised of any treatment needs or problems. Any participants with life-threatening or serious disorders were referred to private dentists or the South Australian Dental Service for urgent assessment of their disorder. If required or requested, participants were assisted with referral to the most appropriate public dental clinic or private dentist for any treatment required.

2.2 Timeline, study design, sample size and sampling

This study was longitudinal in design—baseline data collection commenced during late 1998 and one-year follow-up data collection commenced in late 1999. Two-year follow-up data collection commenced in late 2000. No formal piloting was required for the clinical dental inspections, as all methodologies had been comprehensively used by Dr Chalmers and colleagues in prior research (Chalmers et al. 1996; Slade et al. 1993, 1996; Slade & Spencer 1995, 1997; Thomson et al. 1995, 1999, 2000; Warren et al. 1997). Interviews and dental inspections were conducted at baseline over an eleven-month period, and again at one-year and two-years, using a staggered approach among the dementia and non-dementia participants. Participants had their questionnaires and dental inspections completed annually within a one-month period of their baseline appointment date.

To obtain the dementia participants, the study used a random sample of carers from the carer database of The Alzheimer's Association of South Australia. This database provided an initial list of carers who had contacted the Association during the previous three years, and further monthly carer listings from the database were provided over the following six months. The carer database recorded the names, addresses, and telephone numbers of any carers who had contacted the Association for advice from counsellors or other staff. All carer listings were randomly sorted before carers were contacted using a primary approach letter from the Alzheimer's Association. All mail was sent in a University of Adelaide envelope to minimise any distress to carers and people with dementia that could have been caused by receiving an envelope with 'Alzheimer's Association' printed on it. Carers were then contacted by telephone, approximately 4–7 days after the PAL was mailed to them, and a formal selection protocol was used by the interviewer to determine study participation. The same female telephone interviewer was used to contact all carers, and after introducing herself and the study, she asked each person if they were currently caring for a person with dementia. This interviewer was very experienced with participant selection and the administration of interviews for geriatric research studies. In-scope dementia participants were those who were dentate and community-dwelling and had a formally diagnosed dementia. The sex and age of the person with dementia was also recorded to coordinate as closely as possible with the sampling availability of comparison non-dementia participants. Dementia participants were categorised into one of four groups by their sex (male/female) and their age (<79 years and 80+ years), to enable sex/age group matching with comparison community-dwelling non-dementia participants. If the carer was not interested in participating, the reason why was noted by the interviewer. The specific criteria required for in-scope dementia participants resulted in a large numbers of carers needing to be contacted to obtain the required random sample size for the study. Non-participants from the carer database were categorised as out-of-scope (edentulous); out-of-scope (not community-dwelling, in residential care); out-of-scope (deceased); in-scope (too ill to participate/hospitalised/deceased); in-scope (refusal); and in-scope (refusal, stress from recent dementia diagnosis).

To obtain the non-dementia participants, the study used a random sample of ongoing dentate participants from The South Australian Dental Longitudinal Study (SADLS), who were community-dwelling in Adelaide. The SADLS database was used to preclude any dentate SADLS participants who had: (1) required a home visit at five years because of their functional, cognitive and/or medical problems; or (2) at five years had a medical diagnosis of dementia or cognitive testing score indicative of dementia. Precluding those who required a home visit was essential to ensure that comparison participants did not have cognitive impairment. To enable efficient data collection, the remaining participants

were then categorised by the South Australian Dental Service (SADS) clinic they had attended for their 5-year dental inspection. Participants at each SADS dental clinic were then sorted by sex (male/female) and age categories (<79 years and 80+ years), and randomly sampled to coordinate with the four dementia sampling groups and to use percentages of non-dementia participants closely reflecting those remaining in the SADLS database.

The sampling strategy for dementia participants was based on previous studies conducted in the United States (Jones et al. 1993; Ship 1992; Ship & Puckett 1994; Warren et al. 1997). As all study participants were required to be dentate, sampling approach calculations took into account the changing pattern of edentulism in older Australians (Carter 1997). In previous Australian studies and from AIHW DSRU data, 1970s–80s edentulism rates in the older population were as high as 74–90%. When planning the study, data indicated that approximately 60% of the sample approached to participate would be edentulous. The Alzheimer's Association database did not indicate if the person linked to the carer was currently living in the community. Thus, there were no adequate data available to assist with projecting what percentage of carers approached were still caring for the person with dementia in the community, and what percentage of the people being cared for had moved into residential care. Approximating dentate participation rates to those found in the other longitudinal studies, it was projected that, from the initial sample, up to 20% of those in-scope would refuse to participate.

As specific strategies would be employed for the examination of cognitively impaired and behaviourally difficult older adults with dementia, and dentists experienced in caring for older adults with dementia would be used, loss of subjects for dental inspections because of 'non-cooperation' would be minimal. Data from the SADLS study and The Adelaide Dental Study of Nursing Homes reports (Chalmers et al. 1999, 2000) indicated that a high percentage of 50% or more of the participants had to be excluded from the periodontal probing section of the dental inspection because of the need for medication adjustment if they were on anticoagulants or long-term steroids, and for antibiotic prophylaxis for medical conditions such as joint replacement or rheumatic fever. Comprehensive periodontal probing data collection was therefore not deemed to be a priority of the study. Thus, sample size calculations were based on longitudinal caries data requirements and not on any periodontal data requirements.

Sample size requirements were based on the numbers of available SADLS comparison participants and on estimates of coronal and root caries increments. The only relevant longitudinal study which provided coronal and root caries increment data in groups of dementia participants similar to those in the proposed project was by Jones et al. (1993). Participants in that study had a similar range of cognitive impairment (moderate to severe for the majority) to the dementia subjects for the proposed project. The study would detect the increment difference of 1.41 coronal surfaces per 100 surfaces with a power of 0.86, and would detect a difference of 1.32 coronal surfaces per 100 surfaces with a power of 0.80 ($p=0.05$). For root surfaces the difference of 2.07 root surfaces per 100 surfaces would be detected with a power of 0.94 and a difference of 1.66 root surfaces per 100 surfaces would be detected with a power of 0.80 ($p=0.05$). Dementia subject attrition over the 2-year period is estimated to be 20 participants; this created a requirement for 90 + 20=110 dementia subjects and 110 comparison participants at baseline. The ability to observe caries increments and incidence over two consecutive one-year periods (as opposed to a single period) will further increase the power of the statistical tests to be used.

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

After verbal consent had been obtained from the dementia participant and their carer over the telephone, the name and telephone number of the doctor who diagnosed their dementia was obtained, for confirmation of their dementia diagnosis. A 45-minute appointment was then arranged at the home of the person with dementia (or at The Alzheimer's Association South Australian premises) for an interviewer to complete a questionnaire with the dementia participant and their carer. The dental inspection was conducted at that same appointment by a dentist. The interviewer recorded the dental inspection findings. Confirmation of dementia diagnosis was obtained from the diagnosing doctor on the telephone or in writing.

After verbal consent had been obtained from the non-dementia SADLS participant, the interviewer conducted a telephone interview to complete a questionnaire. A 30-minute appointment was then organised for the non-dementia participant to conduct the dental inspection, either at their home or at a local SADS dental clinic. Non-dementia participants attending the SADS dental clinics were asked to bring their current medications to the appointment. At the appointment, cognitive testing and functional status assessments were also completed. The SADLS participants were familiar with these SADS dental clinics as they had attended them in the previous rounds of data collection for the SADLS study.

For the collection of one-year follow-up data, all baseline dementia and non-dementia participants were again approached by telephone and invited to participate. If participants could not be located at their baseline address/telephone, participants' carers and medical practitioners were telephoned and asked to assist with contacting the participant. For participants, both dementia and non-dementia, who had moved into residential care facilities, written consent for ongoing participation was obtained from the appropriate medical guardian. Where necessary, telephone interviews were conducted with carers/guardians to obtain any necessary questionnaire information. The residential care facilities were then contacted and an appointment organised for completion of the questionnaire and the dental inspection.

The questionnaire used close-ended questions to collect information concerning: sex, age, country of birth, marital status, government-card-holder status, private health insurance status, smoking and alcohol consumption, medical history, current prescription and over-the-counter medications, chewing abilities (from a list of five food types and at one-year diet type), educational background, oral hygiene care frequency and assistance required with oral hygiene care for both dentures and natural teeth, use of oral hygiene products, problems encountered by carers when providing oral hygiene care, any current dental pain or discomfort, any perceived need for dental treatment, dental attendance type (check-up or for a problem), avoidance of dental care because of cost, time since last dental visit, reason for last dental visit, treatment provided at last dental visit and location of last dental visit. For dementia participants, additional questions were asked such as the relationship of the carer to the person with dementia, where the carer lived, the specific dementia diagnosis from a medical practitioner, and the number of years since dementia diagnosis. Many of these interview questions had been developed and used in the SADLS of older adults. The instruments used to assess functional status, affective functioning and cognitive status are all valid and reliable instruments widely used in research with functionally dependent older adults (AIHW 1994). Assessment of functional status was

conducted using the Lawton & Brody (1969) Instrumental Activities of Daily Living scale (IADL) and the Katz et al. (1963) Index of Activities of Daily Living scale (ADL).

The cognitive testing instruments used were the Mini-Mental State Exam (MMSE) (Folstein et al. 1975), the Global Deterioration Scale (GDS) (Reisberg et al. 1982) and the Clock-drawing test (Tuokko et al. 1992). An MMSE and GDS were conducted for all dementia and non-dementia participants. If the subject had completed an MMSE test recently, those results were accepted. The dentist or interviewer conducted the MMSE, GDS and clock-drawing test, and were trained by Dr Chalmers to administer the tests. Dr Chalmers was trained in the United States to administer the tests. The MMSE scores were categorised using the system developed by Mungas (1991). Those participants scoring 26 or greater (out of 30) were categorised as 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. The MMSE could not be completed for participants who were deaf or blind, or who could not talk. The GDS required the administrator to categorise the participant into one of seven categories from normal cognition to very severe cognitive decline. The GDS could be completed for all participants. The clock-drawing test instructed the participant to imagine that a pre-drawn circle was the face of a clock, and required them to place the numbers on the clock and then the hands on to indicate the time twenty minutes to three. If participants were unable to write, a clock-drawing test was not completed.

At the one-year data collection round, additional data were collected concerning carer burden, participants' swallowing problems, their sources of fluoride and date of admission to residential care facility. This data was not collected at baseline. Participants and, if necessary, their carers were asked to rate the severity of any swallowing problems they had from normal to severe. Carer burden was assessed using the Zarit Burden Scale, in which carers rated the frequency of their feelings of burden from never to nearly always (Zarit et al. 1980, 1986). Carers were able to complete this 22-item questionnaire during the dental appointment visit or were able to mail the completed questionnaire in a reply-paid envelope. Only carers of community-dwelling dementia participants were given the burden questionnaire. Participants' swallowing problems were assessed using a standardised four-point scale (Newton et al. 1994). Sources of fluoride from toothpaste, other dental products and water were noted. If the participant had moved into residential care, their date of admission into the facility was noted. The feasibility of assessing tardive dyskinesia and other extrapyramidal adverse effects of antipsychotic medications using scales such as the Abnormal Involuntary Movement scale was considered, but found to be too extensive, time consuming and impractical for use in this study.

The National Institute of Dental Research (NIDR) (1987) protocol was used by calibrated dentists for the dental inspections in the study. Further details concerning this and other protocols used can be found in the Adelaide Dental Study of Nursing Homes Reports (Chalmers et al. 1999, 2000). A specialised dental inspection protocol was used with the community-dwelling dementia participants at baseline and at one-year. This protocol allowed for variation among the participants and focused on meeting each participant's (and carer's) needs and comforts, especially those participants who had moved into residential care at the one-year data collection. It also assisted with strategies to manage behaviour and communication problems (Chalmers 2000a, 2000b).

2.4 Database maintenance and analysis of data

Maintenance of the participant database, epidemiological data collection and entry, and statistical analysis were conducted using SPSS for Windows (Versions 6.1, 8.0 and 10.0). Univariate statistics were computed to describe:

- participation and response rates for dementia and non-dementia participants at baseline and one-year;
- participants' baseline and one-year characteristics, such as their demographic status (card-holder status, sex, age group, marital status), cognitive status (MMSE, GDS and clock-drawing test scores) and functional status (ADL and IADL scores), medical status (types of medical conditions and overall medical conditions), medications (types of medications and overall medications taken), nutritional status (ability to eat five food types, diet type, swallowing problems), oral hygiene assistance and problems, dental history (attendance type, time since last visit, fluoride sources) and admittance to residential care between baseline and one-year, as well as details of dementia type and diagnosis, carer characteristics and carer burden scores (for dementia participants only);
- participants' normative and perceived dental needs; and
- participants' experience of oral diseases and conditions (coronal and root caries, denture status, plaque index scores, oral mucosal lesions and attrition).

Where appropriate, tests of significance (Pearson's chi-square statistic) were used to investigate differences between cognitive status (GDS score) and participants' baseline characteristics.

As there were no available appropriate population-level data for Australians with dementia, population estimates for the experience of oral diseases and conditions could not be calculated and the data were not weighted. Analyses for oral diseases and conditions compared dementia with non-dementia participants only. Thus, surface-level incidence density analyses (accounting for clustering of surfaces within a person) were not able to be completed (Slade & Caplan 1999).

Coronal and root caries increments (new decayed/filled surfaces) were analysed for those dementia and non-dementia 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 5.10 and 5.11 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)

Univariate statistics were used to compute tooth loss (differences in numbers of missing teeth) and changes in the numbers of retained tooth roots between baseline and one-year. The distribution of tooth loss and changes in numbers of retained roots were also computed for dementia and non-dementia participants.

Tests of significance were used to investigate differences in the experience of oral diseases and conditions for dementia and non-dementia participants at baseline and one-year, using characteristics such as medical status, medication status, cognitive status, functional status, nutritional status, swallowing problems, institutionalisation, dental history and oral hygiene care. Characteristics were dichotomised and t-test analyses were used (Slade & Caplan 1999). Caries experience at baseline and one-year, and caries increments among participants (all dementia and non-dementia participants), were also investigated using Spearman correlation analyses. Caries distributions were computed using univariate statistics, and tests of significance (Pearson's chi-square statistic) were used to investigate differences in caries distributions among dementia and non-dementia participants. Univariate statistics were also used to investigate the use of neuroleptic medications, with categorisation of neuroleptic medications by their severity of anticholinergic adverse effects (high/low/very low/none). Caries experience and increments related to neuroleptic medication categories were investigated using tests of significance (non-parametric Kruskal-Wallis test).

3 Examiner reliability

Inter-examiner reliability was analysed using intra-class correlation (Fleiss et al. 1980). Intra-class correlation coefficients of reliability were 0.80 for decayed coronal surfaces, 0.97 for decayed root surfaces, 0.96 for total number of decayed surfaces, 0.99 for total number of filled surfaces and 0.96 for total number of decayed and filled surfaces. These coefficients indicated good to excellent reliability (Fleiss et al. 1980).

4 Response rates—baseline and one-year data collections

Non-participants from the carer database were categorised as out-of-scope (edentulous); out-of-scope (not community-dwelling, in residential care); out-of-scope (deceased); in-scope (too ill to participate/hospitalised/deceased); in-scope (refusal); and in-scope (refusal because of too much stress from recent dementia diagnosis). Participation rates for in-scope individuals with dementia were high (90%) (Table 3.1). However, more out-of-scope individuals who were deceased (n=284), edentulous (n=104), residing in a nursing home (n=201), did not yet have dementia formally diagnosed (n=42) or had incorrect contact details (n=211) were encountered via the carer database than were projected (Table 3.1). Thus, identification of in-scope subjects using the carer database was more time-consuming than expected, and required the use of a staggered approach over time. Corresponding baseline data were collected for 116 age–sex matched community-dwelling older adults without dementia from the SADLS study. All SADLS participants contacted agreed to participate.

Table 3.1: Dementia participants—baseline participation of carers from the Alzheimer's Association (SA) carer database

Participation category	Number of carers
Out-of-scope	
Person did not yet have a formal dementia diagnosis	42
Person with dementia had deceased	284
Person with dementia was edentulous	104
Person with dementia was not community-dwelling	201
Incorrect contact details for carer	211
TOTAL out-of-scope	**842**
In-scope (did not participate)	
Person with dementia is terminally-ill/ hospitalised	3
Carer and/or person with dementia refused	6
Carer and/or person with dementia refused because of stress from recent dementia diagnosis	3
In-scope (participated)	**116**
TOTAL in-scope	**128**
Participation rate for in-scope	**90.6%**
TOTAL number of carers contacted from database	**970**

At one-year, participation rates were high for both dementia (88.8%) and non-dementia groups (97.4%), with 103 dementia and 113 non-dementia one-year participants (Table 3.2). Of the 13 dementia baseline participants who did not participate at one-year, 10 were deceased, one had moved interstate and two refused. Of the three non-dementia baseline participants who did not participate at one-year, one was deceased, one was not contactable and one refused. Between baseline and one-year data collections, 32 of the dementia participants and one of the non-dementia participants had been institutionalised in residential care.

Table 3.2: One-year participation rates for dementia and non-dementia participants

Participation category at one-year	Dementia participants (n=116 at baseline)	Non-dementia participants (n=116 at baseline)
Did not participate		
Moved interstate	1	0
Deceased	10	1
Not contactable	0	1
Refused	2	1
TOTAL not participating	**13**	**3**
Participated		
Community-dwelling	71	112
Institutionalised	32	1
TOTAL participating	**103**	**113**
Participation rate	**88.8%**	**97.4%**

5 Results—baseline data collection

5.1 Baseline characteristics of dementia and non-dementia participants

Tables 4.1–4.4 present participants' baseline characteristics. In Table 4.1 participants' demographic, medical, medication, functional and cognitive characteristics are presented. The sampling strategy resulted in the same percentages of male and female participants for both groups, with slightly more males (56.9%) than females (43.1%). The sampling strategy also resulted in 78.4% of dementia and non-dementia participants being aged 79 years or less and 21.6% aged 80+ years. The majority of participants were born in Australia, with another 21.6% of dementia and 16.4% of non-dementia participants born in the United Kingdom. Remaining participants were born in Ireland, New Zealand and mainly European countries. The distribution of highest educational level varied significantly between the two groups; higher percentages of dementia participants had primary school or university as their highest educational level ($p<0.05$), while more than half of the non-dementia participants had high school as their highest educational level. There were similar percentages of dementia and non-dementia participants for each of the four concession card status categories, with approximately 60% in each group being pension-cardholders, approximately one-quarter being Department of Veterans' Affairs (DVA) cardholders (Note that most of the dementia DVA cardholders had a Gold DVA card), with the remainder having either no cards (~12%) or a Commonwealth Seniors Card only (~3%). General private health insurance was held by 32.8% of dementia and 44.8% of non-dementia participants (Note that this question could not ascertain if 'dental' extras cover was also held). A significantly higher percentage of dementia participants were married (87.1%) compared with non-dementia participants (62.1%) ($p<0.01$). A higher number of non-dementia participants were widowed (26.7%) than were dementia participants (12.1%).

For the dementia participants, 86.2% of their carers were spouses/de factos and 12.9% were children. Nearly all carers lived with the person with dementia (95.7%). All dementia participants had a formal dementia diagnosis, and all non-dementia participants did not have dementia. Three-quarters of the dementia participants had a diagnosis of Alzheimer's disease, 11.2% had a diagnosis of multi-infarct (vascular) dementia, and 6.0% had a mixed diagnosis of both these dementia types. Only 6.9% of the dementia participants had a diagnosis of Dementia with Lewy Bodies (DLB). However, as DLB is a recently introduced diagnostic category for dementia, it is possible that some of the Alzheimer's diagnoses may have been undiagnosed DLB. This could not be assessed further in this study; thus, dementia diagnosis in further analyses has been categorised into Alzheimer's (including mixed Alzheimer's diagnosis) versus other dementia. The majority of dementia participants had their dementia formally diagnosed within the previous 1–4 years (mean=2.8 years). Nearly one-quarter were diagnosed more than five years previously. Note that a formal dementia diagnosis may have been obtained one or more years after clinical dementia symptoms were present.

Dementia participants in this study had significantly more chronic medical conditions (mean=5.2 conditions, SE=0.2) than non-dementia participants (mean=3.6 conditions, SE=0.2) (t-test; $p<0.01$). All but 9.4% of dementia participants had three or more chronic medical conditions, whereas 29.3% of non-dementia participants had less than three chronic medical conditions. The most prevalent condition in both groups was arthritis,

which was reported in approximately 50% of participants in each group. High blood pressure was the next most prevalent condition for non-dementia participants (44.8%), followed by eye problems (cataracts/glaucoma) (36.2%) and cancer (32.8%). Non-dementia participants had a significantly higher prevalence of high blood pressure and cancer ($p<0.05$). Both groups had approximately 30% of participants with heart problems, just under 20% with high cholesterol, 15% with lung problems, and similar percentages with diabetes, osteoporosis, history of rheumatic fever and epilepsy. Dementia participants had a significantly higher prevalence of a diagnosed depression (30.2%), stroke or transient ischaemic attacks (19.8%), or Parkinson's disease (6.0%) (sig. $p<0.05$). Although similar percentages of participants in both groups had an artificial joint replacement, the dementia group had a higher percentage of hip fracture (6.9%). Similar percentages of participants were currently smoking (~7%), and similarly higher percentages (approximately 50%) were currently drinking alcohol. The distribution of number of medications taken differed between the groups, with dementia participants taking more medications (mean=4.5 medications, SE=0.3) than non-dementia participants (mean=3.3 medications, SE=0.2) (t-test; $p<0.01$). One of the most frequent medication categories was aspirin, taken by one-third of participants. Non-dementia participants were taking significantly more antihypertensive medication (44.8%) than dementia participants (29.3%) ($p<0.05$). Dementia participants were taking significantly more centrally acting medications such as acetylcholinesterase inhibitor (Aricept) (35.3%), antidepressants (20.7%), sedatives/anxiolytics (8.6%), movement disorder drugs/l-dopa (5.2%) and neuroleptics (20.7% traditional neuroleptics and 1.7% newer neuroleptics) ($p<0.05$). Approximately 10% of participants in both groups were taking steroid medication.

Functional status abilities of participants were assessed using the Independent 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 person can perform independently. Nearly all non-dementia participants were able to perform most activities independently. However, approximately half of the dementia participants could only perform 0, 1 or 2 activities independently. The ADL scale scores the number of more personal activities for which the person is dependent upon others. All non-dementia participants were dependent for very few, if any, ADLs. In comparison, nearly 20% of dementia participants were dependent for 3–6 ADLs.

Three cognitive testing procedures were attempted for each participant. Note that seven dementia participants could not complete the Mini-Mental State Exam (MMSE) as they were blind, deaf, couldn't talk, couldn't write and/or refused. The clock-drawing test was not completed by 37 dementia and two non-dementia participants as they could not write or refused. All non-dementia participants scored in the normal/forgetful categories of the Global Deterioration Scale (GDS); all but one non-dementia participant scored in the normal MMSE category (Note that one participant scored in the mild MMSE category); and all but 3.5% scored 0–5 errors (maximum=30 errors) for the clock-drawing test. These results confirmed that no non-dementia participants had clinically significant dementia. The distribution of dementia participants in the MMSE was similar to that of the GDS, with approximately one-quarter in the severe dementia category, approximately 35% in the moderate category, and the remainder in the mild/normal categories. More than half of the dementia participants had clock-drawing test scores indicative of cognitive impairment. Note that, as dementia symptoms vary greatly, it is possible for people with a diagnosed dementia to score well on cognitive testing procedures in the earlier stages of dementia.

Table 4.1: Dementia and non-dementia participants—baseline demographic, medical, medication, functional and cognitive characteristics (n=232) (per cent)

	Dementia (n=116)	Non-dementia (n=116)
Sex		
Male	56.9	56.9
Female	43.1	43.1
Age group		
<79 years	78.4	78.4
80+ years	21.6	21.6
Country of birth		
Australia	57.8	69.0
United Kingdom	21.6	16.4
Ireland	0.9	1.7
New Zealand	0.9	0.0
Other country	19.0	12.9
Highest educational level**		
Primary school	31.1	19.0
High school	37.1	56.9
Trade school	15.5	15.5
University	16.4	8.6
Concession card status		
Pension Concession Card	57.8	62.1
Veterans Affairs Card	26.7	24.1
Commonwealth Seniors Card only	3.4	2.6
No cards	12.1	11.2
Private health insurance		
Yes	32.8	44.8
No	67.2	55.2
Marital status*		
Married	87.1	62.1
Widowed	12.1	26.7
Divorced/Separated	0.9	9.5
Never married	0.0	1.7
Relationship of carer		
Spouse/de facto	86.2	—
Son-/daughter-in-law	12.9	—
Other	0.9	—
Where carer lives		
With the person with dementia	95.7	—
Visits person with dementia regularly	2.6	—
Other	1.7	—
A diagnosed dementia	100.0	0.0
Dementia diagnosis		
Alzheimer's disease	75.9	—
Multi-infarct dementia	11.2	—
Dementia with Lewy Bodies	6.9	—
Mixed dementia	6.0	—

* sig. p<0.01 chi-square test
** sig. p<0.05 chi-square test
— not applicable

(continued)

Table 4.1 (continued): Dementia and non-dementia participants—baseline demographic, medical, medication, functional and cognitive characteristics (n=232) (per cent)

	Dementia (n=116)	Non-dementia (n=116)
Years since dementia diagnosis[a]		
<1	11.2	—
1–2	43.1	—
3–4	22.4	—
5–6	19.0	—
7–8	3.5	—
9–10	0.9	—
Number of chronic medical conditions*		
0	0.0	6.0
1–2	9.4	23.3
3–4	28.4	44.0
5–6	37.1	19.0
7–8	18.1	5.1
9+	7.0	2.7
History of arthritis	47.4	53.4
History of a diagnosed depression*	30.2	7.8
History of high blood pressure**	30.2	44.8
History of heart problems	30.2	26.7
History of eye problems (cataracts/glaucoma)	27.6	36.2
History of stroke or transient ischaemic attacks**	19.8	8.6
History of high cholesterol	19.0	16.4
History of asthma/bronchitis/lung problems	14.7	14.7
History of cancer*	17.2	32.8
History of artificial joint replacement	17.2	11.2
History of diabetes	11.2	6.0
History of osteoporosis	9.5	10.3
History of rheumatic fever	8.6	3.4
History of hip fracture**	6.9	0.9
History of Parkinson's disease*	6.0	0.0
History of epilepsy	5.2	1.7
Currently smokes	7.8	6.9
Currently drinks alcohol	44.0	56.0

a Person may have had dementia for one or more years prior to formal diagnosis.

(continued)

* sig. p<0.01 chi-square test
** sig. p<0.05 chi-square test

Table 4.1 (continued): Dementia and non-dementia participants—baseline demographic, medical, medication, functional and cognitive characteristics (n=232) (per cent)

	Dementia (n=116)	Non-dementia (n=116)
Total number of medications**		
0	4.3	10.3
1–2	21.5	34.5
3–4	31.9	26.7
5–6	23.3	14.6
7–8	9.5	9.5
9+	9.5	4.4
Taking aspirin medication	37.1	33.6
Taking acetylcholinesterase inhibitor medication*[b]	35.3	0.0
Taking antihypertensive medication**	29.3	44.8
Taking antidepressant medication*	20.7	5.2
Taking steroid medication	10.3	9.5
Taking sedative/anxiolytic medication**	8.6	2.6
Taking movement disorder or l-dopa medication**	5.2	0.9
Taking neuroleptic (traditional) medication*	20.7	0.9
Taking neuroleptic (new generation) medication	1.7	0.0
Taking neuroleptic medication (all types)*	22.4	0.9
ADL score (number of dependent activities)*		
0–2	81.9	100.0
3–4	2.6	0.0
5–6	15.5	0.0
IADL score (number of independent activities)*		
0–2	53.4	0.0
3–5	44.9	56.9
6–8	1.7	43.1
MMSE score (cognitive decline)*	(n=109)[c]	
<10 (severe)	24.8	0.0
11–20 (moderate)	35.8	0.0
21–25 (mild)	21.1	0.9
26–30 (normal)	18.3	99.1
GDS score (cognitive decline)*		
1–2 (normal/forgetfulness)	5.2	100.0
3 (mild)	29.3	0.0
4 (moderate)	8.6	0.0
5 (moderately severe)	30.2	0.0
6 (severe)	19.0	0.0
7 (very severe)	7.8	0.0
Clock-drawing test score (number of errors)*	(n=79)[d]	(n=114)[e]
0–5	44.3	96.5
6–10	19.0	3.5
11–20	30.4	0.0
21–30	6.3	0.0

b The only acetylcholinesterase inhibitor being taken was Aricept; no participants were taking Tacrine.
c 7 participants could not do the MMSE test as they were blind, deaf, couldn't talk, couldn't write and/or refused.
d 37 participants could not do the clock-drawing test as they couldn't write and/or refused.
e 2 participants could not do the clock-drawing test as they couldn't write.

* sig. p<0.01 chi-square test
** sig. p<0.05 chi-square test

Table 4.2 presents chewing ability for dementia and non-dementia participants. The majority of participants could chew 2–3 of the foods listed—boiled vegetables, hamburger, meat, carrot and apple. However, there were more dementia participants who could not eat as many food types ($p<0.01$). Most participants in both groups were able to chew boiled vegetables and hamburger. However, fewer dementia participants could chew harder foods (meat, carrot) ($p<0.01$). Similarly, nearly one-quarter of dementia and non-dementia participants could not eat a piece of fresh apple.

Table 4.2: Dementia and non-dementia participants—baseline chewing ability (n=232) (per cent)

	Dementia (n=116)	Non-dementia (n=116)
Number of foods can chew*		
0	0.0	0.0
1	1.7	0.9
2	8.6	0.9
3	12.1	7.0
4	9.5	20.0
5	68.1	71.3
Able to chew		
Boiled vegetables	100.0	100.0
Hamburger	98.3	100.0
Firm meat*	85.3	99.1
Piece of fresh carrot*	75.9	91.4
Piece of fresh apple	74.1	70.7

* sig. $p<0.01$ chi-square test

Table 4.3 presents participants' dental history characteristics. There were very few significant differences for dental history characteristics between the two groups. Nineteen percent of dementia and 11.2% of non-dementia participants had dental pain or discomfort at the time of the dental inspection. Perceived need for dental treatment was low; approximately one-quarter of participants indicated a need for dental treatment. Slightly more participants were attending the dentist for a regular check-up (55%) rather than for a dental problem (45%). Non-dementia participants had visited the dentist more recently than had dementia participants; 79.3% of non-dementia and 59.5% of dementia participants had visited within the 12 months prior to the dental inspection ($p<0.01$). Another ~10% of participants had visited 1–2 years prior to the dental inspection; 17.2% of dementia participants had last visited a dentist more than four years ago. The mean number of months since last dental visit was 27.9 (SE=4.1) for dementia and 12.2 (SE=1.6) for non-dementia participants (t-test; $p<0.01$). Participants in both groups last attended for a range of procedures, with nearly half the participants having a check-up, and one-third having restorations. Teeth cleaning was provided for 13.8% of dementia and 50.9% of non-dementia participants. Nearly all participants in both groups had their dental treatment provided at a dental surgery/clinic, with very little treatment provided at off-site locations.

Table 4.3: Dementia and non-dementia participants—baseline dental history characteristics (n=232) (per cent)

	Dementia (n=116)	Non-dementia (n=116)
Any dental pain or discomfort currently		
Yes	19.0	11.2
No	81.0	88.8
Need dental treatment at present		
Yes	25.0	24.1
No	75.0	75.9
Attend dentist		
For check-ups	54.3	55.2
For a dental problem	45.7	44.8
Last dental visit*		
<12 months	59.5	79.3
13–24 months	12.1	8.6
25–36 months	6.0	6.9
37–48 months	5.2	0.0
49–60 months	6.0	1.7
61–120 months	8.6	3.4
121+ months	2.6	0.0
Treatment at last visit[a]		
Check-up	47.4	43.1
Cleaning	13.8	50.9
Filling(s)	30.2	37.9
Crown and bridgework	2.6	5.2
Extraction	11.2	15.5
Denture adjustment	2.6	7.8
New dentures	3.4	7.8
Don't know	6.0	2.6
Location of last dental visit		
Dental surgery/clinic	97.4	96.6
Nursing home	0.0	2.6
Don't know	2.6	0.9

a Percentages do not sum to 100 as participants may have had more than one type of treatment.

* sig. $p<0.01$ chi-square test

** sig. $p<0.05$ chi-square test

Table 4.4 presents participants' oral hygiene care characteristics. For denture wearers, the frequency of denture cleaning was reported to be once daily or more for the majority of participants. No non-dementia participants required assistance to clean their dentures, but one-quarter of dementia participants did require assistance ($p<0.01$). Nearly all participants reported that their natural teeth were cleaned once daily or more. However, non-dementia participants' teeth were cleaned more frequently than dementia participants' teeth ($p<0.01$). No non-dementia participants required assistance to clean their teeth, but nearly one-quarter of dementia participants did require assistance ($p<0.01$). Carers had difficulties with oral hygiene care with one-quarter of dementia participants; there were no difficulties with non-dementia participants ($p<0.01$). The most common difficulties were: refusal of oral hygiene care, not opening their mouth, not understanding directions, forgetting/needing to be reminded to do oral hygiene care, not able to rinse/spit, and biting the toothbrush or carer. Nearly all participants used a fluoride toothpaste when cleaning their teeth. Significantly more non-dementia participants were using dental floss or interdental cleaning sticks ($p<0.01$). No participants were using a therapeutic mouthrinse containing fluoride; 19% of dementia and 29.3% of non-dementia participants were using cosmetic mouthrinses (not containing fluoride).

Table 4.4: Dementia and non-dementia participants—baseline oral hygiene care characteristics (n=232) (per cent)

	Dementia (n=116)	Non-dementia (n=116)
Frequency of denture cleaning	(n=56 denture wearers)	(n=66 denture wearers)
Twice daily or more	26.8	48.5
Once daily	58.9	43.9
Several times a week	5.4	3.0
Less than once a week	1.8	1.5
Hardly ever	5.4	3.0
Never	1.8	0.0
Assistance needed cleaning dentures*	(n=56 denture wearers)	(n=66 denture wearers)
Yes – some	12.5	0.0
Yes – total	12.5	0.0
No	75.0	100.0
Frequency of teeth cleaning*		
Twice daily or more	44.8	64.7
Once daily	42.2	31.9
Several times a week	3.4	2.6
Less than once a week	5.2	0.9
Hardly ever	2.6	0.0
Never	1.7	0.0
Assistance needed cleaning teeth*		
Yes – some	11.2	0.0
Yes – total	12.9	0.0
No	75.9	100.0
Number of difficulties carer has with oral care*		
0	76.7	100.0
1–2	13.7	0.0
3–4	8.6	0.0
5+	0.9	0.0

* sig. $p<0.01$ chi-square test
** sig. $p<0.05$ chi-square test

(continued)

Table 4.4 (continued): Dementia and non-dementia participants – baseline oral hygiene care characteristics (n=232) (per cent)

	Dementia (n=116)	Non-dementia (n=116)
Person refuses oral hygiene care	12.1	0.0
Person does not open their mouth	8.6	0.0
Person bites toothbrush/swab/nursing staff	4.3	0.0
Person kicks or hits out during oral care	0.0	0.0
Person does not understand carer's directions about oral care	6.0	0.0
Person can not rinse/spit	5.2	0.0
Person spits when trying to clean teeth	0.0	0.0
Person uses offensive language/is aggressive	1.7	0.0
Person's dentures can't be taken out of the mouth or can't be put back into mouth	1.7	0.0
Person moves their head or body around (excessively)	0.0	0.0
Person's head faces down toward their chest so staff can't get to their mouth	0.0	0.0
Person is tired/sleepy	0.0	0.0
Person forgets/needs reminding to do oral care	6.9	0.0
Person uses a fluoride toothpaste when brushing teeth	94.0	99.1
Person uses a floss or interdental sticks*	33.6	69.0
Person uses a mouthrinse (cosmetic, not containing fluoride)	19.0	29.3
Person uses a mouthrinse (therapeutic, containing fluoride)	0.0	0.0

* sig. p<0.01 chi-square test
** sig. p<0.05 chi-square test

5.2 Dementia participants' characteristics and cognitive status

Table 4.5 presents the reasons why the Mini-Mental State Exam (MMSE) and the clock-drawing test were not completed for participants. The main reasons for not completing the MMSE were related to communication problems and participants' difficulties with vision, talking and hearing (57.1%), or refusal to do the MMSE (42.9%). The Global Deterioration Scale (GDS) was completed for all dementia and non-dementia participants. The clock-drawing test was not able to be completed by 37 dementia participants and two non-dementia participants, mainly because they were not able to write. Table 4.6 presents MMSE scores by GDS scores, grouped into normal–mild and moderate–severe cognitive impairment, for all participants. Approximately 10% of participants were classified into a lower or higher GDS category than was achieved using the MMSE. Further analyses in this section have been completed using the GDS scores grouped into normal cognition/forgetfulness, mild cognitive decline, moderate cognitive decline, and severe cognitive decline.

Table 4.5: Reasons why MMSE and clock-drawing test not completed for participants at baseline (per cent)

Reason	Dementia	Non-dementia
MMSE	(n=7)	(n=0)
Could not talk/hear	42.9	n.a.
Refused	42.9	n.a.
Could not see well enough/blind	14.2	n.a.
Clock-drawing test	(n=37)	(n=2)
Could not write	70.3	100.0
Refused	29.9	0.0

n.a. not available

Table 4.6: MMSE scores by GDS scores (n=225) (per cent)

	MMSE scores	
GDS score	0–20 (moderate–severe cognitive impairment)	21–30 (normal–mild cognitive impairment)
1–3 (normal–mild cognitive impairment)	12.1	89.9
4–7 (moderate–severe cognitive impairment)	87.9	10.1

Table 4.7 presents dementia participants' demographic, medical, medication, functional, and cognitive characteristics by their GDS scores. The number of years since dementia diagnosis was associated with worsening dementia severity ($p<0.05$). Alcohol consumption decreased with worsening dementia severity, especially in the severe group ($p<0.05$). Several medical conditions were more prevalent in the lower dementia severity groups; artificial joints and hip fractures were more prevalent in the normal group and lung problems and eye problems more prevalent in the mild dementia group ($p<0.05$). The use of neuroleptic medications increased with worsening dementia severity, especially in the moderate and severe groups ($p<0.01$). The number of IADLs able to be performed independently decreased with worsening dementia severity, and the number of dependent ADLs increased with worsening dementia severity ($p<0.01$).

Table 4.7: Dementia participants—cognitive status by baseline demographic, medical, medication, functional and cognitive characteristics (n=116) (per cent)

	GDS scores (cognitive decline)			
	1–2 (normal/ forgetful) (n=6)	3 (mild) (n=34)	4–5 (moderate) (n=45)	6–7 (severe) (n=31)
Sex				
Male	83.3	64.7	57.8	41.9
Female	16.7	35.3	42.2	58.1
Age group				
<79 years	50.0	79.4	80.0	80.6
80+ years	50.0	20.6	20.0	19.4
Country of birth				
Australia	50.0	64.7	51.1	61.3
United Kingdom/Ireland	16.7	23.5	22.2	22.6
Other country	33.3	11.8	26.7	16.1
Highest educational level				
Primary school	0.0	17.6	37.8	41.9
High school	33.3	41.2	33.3	38.7
Trade school	16.7	20.6	13.3	12.9
University	50.0	20.6	15.6	6.5
Concession card status				
Pension Concession Card	33.3	61.8	62.2	51.6
Veterans Affairs Card	50.0	23.5	24.4	29.0
Commonwealth Seniors Card only	16.7	2.9	2.2	3.2
No cards	0.0	11.8	11.1	16.1
Private health insurance				
Yes	66.7	32.4	33.3	25.8
Marital status				
Married	100.0	88.2	86.7	83.9
Widowed	0.0	2.9	0.0	0.0
Divorced/Separated	0.0	8.8	13.3	16.1

a Person may have had dementia for one or more years prior to formal diagnosis.

(continued)

* sig. $p<0.01$ chi-square test

** sig. $p<0.05$ chi-square test

Table 4.7 (continued): Dementia participants—cognitive status by baseline demographic, medical, medication, functional and cognitive characteristics (n=116) (per cent)

	GDS scores (cognitive decline)			
	1–2 (normal/ forgetful) (n=6)	3 (mild) (n=34)	4–5 (moderate) (n=45)	6–7 (severe) (n=31)
Relationship of carer				
Spouse/de facto	100.0	91.2	84.4	80.6
Son-/daughter-in-law	0.0	8.8	13.3	19.4
Other	0.0	0.0	2.2	0.0
Where carer lives				
With the person with dementia	100.0	88.2	97.8	100.0
Visits person with dementia regularly	0.0	8.8	0.0	0.0
Other	0.0	2.9	2.2	0.0
A diagnosed dementia	100.0	100.0	100.0	100.0
Dementia diagnosis				
Alzheimer's disease	83.3	73.5	73.3	80.6
Multi-infarct dementia	16.7	14.7	8.9	9.7
Dementia with Lewy Bodies	0.0	11.8	4.4	3.2
Mixed dementia	0.0	0.0	13.3	6.5
Years since dementia diagnosis[a]**				
<1	33.3	23.5	6.7	0.0
1–2	50.0	61.7	35.5	32.3
3–4	0.0	11.7	31.1	25.8
5–6	16.7	2.9	24.4	29.1
7–8	0.0	0.0	0.0	12.9
9–10	0.0	0.0	2.2	0.0
Number of chronic medical conditions				
0	0.0	0.0	0.0	0.0
1–2	0.0	2.9	8.9	19.4
3–4	16.7	17.6	33.3	35.5
5–6	50.0	35.3	37.8	35.5
7–8	33.3	29.4	17.8	3.2
9+	0.0	14.7	2.2	6.5
History of arthritis	50.0	55.9	46.7	38.7
History of a diagnosed depression	16.7	29.4	33.3	29.0
History of high blood pressure	16.7	38.2	24.4	32.3
History of heart problems	50.0	38.2	33.3	12.9
History of eye problems (cataracts/glaucoma)*	16.7	47.1	22.2	16.1
History of stroke or transient ischaemic attacks	16.7	17.6	22.2	19.4
History of high cholesterol	0.0	29.4	17.8	12.9
History of asthma/bronchitis/lung problems*	0.0	26.5	15.6	3.2

a Person may have had dementia for one or more years prior to formal diagnosis.

(continued)

* sig. p<0.01 chi-square test
** sig. p<0.05 chi-square test

Table 4.7 (continued): Dementia participants—cognitive status by baseline demographic, medical, medication, functional and cognitive characteristics (n=116) (per cent)

	GDS scores (cognitive decline)			
	1–2 (normal/ forgetful) (n=6)	3 (mild) (n=34)	4–5 (moderate) (n=45)	6–7 (severe) (n=31)
History of cancer	0.0	17.6	17.8	19.4
History of artificial joint replacement*	66.7	14.7	11.1	19.4
History of diabetes	16.7	11.8	15.6	3.2
History of osteoporosis	0.0	17.6	6.7	6.5
History of rheumatic fever	0.0	8.8	8.9	9.7
History of hip fracture*	50.0	8.8	4.4	0.0
History of Parkinson's disease	0.0	8.8	6.7	3.2
History of epilepsy	0.0	5.9	2.2	9.7
Currently smokes	16.7	8.8	11.1	0.0
Currently drinks alcohol**	50.0	52.9	51.1	22.6
Total number of medications				
0	0.0	2.9	4.4	6.5
1–2	16.7	20.6	17.8	29.0
3–4	33.3	35.3	26.7	35.5
5–6	16.7	20.6	26.7	22.6
7–8	16.7	8.8	15.6	0.0
9+	16.7	11.8	8.9	6.5
Taking aspirin medication	66.7	38.2	35.6	32.3
Taking acetylcholinesterase inhibitor medication[b]	50.0	44.1	37.8	19.4
Taking antihypertensive medication	33.3	32.4	24.4	32.3
Taking antidepressant medication	16.7	23.5	24.4	12.9
Taking steroid medication	16.7	17.6	6.7	6.5
Taking sedative/anxiolytic medication	0.0	5.9	6.7	16.1
Taking movement disorder or l-dopa medication	0.0	2.9	11.1	0.0
Taking neuroleptic (traditional) medication**	0.0	5.9	26.7	32.3
Taking neuroleptic (new generation) medication	0.0	0.0	2.2	3.2
Taking neuroleptic medication (all types)*	0.0	5.9	28.9	35.5
ADL score (number of dependent activities)*				
0–2	100.0	100.0	93.3	41.9
3–4	0.0	0.0	2.2	6.5
5–6	0.0	0.0	4.4	51.6
IADL score (number of independent activities)*				
0–2	16.7	26.5	53.3	90.3
3–5	83.3	67.6	46.7	9.7
6–8	0.0	5.9	0.0	0.0

b The only acetylcholinesterase inhibitor being taken was Aricept; no participants were taking Tacrine.

* sig. p<0.01 chi-square test

** sig. p<0.05 chi-square test

Table 4.8 presents dementia participants' chewing abilities by GDS scores. Fewer food types could be eaten as dementia severity increased, but this was not statistically significant. With worsening dementia severity, harder food types were less frequently able to be eaten, but this was not significant.

Table 4.8: Dementia participants—cognitive status by baseline chewing ability (n=116) (per cent)

	GDS scores (cognitive decline)			
	1–2 (normal/ forgetful) (n=6)	3 (mild) (n=34)	4–5 (moderate) (n=45)	6–7 (severe) (n=31)
Number of foods can chew				
0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	6.5
2	0.0	0.0	11.1	16.1
3	0.0	17.6	11.1	9.7
4	0.0	14.7	8.9	6.5
5	100.0	67.6	68.9	61.3
Able to chew				
Boiled vegetables	100.0	100.0	100.0	100.0
Hamburger	100.0	100.0	100.0	93.5
Firm meat	100.0	94.1	84.4	74.2
Piece of fresh carrot	100.0	82.4	75.6	64.5
Piece of fresh apple	100.0	73.5	75.6	67.7

Note: not sig. chi-square test p>0.05

Tables 4.9 and 4.10 present various dementia participant characteristics by GDS score. In Table 4.9 dental history is presented by GDS. Note that participants with higher GDS scores had more severe cognitive impairment. There were no significant trends by GDS score for responses concerning the participant's dental pain or discomfort or need for dental treatment. However, only 9.7% of the severe dementia group reported any current dental pain or discomfort compared with approximately double or more that percentage in the other GDS categories. Similar percentages of dementia participants perceived a need for dental treatment (ranging from 16.7% to 29.4%). Although no significant difference was found for time since last dental visit, 32.3% of those in the severe dementia category had visited in the previous 12 months compared with 70% or more in the other three dementia categories.

Table 4.9: Dementia participants—cognitive status by baseline dental history characteristics (n=116) (per cent)

	GDS scores (cognitive decline)			
	1–2 (normal/ forgetful) (n=6)	3 (mild) (n=34)	4–5 (moderate) (n=45)	6–7 (severe) (n=31)
Any dental pain or discomfort currently				
Yes	16.7	26.5	20.0	9.7
Need dental treatment at present				
Yes	16.7	29.4	24.4	22.6
Attend dentist				
For check-ups	83.3	52.9	60.0	41.9
For a dental problem	16.7	47.1	40.0	58.1
Last dental visit				
<12 months	83.3	67.6	68.9	32.3
13–24 months	0.0	11.8	8.9	19.4
25–36 months	16.7	2.9	8.9	3.2
37–48 months	0.0	2.9	2.2	12.9
49–60 months	0.0	5.9	0.0	16.1
61–120 months	0.0	5.9	8.9	12.9
121+ months	0.0	2.9	2.2	3.2
Location of last dental visit				
Dental surgery/clinic	100.0	97.1	100.0	93.5
Nursing home	0.0	0.0	0.0	0.0
Don't know	0.0	2.9	0.0	6.5

Note: not sig. chi-square test p>0.05

Table 4.10 presents dementia participants' oral hygiene care by GDS score. There were no significant differences for the frequency of denture cleaning between GDS score groups. As participants' GDS scores increased with more severe cognitive impairment, there was a decrease in the reported frequency of cleaning of natural teeth. However, the frequency of oral hygiene care was very difficult to accurately ascertain at an individual participant level. A clear pattern was evident between GDS groups for the questions concerning the need for assistance with cleaning of dentures and natural teeth. All but one-third of the severely cognitively impaired group required assistance with oral hygiene care activities. As GDS increased with more severe cognitive impairment, higher percentages of participants required total assistance. None of the normal or mild cognitive range group (GDS scores 1–3) required total assistance with cleaning teeth, but 38.7% of severely cognitively impaired participants required total assistance.

Table 4.10 also presents difficulties that carers encountered with dementia participants' oral hygiene care by the participants' GDS score. When the total number of difficulties for each dementia participant is considered, the majority of carers encountered one or more difficulties for the severely cognitively impaired participants. Carers had 5+ difficulties with 3.2%, 3–4 difficulties with 25.8% and 1–2 difficulties with 35.5% of the severely cognitively impaired residents. Almost none of the carers for the mildly cognitively impaired and normal groups of residents had any difficulties with oral hygiene care.

A pattern emerged across the GDS groups for all 12 difficulties with oral hygiene care, with the highest percentages of difficulties occurring in the severely cognitively impaired group of participants. The most frequently reported difficulties were with participants:

- not opening their mouth;
- refusing oral hygiene care;
- not understanding staff's directions about oral care;
- not being able to rinse/spit;
- biting the toothbrush or carer;
- forgetting to do oral hygiene care or needing reminding;
- using offensive language/aggressive; and
- whose dentures were not able to be removed/put back in the mouth.

Nearly all dementia participants used a fluoride toothpaste when brushing their teeth. However, there were fewer participants doing so in the more severe dementia categories (not sig.). There were significantly fewer participants using interdental floss or sticks in the more severe dementia groups ($p<0.01$). Half of the normal group used a cosmetic mouthwash, and this percentage decreased to approximately 20% in the other three dementia categories (not sig.). There were no participants using a therapeutic mouthrinse containing fluoride.

Table 4.10: Dementia participants—cognitive status by baseline oral hygiene care characteristics (n=116) (per cent)

	GDS scores (cognitive decline)			
	1–2 (normal/ forgetful) (n=6)	3 (mild) (n=34)	4–5 (moderate) (n=45)	6–7 (severe) (n=31)
Frequency of denture cleaning				
Twice daily or more	100.0	29.4	21.7	15.4
Once daily	0.0	58.8	60.9	69.2
Several times a week	0.0	5.9	4.3	7.7
Less than once a week	0.0	0.0	4.3	0.0
Hardly ever	0.0	5.9	4.3	7.7
Never	0.0	0.0	4.3	0.0
Assistance needed cleaning dentures*				
Yes – some	0.0	0.0	17.4	23.1
Yes – total	0.0	5.9	4.3	38.5
No	100.0	94.1	78.3	38.5
Frequency of teeth cleaning				
Twice daily or more	83.3	61.8	33.3	35.5
Once daily	16.7	35.3	53.3	38.7
Several times a week	0.0	0.0	4.4	6.5
Less than once a week	0.0	2.9	6.7	6.5
Hardly ever	0.0	0.0	0.0	9.7
Never	0.0	0.0	2.2	3.2
Assistance needed cleaning teeth*				
Yes – some	0.0	0.0	8.9	29.0
Yes – total	0.0	0.0	6.7	38.7
No	100.0	100.0	84.4	32.3
Number of difficulties carer has with oral care*				
0	100.0	97.1	86.7	35.5
1–2	0.0	2.9	8.9	35.5
3–4	0.0	0.0	4.4	25.8
5+	0.0	0.0	0.0	3.2
Person refuses oral hygiene care*	0.0	0.0	8.9	25.8
Person does not open their mouth*	0.0	0.0	4.4	25.8
Person bites toothbrush/swab/nursing staff	0.0	0.0	0.0	16.1
Person kicks or hits out during oral care	0.0	0.0	0.0	0.0
Person does not understand carer's directions about oral care*	0.0	0.0	0.0	22.6
Person can not rinse/spit*	0.0	0.0	0.0	16.1
Person spits when trying to clean teeth	0.0	0.0	0.0	0.0
Person uses offensive language/is aggressive	0.0	0.0	0.0	6.5
Person's dentures can't be taken out of the mouth or can't be put back into mouth	0.0	0.0	0.0	6.5
Person moves their head or body around (excessively)	0.0	0.0	0.0	0.0
Person's head faces down toward their chest so staff can't get to their mouth	0.0	0.0	0.0	0.0
Person is tired/sleepy	0.0	0.0	0.0	0.0
Person forgets/needs reminding to do oral care**	0.0	0.0	8.9	12.9

* sig. p<0.01 chi-square test

** sig. p<0.05 chi-square test

(continued)

Table 4.10 (continued): Dementia—cognitive status by baseline oral hygiene care characteristics (n=116) (per cent)

	GDS scores (cognitive decline)			
	1–2 (normal/ forgetful) (n=6)	3 (mild) (n=34)	4–5 (moderate) (n=45)	6–7 (severe) (n=31)
Person uses a fluoride toothpaste when brushing teeth	100.0	100.0	93.3	87.1
Person uses a floss or interdental sticks*	50.0	52.9	33.3	9.7
Person uses a mouthrinse (cosmetic, not containing fluoride)	50.0	14.7	20.0	16.1
Person uses a mouthrinse (therapeutic, containing fluoride)	0.0	0.0	0.0	0.0

* sig. p<0.01 chi-square test

5.3 Oral diseases and conditions

5.3.1 Dentures

Dementia and non-dementia participants' denture status is presented in Tables 4.11 and 4.12 for the maxilla and mandible respectively. Full upper dentures were worn by 20.7% of the dementia participants and by 27.6% of the non-dementia participants. No participants wore full lower dentures. An upper partial denture was worn by 23.3% of dementia and 27.6% of non-dementia participants, and another 2.6% of dementia participants owned a denture but did not wear it. A lower partial denture was worn by 14.7% of dementia and 27.6% of non-dementia participants, with another 2.6% of dementia participants and 0.9% of non-dementia participants owning a denture but not wearing it. The percentage of participants who did not wear an upper denture was 53.4% of dementia and 44.8% of non-dementia participants. The percentage of participants who did not wear a lower denture was 82.8% of dementia and 71.6% of non-dementia participants.

Table 4.11: Dementia and non-dementia participants—denture status in maxilla (n=232)

	Denture status (%)			
	Full denture	Partial denture	Denture owned but not worn	No denture
Dementia (n=116)	20.7	23.3	2.6	53.4
Non-dementia (n=116)	27.6	27.6	0.0	44.8

Table 4.12: Dementia and non-dementia participants—denture status in mandible (n=232)

	Denture status (%)			
	Full denture	Partial denture	Denture owned but not worn	No denture
Dementia (n=116)	0.0	14.7	2.6	82.8
Non-dementia (n=116)	0.0	27.6	0.9	71.6

Table 4.13 presents the combinations of upper and lower dentures worn by participants. The percentage of particpants who owned a denture for one or both arches was 47% of dementia and 56% of non-dementia participants. No participants wore full upper and lower dentures. A partial denture was worn by 32.7% of dementia and 44.0% of non-dementia participants in one or both arches. Partial upper and lower dentures were worn by 5.2% of dementia and 11.2% of non-dementia participants. The percentage of participants who did not wear any upper or lower dentures was 50% of dementia and 44% of non-dementia participants.

Table 4.13: Dementia and non-dementia participants—types of dentures worn (n=232) (per cent)

Denture type			
Upper denture	Lower denture	Dementia (n=116)	Non-dementia (n=116)
Full	Full	0.0	0.0
Full	Not worn	0.0	0.9
Full	No denture	14.7	11.2
Full	Partial	6.0	15.5
Partial	Full	0.0	0.0
Partial	Partial	5.2	11.2
No denture	Partial	3.4	0.9
Partial	No denture	18.1	16.4
Partial	Not worn	0.0	0.0
Not worn	Not worn	2.6	0.0
Not worn	No denture	0.0	0.0
No denture	No denture	50.0	44.0

Table 4.14 presents the denture problems of denture wearers. Among denture wearers, the highest percentages of denture problems occurred in relation to inadequate retention and stability of participants' upper and lower dentures. Inadequate retention (21.6%) and stability (15.7%) were the main problems with dementia participants' upper dentures. Inadequate retention (34.9%) and stability (28.6%) were also the main problems with non-dementia participants' upper dentures. Staining and debris accumulation on the denture surface was the most frequent material inadequacy on dentures, the highest being 18% found on dementia participants' upper dentures. Non-dementia participants' lower dentures had the highest number of defects, such as broken or missing teeth or fractured denture material (6.3%).

Table 4.14: Dementia and non-dementia denture wearers—denture problems (per cent)

Denture problem	Dementia	Non-dementia
Upper denture	**(n=51)**	**(n=64)**
Retention unsatisfactory	21.6	34.9
Stability unsatisfactory	15.7	28.6
Material inadequacies	18.0	6.5
Defects	4.1	1.6
Lower denture	**(n=17)**	**(n=32)**
Retention unsatisfactory	17.7	21.9
Stability unsatisfactory	11.8	15.2
Material inadequacies	6.3	12.5
Defects	0.0	6.3
Occlusion unsatisfactory (for all dentures)	**7.1**	**17.5**

5.3.2 Oral mucosal lesions and conditions

Table 4.15 presents the distribution of oral mucosal lesions/conditions among the dementia and non-dementia participants. Denture-related lesions/conditions were prevalent in dementia denture wearers, with 28.6% having denture stomatitis in the maxilla and 5.8% having angular cheilitis. Denture stomatitis in the maxilla was lower in non-dementia participants (11.3%). The prevalence of other oral mucosal lesions/conditions was low. Actinic keratosis was observed in 6.9% of dementia and 8.6% of non-dementia participants.

Table 4.15: Dementia and non-dementia participants—oral mucosal lesions/conditions (per cent)

Oral mucosal lesion/condition	Dementia	Non-dementia
Denture-related lesions/conditions	**(n=56)**	**(n=66)**
Denture stomatitis – maxilla	28.6	11.3
Angular cheilitis	5.8	1.6
Other denture-related lesions	0.0	14.1
Ulceration – mandible	0.0	9.4
Hyperplasia	0.0	8.1
Ulceration – maxilla	0.0	6.5
Denture stomatitis – mandible	0.0	6.5
Other lesions/conditions	**(n=116)**	**(n=116)**
Cheek/lip biting	7.8	0.9
Actinic keratosis	6.9	8.6
Amalgam tattoo	3.4	6.9
Fissured tongue	2.6	0.9
Ulcer, non-specific	1.7	0.9
Nicotinic stomatitis	1.7	0.0
Gingival hyperplasia	1.7	0.0
Candidiasis – pseudomembranous	0.9	0.0
Geographic tongue	0.0	1.7
Herpes labialis	0.0	0.9
Candidiasis – erythematous	0.0	0.0
Leukoplakia	0.0	0.0
Mucocele	0.0	0.0

5.3.3 Tooth status

Table 4.16 presents dementia and non-dementia participants' tooth status—mean number of teeth (and standard deviation) that were decayed, missing or filled (DMFT), or 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'. Dementia participants had a mean number of 0.3 decayed tooth crowns, 14.0 missing teeth, 8.9 filled/crowned tooth crowns, 0.5 retained roots and 0.01 teeth that could not be scored because of 'plaque'. Their DMFT was 23.2 teeth. Non-dementia participants had a mean number of 14.8 missing teeth, 0.1 retained roots and 0.01 teeth that could not be scored because of 'plaque'. Their DMFT was 24.0 teeth. Dementia participants had more retained roots and more decayed tooth crowns ($p<0.01$).

Table 4.16: Dementia and non-dementia participants—tooth status (n=232)

	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
Dementia (n=116)	0.30	0.8	14.0	6.8	8.9	6.3	23.2	5.6	0.5	1.9	0.01	0.09
Non-dementia (n=116)	0.03	0.2	14.8	7.8	9.1	6.2	24.0	4.2	0.1	0.6	0.01	0.09

* sig. p<0.01 t-test
\# Teeth were present but could not be scored because they were covered in plaque, calculus or other debris.

5.3.4 Coronal caries

Table 4.17 presents the mean number of coronal surfaces with caries experience for dementia and non-dementia participants. Dementia participants had a higher mean number of decayed surfaces (0.5) in comparison to participants without dementia (0.03) ($p<0.01$). For participants with dementia, the mean number of decayed coronal surfaces (0.5) was higher than the number of decayed tooth crowns (0.3), indicating that multiple surfaces were affected on some individual teeth. Mean number of filled surfaces was 22.1 for dementia and 24.7 for non-dementia participants. Coronal decayed and filled surfaces (DFS) and coronal caries attack rates were not significantly different. Mean coronal DFS was 22.6 for dementia and 24.8 for non-dementia participants. Coronal caries attack rates were 27.6% for dementia and 30.0% for non-dementia participants. Mean number of plaque-covered surfaces was 0.02 for dementia and 0.09 for non-dementia participants.

Table 4.17: Dementia and non-dementia participants—coronal surface caries (n=232)

	Decayed surfaces*		Filled surfaces		Coronal DFS		Plaque surfaces#		Attack rate (%)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Dementia (n=116)	0.50	1.2	22.1	20.5	22.6	20.4	0.02	0.2	27.6	20.9
Non-dementia (n=116)	0.03	0.2	24.7	19.9	24.8	19.9	0.09	0.9	30.0	17.7

* sig. p<0.01 t-test
\# Teeth were present but could not be scored because they were covered in plaque, calculus or other debris.

5.3.5 Root caries

Table 4.18 presents the mean number of root surfaces with caries experience for dementia and non-dementia participants. Dementia participants had a higher mean number of decayed root surfaces (0.8), in comparison to participants without dementia (0.3) ($p<0.01$). Mean number of filled root surfaces was 3.2 for dementia and 3.6 for non-dementia participants. Mean number of decayed and filled root surfaces (DFS) and root caries attack rates (equivalent to the Root Caries Index (RCI)) were not significantly different. Mean root DFS was 4.0 for dementia and 3.8 for non-dementia participants. Root caries attack rates were 18.7% for dementia and 21.6% for non-dementia participants. Mean number of plaque-covered surfaces was 1.3 for both dementia and non-dementia participants.

Table 4.18: Dementia and non-dementia participants—root surface caries (n=232)

	Decayed surfaces*		Filled surfaces		Root DFS		Plaque surfaces#		RCI (%)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Dementia (n=116)	0.8	1.6	3.2	3.7	4.0	4.0	1.3	3.2	18.7	17.6
Non-dementia (n=116)	0.3	0.8	3.6	3.3	3.8	3.4	1.3	4.5	21.6	19.0

* sig. $p<0.01$ t-test
\# Teeth were present but could not be scored because they were covered in plaque, calculus or other debris.

5.3.6 Caries distribution in dementia and non-dementia participants

Caries distribution in dementia and non-dementia participants is presented in Tables 4.19 and 4.20. In Table 4.19 the distribution of decayed surfaces is presented. Dementia participants had higher numbers of decayed coronal surfaces than did non-dementia participants, with 22.4% of dementia and 2.6% of non-dementia participants having one or more decayed coronal surfaces. Of the dementia participants, 12.1% had one decayed coronal surface, 4.3% had two decayed coronal surfaces and 6.0% had three or more decayed coronal surfaces. Of the non-dementia participants, 2.6% had one decayed coronal surface. There were 31.1% of dementia and 14.8% of non-dementia participants who had one or more decayed root surface. Of the dementia participants, 14.7% had one decayed root surface, 6.9% had two decayed root surfaces and 9.5% had three or more decayed root surfaces. Of the non-dementia participants, 6.9% had one decayed root surface, 5.2% had two decayed root surfaces and 2.7% had three or more decayed root surfaces.

Table 4.19: Caries distribution for dementia and non-dementia participants at baseline—decayed surfaces (n=232) (per cent)

	Decayed coronal surfaces*		Decayed root surfaces	
	Dementia (n=116)	Non-dementia (n=116)	Dementia (n=116)	Non-dementia (n=116)
0 surfaces	77.6	97.4	69.0	85.3
1 surface	12.1	2.6	14.7	6.9
2 surfaces	4.3	0.0	6.9	5.2
3+ surfaces	6.0	0.0	9.5	2.7

* sig. p<0.01 chi-square test

In Table 4.20 the distribution of decayed/filled surfaces (DFS) is presented. DFS distribution was similar for both dementia and non-dementia participants. All but 5.2% of dementia and 6.9% of non-dementia participants had one or more decayed/filled coronal surface. There were 50.9% of dementia and 42.2% of non-dementia participants with 1–20 decayed/filled coronal surfaces, 27.6% of dementia and 32.8% of non-dementia participants with 21–40 decayed/filled coronal surfaces, and 16.4% of dementia and 18.1% of non-dementia participants with more than 41 decayed/filled coronal surfaces. There were 21.7% of dementia and 16.4% of non-dementia participants without any decayed/filled root surfaces, with nearly all of the remaining participants having 1–10 decayed/filled root surfaces. Only 6.1% of dementia and 6.9% of non-dementia participants had 11–20 decayed/filled root surfaces.

Table 4.20: Caries distribution for dementia and non-dementia participants at baseline—decayed/filled surfaces (DFS) (n=232) (per cent)

Decayed/filled coronal surfaces			Decayed/filled root surfaces		
	Dementia (n=116)	Non-dementia (n=116)		Dementia (n=116)	Non-dementia (n=116)
0 surfaces	5.2	6.9	**0 surfaces**	21.7	16.4
1–20 surfaces	50.9	42.2	**1–10 surfaces**	72.2	76.7
21–40 surfaces	27.6	32.8	**11–20 surfaces**	6.1	6.9
41+ surfaces	16.4	18.1	**21+ surfaces**	0.0	0.0

Note: not sig. p<0.01 chi-square test

In Table 4.21 participants' decayed coronal surfaces by decayed root surfaces is presented. Of the 116 dementia participants, 57.8% had no decayed coronal or root surfaces and 11.2% had both decayed coronal and decayed root surfaces. There were 11.2% of dementia participants with decayed coronal but not decayed root surfaces, and 19.8% with decayed root but not decayed coronal surfaces. Of the 116 non-dementia participants, 84.5% had no decayed coronal or root surfaces and 1.7% had both decayed coronal and decayed root surfaces. There were 0.9% of non-dementia participants with decayed coronal but not decayed root surfaces, and 12.9% with decayed root but not decayed coronal surfaces.

Table 4.21: Participants' decayed coronal surfaces by decayed root surfaces at baseline (n=232) (per cent)

	Decayed root surfaces			
	Dementia (n=116)		Non-dementia (n=116)	
Decayed coronal surfaces	**None**	**1+**	**None**	**1+**
None	57.8	19.8	84.5	12.9
1+	11.2	11.2	0.9	1.7

5.3.7 Retained roots

Table 4.22 presents numbers of retained roots (decayed or sound) for dementia and non-dementia participants. Of the mean 0.5 retained roots for dementia participants, there was a mean of 0.3 decayed compared with 0.2 sound retained roots. Non-dementia participants had a mean of 0.01 decayed and 0.1 sound retained roots. Dementia participants had a higher number of decayed retained roots ($p<0.01$).

Table 4.22: Dementia and non-dementia participants—retained roots (n=232)

	Retained root decayed		Retained root sound	
	Mean	SD	Mean	SD
Dementia (n=116)	0.3	1.8	0.2	0.5
Non-dementia (n=116)	0.01	0.09	0.1	0.6

Note: not sig. p>0.05 t-test

5.3.8 Attrition

Dementia participants had a mean number of 16.5 teeth present. Non-dementia participants had a mean number of 15.7 teeth present. Table 4.23 presents the attrition status for participants. The majority of participants' teeth showed signs of attrition. Dementia participants had a mean of 3.7 teeth with enamel attrition, 9.9 teeth with dentine attrition and 0.1 teeth with severe attrition, leaving 2.8 teeth with no evidence of attrition. Non-dementia participants had a mean of 3.0 teeth with enamel attrition, 10.7 teeth with dentine attrition and 0.1 teeth with severe attrition, leaving 2.0 teeth with no evidence of attrition.

Table 4.23: Dementia and non-dementia participants—attrition (n=232)

	Mean number of teeth	
Attrition status	**Dementia (n=116)**	**Non-dementia (n=116)**
No attrition	2.8	2.0
Enamel*	3.7	3.0
Dentine**	9.9	10.7
Severe#	0.1	0.1
Total	**16.5**	**15.7**

* Enamel = occlusal/incisal enamel was worn so that dentine was exposed.
** Dentine = entire occlusal/incisal enamel was obliterated, leaving an enamel ring.
# Severe = tooth has worn to the gingival margin (≤ 1/3 crown is present).

Notes: 1. not sig. p>0.05 t-test
2. excludes crowned teeth and retained roots

5.3.9 Periodontal conditions

Table 4.24 presents participants' conditions (type and number) that precluded a periodontal inspection. Twenty-three per cent of dementia and 16.4% of non-dementia participants had artificial joints, heart valves or prostheses; 3.4% of dementia and 5.2% of non-dementia participants had a bleeding problem; and 6.0% of dementia and 9.5% of non-dementia participants would have required further consultation with medical practitioners and possible modification of their medications. Thirty-two per cent of dementia and 28.5% of non-dementia participants were precluded from the periodontal inspection because they had one or two of these conditions. Some of the remaining participants did not have a periodontal inspection completed because of access difficulties, or because the teeth and gingival tissues were covered in plaque and calculus. These high numbers precluded further analysis of the periodontal data.

Table 4.24: Dementia and non-dementia participants—conditions precluding periodontal inspection (n=232) (per cent)

	Dementia (n=116)	Non-dementia (n=116)
Type of condition		
Rheumatic fever, artificial joints, heart valves or prostheses	23.3	16.4
A bleeding problem	3.4	5.2
Medications	6.0	9.5
Number of conditions		
No conditions	68.1	71.6
One condition	31.0	23.3
Two conditions	0.9	5.2

5.3.10 Plaque accumulation

Table 4.25 presents participants' mean Plaque Index (PI) scores (possible range 0–3). Participants without any of the six key teeth for scoring of the plaque index were not included. Mean PI score for all dementia participants was 0.7 and for non-dementia participants was 0.6. As there were limited amounts of plaque present and no significant differences between dementia and non-dementia groups, no further baseline analyses have been completed for plaque accumulation.

Table 4.25: Dementia and non-dementia participants—Mean Plaque Index scores (n=224)

Mean PI score[a]	
Dementia (n=114)	**Non-dementia (n=110)**
0.7	**0.6**

a Participants without any of the six key teeth for scoring of the plaque index were not included.

Note: not significant p>0.05 t-test

5.4 Participants' characteristics associated with oral diseases and conditions

5.4.1 Tooth status

Table 4.26 presents tooth status by dementia participants' characteristics. Dementia participants who had not visited a dentist for more than 12 months and whose carers had difficulties with their oral hygiene care had more decayed tooth crowns ($p<0.05$). Dementia participants who were aged 80+ years, were not taking acetylcholinesterase inhibitor medication, were government-cardholders, did not have private health insurance and could eat fewer food types had more missing teeth ($p<0.05$). Dementia participants who were not taking acetylcholinesterase inhibitor medication, had not visited a dentist for more than 12 months, were government-cardholders, did not have private health insurance, had moderate to severe dementia (MMSE score), had a non-Alzheimer's type of dementia, and could eat fewer food types, and whose carers did not have difficulties with oral hygiene care had fewer filled tooth crowns ($p<0.05$). Dementia participants who had not visited a dentist for more than 12 months, were not dependent for many activities of daily living (ADLs), were diagnosed two or less years previously and did not need assistance cleaning their teeth, and whose carers had difficulties with oral hygiene care, had a higher DMFT ($p<0.05$).

Table 4.27 presents tooth status by non-dementia participants' characteristics. There were no significant differences for the numbers of decayed tooth crowns for any of the participants' characteristics. Non-dementia participants who were male, had not visited a dentist for more than 12 months, were government-cardholders, did not have private health insurance and could eat fewer food types had more missing teeth ($p<0.05$). Non-dementia participants who were male, had not visited a dentist for more than 12 months, were government-cardholders and did not have private health insurance had fewer filled tooth crowns ($p<0.05$). Non-dementia participants who could eat fewer food types had a higher DMFT ($p<0.05$).

Table 4.26: Dementia participants—tooth status by baseline characteristics (n=116)

		Number of decayed crowns		Number of missing teeth		Number of filled/crowned crowns		DMFT		Number of retained roots	
	n	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Sex											
Male	66	0.3	0.8	13.2	6.9	9.5	6.4	23.0	6.2	0.3	0.7
Female	50	0.3	0.8	15.2	6.5	8.0	6.2	23.6	4.8	0.7	2.8
Age											
<79 years	91	0.4	0.7	**13.4	6.8	9.1	6.4	22.9	5.8	0.2	0.6
80+ years	25	0.3	1.0	16.4	6.5	8.0	6.0	24.7	4.9	1.3	3.8
Number of medical conditions											
0–3	29	0.5	1.0	11.9	7.0	9.9	8.2	22.3	6.9	1.1	3.6
4+	87	0.3	0.7	14.8	6.6	8.5	5.6	23.6	5.2	0.3	0.6
History of depression											
Yes	35	0.2	0.5	13.9	7.5	8.9	7.0	23.0	5.6	0.2	0.5
No	81	0.4	0.9	14.1	6.5	8.8	6.0	23.4	5.7	0.6	2.2
Number of medications											
0–2	30	0.5	1.2	12.5	6.7	8.4	6.9	21.4	7.3	1.1	3.5
3+	86	0.3	0.6	14.6	6.7	9.0	6.1	23.9	4.8	0.2	0.6
Taking traditional neuroleptic medication											
Yes	24	0.4	0.7	14.1	7.5	8.6	6.6	23.1	5.2	0.3	0.9
No	92	0.3	0.8	14.0	6.7	8.9	6.3	23.3	5.8	0.5	2.1
Taking acetylcholinesterase inhibitor medication											
Yes	41	0.2	0.5	*11.8	6.1	**10.8	6.9	22.8	5.3	0.2	0.7
No	75	0.4	0.4	15.3	6.9	7.8	5.8	23.5	5.9	0.6	2.3
Taking antihypertensive medication											
Yes	34	0.2	0.5	14.8	6.2	9.4	5.5	24.4	4.3	0.2	0.5
No	82	0.4	0.9	13.7	7.0	8.7	6.6	22.7	6.1	0.6	2.2
Taking antidepressant medication											
Yes	24	0.3	0.7	14.6	7.4	8.8	6.2	23.7	5.5	0.2	0.5
No	92	0.4	0.8	13.9	6.7	8.9	6.4	23.1	5.7	0.5	2.1
Time since last visit											
≤12 months	69	*0.1	0.4	13.3	6.6	*11.0	6.4	*24.4	4.7	0.5	2.4
>12 months	47	0.6	1.1	15.1	7.0	5.8	4.8	21.5	6.4	0.3	0.8
Government card											
Yes	98	0.4	0.8	*14.8	6.6	*7.9	5.6	23.1	5.7	0.5	2.0
No	18	0.2	0.5	9.8	6.2	14.3	7.3	24.3	5.2	0.3	1.0

* sig. p<0.01 t-test
** sig. p<0.05 t-test

(continued)

Table 4.26 (continued): Dementia participants—tooth status by baseline characteristics (n=116)

		Number of decayed crowns		Number of missing teeth		Number of filled/crowned crowns		DMFT		Number of retained roots	
	n	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Private health insurance											
Yes	38	0.3	0.7	*11.3	5.9	*11.9	6.8	23.5	4.7	0.3	0.8
No	78	0.4	0.8	15.4	6.8	7.4	5.5	23.1	6.1	0.5	2.2
ADL score (no. of dependent activities)											
0–2	95	0.4	0.8	14.1	6.9	9.4	6.2	**23.8	5.3	0.3	0.7
3–6	21	0.3	0.6	13.9	6.7	6.6	6.3	20.8	6.6	1.1	4.1
IADL score (no. of independent activities)											
0–2	62	0.3	0.6	14.2	6.4	8.0	6.0	22.5	5.7	0.6	2.4
3–8	54	0.4	1.0	13.9	7.2	9.9	6.6	24.1	5.5	0.3	0.9
MMSE score											
0–20 (severe/mod)	66	0.3	0.7	14.2	6.8	**7.8	6.2	22.3	6.1	0.6	2.4
21–30 (mild/normal)	43	0.4	1.0	13.7	7.2	10.2	6.4	24.3	5.0	0.3	0.8
Dementia type											
Alzheimer's	95	0.3	0.8	13.5	6.6	**9.4	6.4	23.3	5.7	0.5	2.1
Other	21	0.4	0.8	16.6	7.2	6.4	5.3	23.4	5.4	0.1	0.5
GDS score											
1–3 (normal/mild)	40	0.4	0.9	13.5	6.4	10.2	6.3	24.0	4.7	0.2	0.5
4–7 (mod/severe)	76	0.3	0.8	14.3	7.0	8.2	6.3	22.8	6.1	0.6	2.3
Years since dementia diagnosis											
<2 years	63	0.4	0.9	14.7	6.8	9.4	6.1	**24.4	4.9	0.3	0.7
3+ years	53	0.3	0.6	13.3	6.8	8.2	6.6	21.8	6.1	0.6	2.7
Number of foods can eat											
0–3	26	0.3	1.0	*18.2	7.1	*5.1	4.3	23.5	5.5	1.2	3.8
4–5	90	0.3	0.3	12.9	6.2	10.0	6.4	23.2	5.7	0.2	0.6
Has difficulties with oral hygiene											
Yes	89	**0.2	0.6	14.1	6.9	**9.6	6.2	**23.9	5.2	0.3	0.7
No	27	0.7	1.2	13.8	6.5	6.5	6.1	21.0	6.5	1.1	3.7
Needs assistance with cleaning teeth											
Yes	28	0.3	0.6	13.6	6.3	7.3	6.4	**21.2	6.6	0.9	3.6
No	88	0.3	0.9	14.2	7.0	9.4	6.2	23.9	5.2	0.3	0.8
Total	**116**	**0.3**	**0.8**	**14.0**	**6.8**	**8.9**	**6.3**	**23.2**	**5.6**	**0.5**	**1.9**

* sig. p<0.01 t-test
** sig. p<0.05 t-test

Table 4.27: Non-dementia participants—tooth status by baseline characteristics (n=116)

		Number of decayed crowns		Number of missing teeth		Number of filled/crowned crowns		DMFT		Number of retained roots	
	n	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Sex											
Male	66	0.05	0.2	*16.6	8.1	*7.6	6.1	24.3	4.2	0.20	0.8
Female	50	0.00	0.0	12.5	6.9	11.2	5.8	23.6	4.3	0.04	0.2
Age											
<79 years	91	0.03	0.0	14.6	7.8	9.3	6.4	24.0	4.2	0.1	0.7
80+ years	25	0.00	0.0	15.6	7.9	8.4	5.6	24.0	4.4	0.2	0.5
Number of medical conditions											
0–2	63	0.02	0.1	14.5	7.9	9.1	6.2	23.7	4.5	0.2	0.8
3+	53	0.04	0.2	15.2	7.8	9.1	6.2	24.3	4.0	0.1	0.3
Number of medications											
0–2	52	0.02	0.1	15.4	8.5	8.4	6.5	23.8	4.6	0.20	0.9
3+	34	0.03	0.2	14.4	7.3	9.7	5.9	24.2	3.9	0.06	0.2
Taking antihypertensive medication											
Yes	52	0.02	0.1	15.6	7.4	8.0	5.7	23.7	3.6	0.04	0.2
No	64	0.03	0.2	14.2	8.2	10.0	6.5	24.3	4.7	0.20	0.8
Time since last visit											
≤12 months	92	0.01	0.1	*13.7	7.6	*10.1	6.0	23.9	4.2	0.20	0.7
>12 months	24	0.08	0.3	19.1	7.6	5.3	5.6	24.5	4.3	0.08	0.3
Government card											
Yes	100	0.02	0.1	**15.5	7.7	*8.3	5.7	23.9	4.3	0.1	0.7
No	16	0.07	0.3	10.5	7.4	14.1	7.1	24.7	3.5	0.1	0.3
Private health insurance											
Yes	52	0.04	0.2	**13.0	8.2	*11.1	6.6	24.2	4.4	0.08	0.3
No	64	0.02	0.1	16.3	7.3	7.5	5.4	23.9	4.1	0.20	0.8
Number of foods can eat											
0–3	10	0.00	0.0	*21.7	7.7	6.1	6.7	*27.8	2.9	0.4	0.7
4–5	105	0.03	0.2	14.2	7.6	9.5	6.1	23.7	4.2	0.1	0.6
Total	**116**	**0.03**	**0.2**	**14.8**	**7.8**	**9.1**	**6.2**	**24.0**	**4.2**	**0.1**	**0.6**

* sig. p<0.01 t-test
** sig. p<0.05 t-test

5.4.2 Coronal caries

Table 4.28 presents coronal caries surface experience by dementia participants' characteristics. Dementia participants who were government-cardholders, who were not taking acetylcholinesterase inhibitor medication, time since last visit was >12 months and whose carers had difficulties with their oral hygiene care had more decayed surfaces ($p<0.05$). Dementia participants with fewer filled teeth and a lower DFS score were those who were not taking acetylcholinesterase inhibitors, had not visited the dentist for more than 12 months, were government-cardholders, had no private health insurance, were not independently able to do many IADLs, had moderate to severe dementia (MMSE score), had a non-Alzheimer's type of dementia and could eat fewer food types, and whose carers had difficulties with their oral hygiene care (FS only) ($p<0.05$). Coronal caries attack rates were lower for government-cardholders and those participants who had not visited the dentist for more than 12 months ($p<0.05$).

Table 4.29 presents coronal caries surface experience by non-dementia participants' characteristics. There were no significant differences for numbers of decayed coronal surfaces for participants' characteristics. Non-dementia participants with fewer filled teeth, a lower DFS score and a lower coronal caries attack rate were males and those who were taking antihypertensives, had a time since last visit >12 months, were government-cardholders, and had no private health insurance ($p<0.05$).

Table 4.28: Dementia participants—coronal caries by baseline characteristics (n=116)

		Decayed surfaces		Filled surfaces		Coronal DFS		Attack rate (%)	
	n	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Sex									
Male	66	0.5	1.1	23.8	21.2	24.3	21.2	28.2	19.1
Female	50	0.5	1.2	19.8	19.4	20.3	19.3	23.2	23.2
Age									
<79 years	91	0.5	1.1	22.2	20.4	22.8	20.2	25.7	19.0
80+ years	25	0.3	1.2	21.5	21.7	21.8	21.6	34.5	26.1
Number of medical conditions									
0–3	29	0.6	1.2	26.7	27.5	27.3	27.4	21.1	26.6
4+	87	0.4	1.1	20.6	17.4	21.0	17.4	26.4	18.7
History of depression									
Yes	35	0.3	0.8	23.3	24.1	23.6	24.0	27.4	24.3
No	81	0.5	1.3	21.6	18.8	22.1	18.8	27.7	19.4
Number of medications									
0–2	30	0.7	1.7	21.5	23.1	22.2	23.0	28.7	25.3
3+	86	0.4	0.9	22.3	19.6	22.7	19.6	27.3	19.3
Taking traditional neuroleptic medication									
Yes	24	0.5	0.9	21.0	19.9	21.5	20.2	24.3	16.4
No	92	0.5	1.2	22.4	20.7	22.8	20.6	28.5	21.9
Taking acetylcholinesterase inhibitor medication									
Yes	41	**0.3	0.6	**28.5	24.4	**28.8	24.3	29.0	19.8
No	75	0.6	1.4	18.6	17.2	19.2	17.2	26.9	21.6
Taking antihypertensive medication									
Yes	34	0.4	1.0	22.3	17.3	22.7	17.3	29.2	20.5
No	82	0.5	1.2	22.0	21.7	22.5	21.7	27.0	21.2
Taking antidepressant medication									
Yes	24	0.4	21.4	21.4	20.2	21.8	20.0	28.2	21.8
No	92	0.5	22.3	22.3	20.6	22.8	20.6	27.5	20.8
Time since last visit									
≤12 months	69	*0.2	0.6	*29.2	22.3	*29.4	22.2	*34.8	21.7
>12 months	47	0.9	1.6	11.7	11.3	12.5	11.7	17.1	14.3
Government card									
Yes	98	**0.5	1.2	*19.0	17.6	*19.5	17.6	**25.9	20.7
No	18	0.2	0.5	39.1	26.4	39.2	26.4	36.7	20.3

* sig. p<0.01 t-test
** sig. p<0.05 t-test

(continued)

Table 4.28 (continued): Dementia participants—coronal caries by baseline characteristics (n=116)

		Decayed surfaces		Filled surfaces		Coronal DFS		Attack rate (%)	
	n	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Private health insurance									
Yes	38	0.3	0.9	*32.2	23.3	*32.5	23.3	32.5	20.0
No	78	0.5	1.3	17.2	17.0	17.7	17.0	25.2	21.0
ADL score (no. of dependent activities)									
0–2	95	0.5	1.2	23.6	20.5	24.1	20.4	28.6	20.0
3–6	21	0.4	0.9	15.2	19.4	15.7	19.3	23.3	24.5
IADL score (no. of independent activities)									
0–2	62	0.4	1.0	**18.6	18.1	**19.0	18.0	25.0	20.2
3–8	54	0.5	1.3	26.1	22.3	26.6	22.3	30.6	21.5
MMSE score									
0–20 (severe/mod)	65	0.5	1.2	**18.8	19.6	**19.2	19.5	25.1	21.6
21–30 (mild/normal)	43	0.5	1.2	26.8	21.7	27.3	21.7	30.8	20.6
Dementia type									
Alzheimer's	95	0.4	1.1	**24.0	21.1	**24.4	21.1	29.2	2.2
Other	21	0.6	1.2	13.4	14.5	14.1	14.6	20.5	3.9
GDS score									
1–3 (normal/mild)	40	0.5	1.4	26.4	21.5	26.9	21.4	30.8	20.3
4–7 (mod/severe)	76	0.5	1.0	19.8	19.7	20.3	19.6	25.9	21.2
Years since dementia diagnosis									
<2 years	63	0.5	1.3	23.6	19.8	24.1	19.7	30.0	20.7
3+ years	53	0.5	1.0	20.3	21.3	20.8	21.3	24.8	21.0
Number of foods can eat									
0–3	26	0.4	1.3	*11.5	13.2	*11.9	13.3	23.0	23.3
4–5	90	0.5	1.1	25.2	21.2	25.7	21.1	28.9	20.1
Has difficulties with oral hygiene									
Yes	89	**1.0	1.9	**15.7	18.6	16.7	18.9	24.3	24.1
No	27	0.3	0.7	24.0	20.7	24.3	20.6	28.6	19.9
Needs assistance with cleaning teeth									
Yes	28	0.4	0.8	16.8	19.2	17.2	19.1	23.7	22.4
No	88	0.5	1.2	23.8	20.7	24.3	20.6	28.9	20.4
Total	**116**	**0.5**	**1.2**	**22.1**	**20.5**	**22.6**	**20.4**	**27.6**	**20.9**

* sig. p<0.01 t-test
** sig. p<0.05 t-test

Table 4.29: Non-dementia participants—coronal caries by baseline characteristics (n=116)

		Decayed surfaces		Filled surfaces		Coronal DFS		Attack rate (%)	
	n	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Sex									
Male	66	0.05	0.2	*20.2	18.0	*20.3	18.0	**26.6	17.1
Female	50	0.00	0.0	30.7	20.9	30.7	20.9	33.7	18.0
Age									
<79 years	91	0.03	0.2	25.8	20.8	25.8	20.8	30.3	18.2
80+ years	25	0.00	0.0	21.0	16.0	21.0	16.0	27.3	16.1
Number of medical conditions									
0–2	63	0.02	0.1	25.6	20.0	25.7	19.9	31.3	19.1
3+	53	0.04	0.2	23.7	20.0	23.7	20.0	27.7	16.0
Number of medications									
0–2	52	0.02	0.1	23.3	20.8	23.3	20.8	29.3	20.2
3+	64	0.03	0.2	25.9	19.2	26.0	19.3	29.9	16.0
Taking antihypertensive medication									
Yes	52	0.02	0.1	**20.2	16.0	**20.3	16.0	**24.6	12.7
No	64	0.03	0.2	28.4	22.1	28.4	22.1	33.8	20.1
Time since last visit									
≤12 months	92	0.01	0.1	*28.0	19.9	*28.0	19.9	*32.1	16.9
>12 months	24	0.08	0.3	12.1	14.0	12.2	14.1	20.2	18.0
Government card									
Yes	100	0.02	0.1	*21.7	16.8	*21.7	16.8	*27.9	16.2
No	16	0.06	0.3	43.9	26.8	44.0	26.7	40.7	23.0
Private health insurance									
Yes	52	0.04	0.2	*31.3	22.8	*31.3	22.8	*33.5	20.1
No	64	0.02	0.1	19.4	15.4	19.5	15.4	26.5	15.0
Total	**116**	**0.03**	**0.2**	**24.7**	**19.9**	**24.8**	**19.9**	**30.0**	**17.7**

* sig. p<0.01 t-test
** sig. p<0.05 t-test

5.4.3 Root caries

Table 4.30 presents root caries surface experience by dementia participants' characteristics. Dementia participants who had not visited the dentist for more than 12 months and could do fewer IADLs independently had more decayed surfaces ($p<0.05$). Dementia participants with fewer filled root surfaces were those who were not taking acetylcholinesterase inhibitors, had not visited the dentist for more than 12 months, were government-cardholders, had no private health insurance and had moderate to severe dementia (MMSE score) ($p<0.05$). Dementia participants with a lower root DFS score were those who were not taking acetylcholinesterase inhibitors, had not visited the dentist for more than 12 months and were government-cardholders ($p<0.05$). Dementia participants with more plaque-covered root surfaces were those who could not do many IADLs independently, had moderate to severe dementia (MMSE and GDS scores), had been 3+ years since their dementia diagnosis, could eat fewer food types, needed assistance with cleaning their teeth, were taking fewer medications and were not taking antihypertensive or antidepressant medication ($p<0.05$). Root caries attack rates (Root Caries Index (RCI)) were higher for those participants who had not visited the dentist for more than 12 months ($p<0.05$).

Table 4.31 presents root caries surface experience by non-dementia participants' characteristics. There were no significant differences for numbers of decayed root surfaces, filled root surfaces, plaque-covered root surfaces, DFS, or RCI for any of the participants' characteristics.

Table 4.30: Dementia participants—root caries by baseline characteristics (n=116)

	Decayed surfaces			Filled surfaces		Root DFS		Plaque surfaces[#]		RCI (%)	
	n	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Sex											
Male	66	0.8	1.9	3.7	3.9	4.5	4.2	1.7	3.9	18.9	16.2
Female	50	0.7	1.3	2.6	3.3	3.3	3.6	0.9	1.8	18.3	19.6
Age											
<79 years	91	0.8	1.5	3.1	3.8	3.9	4.0	1.6	3.5	17.3	16.2
80+ years	25	0.8	2.0	3.4	3.4	4.2	4.0	0.6	1.5	23.7	21.2
Number of medical conditions											
0–3	29	0.7	1.1	2.9	3.3	3.6	3.9	1.7	2.6	18.3	21.6
4+	87	0.8	1.8	3.3	3.8	4.1	4.0	1.2	3.4	18.8	16.3
History of depression											
Yes	35	1.1	2.2	3.3	4.7	4.4	5.2	0.7	1.7	20.3	20.1
No	81	0.6	1.3	3.2	3.2	3.8	3.4	1.6	3.7	18.0	16.7
Number of medications											
0–2	30	0.8	1.8	3.0	3.2	3.8	3.9	**2.5	3.9	18.9	21.7
3+	86	0.8	1.6	3.3	3.8	4.0	4.0	0.9	2.8	15.6	16.2
Taking neuroleptic medication											
Yes	24	0.9	2.0	2.9	3.1	3.8	3.8	2.0	2.5	15.3	15.2
No	92	0.7	1.6	3.3	3.8	4.0	4.1	1.2	3.4	19.6	18.2
Taking acetylcholinesterase inhibitor medication											
Yes	41	0.7	1.4	*4.4	4.7	**5.1	5.1	0.9	1.7	21.2	16.8
No	75	0.8	1.8	2.6	2.8	3.4	3.1	1.6	3.8	17.2	18.1
Taking antihypertensive medication											
Yes	34	0.9	1.6	3.8	5.3	4.7	5.4	**0.4	1.0	18.5	16.7
No	82	0.7	1.7	3.0	2.8	3.7	3.3	1.7	3.7	18.7	18.1
Taking antidepressant medication											
Yes	24	0.7	1.5	2.9	4.5	3.5	4.6	**0.6	1.2	14.4	16.7
No	92	0.8	1.7	3.3	3.4	4.1	3.8	1.5	3.5	19.8	17.8
Time since last visit											
≤12 months	69	**0.5	0.9	*4.2	4.1	**4.7	4.3	0.8	1.7	*22.1	17.7
>12 months	47	1.2	2.3	1.7	2.2	2.9	3.3	2.0	4.5	13.5	16.5
Government card											
Yes	98	0.8	1.7	**2.8	3.0	**3.6	3.4	1.2	2.5	17.9	17.6
No	18	0.7	1.2	5.2	5.7	5.9	6.2	2.1	5.7	23.2	17.7

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

* sig. p<0.01 t-test

** sig. p<0.05 t-test

(continued)

Table 4.30 (continued): Dementia participants—root caries by baseline characteristics (n=116)

	Decayed surfaces			Filled surfaces		Root DFS		Plaque surfaces[#]		RCI (%)	
	n	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Private health insurance											
Yes	38	0.5	1.3	**4.2	4.6	4.7	4.7	1.6	4.0	20.5	15.6
No	78	0.8	1.8	2.7	3.1	3.6	3.6	1.2	2.8	17.8	18.6
ADL score (no. of dependent activities)											
0–2	95	0.7	1.3	3.4	3.8	4.1	3.9	0.9	1.9	18.2	14.7
3–6	21	1.3	2.7	2.2	3.2	3.5	4.6	3.3	6.1	20.5	27.5
IADL score (no. of independent activities)											
0–2	62	**1.0	2.1	2.9	3.4	4.0	3.9	*2.1	4.1	17.8	18.7
3–8	54	0.5	0.8	3.5	4.0	4.0	4.1	0.5	1.3	19.7	16.5
MMSE score											
0–20 (severe/mod)	66	0.9	1.9	**2.6	3.0	3.5	3.6	*2.0	4.0	16.8	18.6
21–30 (mild/normal)	43	0.6	1.2	4.1	4.2	4.7	4.2	0.5	1.2	22.1	16.0
Dementia type											
Alzheimer's	95	0.6	1.4	3.4	3.9	4.0	4.1	1.4	3.1	19.8	18.4
Other	21	1.5	2.5	2.2	2.3	3.8	3.3	1.3	3.7	13.5	12.8
GDS score											
1–3 (normal/mild)	40	0.5	1.2	3.3	3.3	3.8	3.6	*0.5	1.3	18.9	16.5
4–7 (mod/severe)	76	0.9	1.8	3.2	3.9	4.1	4.2	1.8	3.8	18.5	18.3
Years since dementia diagnosis											
<2 years	63	0.6	1.4	3.4	3.8	4.0	4.1	**0.8	2.6	19.1	16.4
3+ years	53	0.9	1.9	3.0	3.5	3.9	3.9	2.0	3.7	18.1	19.2
Number of foods can eat											
0–3	26	0.7	1.7	2.7	2.5	3.4	3.2	**2.4	4.9	21.4	23.0
4–5	90	0.8	1.6	3.3	4.0	4.1	4.2	1.0	2.5	17.9	15.9
Has difficulties with oral hygiene											
Yes	89	1.2	2.5	2.3	3.2	3.6	4.3	**3.0	5.6	18.9	23.7
No	27	0.6	1.3	3.5	3.8	4.1	3.9	0.9	1.8	18.6	15.6
Needs assistance with cleaning teeth											
Yes	28	1.2	2.3	2.4	2.9	3.6	4.0	**3.3	5.4	19.9	24.2
No	88	0.6	1.3	3.5	3.9	4.1	4.0	0.8	1.7	18.2	15.1
Total	**116**	**0.8**	**1.6**	**3.2**	**3.7**	**4.0**	**4.0**	**1.3**	**3.2**	**18.7**	**17.6**

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

* sig. p<0.01 t-test

** sig. p<0.05 t-test

Table 4.31: Non-dementia participants—root caries by baseline characteristics (n=116)

		Decayed surfaces		Filled surfaces		Root DFS		Plaque surfaces[#]		RCI (%)	
	n	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Sex											
Male	66	0.3	0.7	3.4	3.4	3.7	3.5	1.6	5.7	19.9	18.4
Female	50	0.3	1.0	3.7	3.3	4.0	3.4	0.9	1.9	23.8	19.7
Age											
<79 years	91	0.3	0.8	3.4	3.3	3.7	3.4	1.3	4.9	20.9	18.1
80+ years	25	0.3	0.8	4.0	3.6	4.4	3.7	1.4	2.5	24.2	22.1
Number of medical conditions											
0–2	63	0.2	0.7	3.8	3.7	4.1	3.8	2.0	5.9	22.5	20.0
3+	53	0.3	0.9	3.2	2.8	3.6	3.0	0.5	1.5	20.5	17.8
Number of medications											
0–2	52	0.3	0.7	3.4	3.6	3.6	3.7	1.9	6.4	21.0	20.7
3+	64	0.3	0.9	3.7	3.1	4.0	3.2	0.8	1.8	22.0	17.7
Time since last visit											
≤12 months	92	0.2	0.6	3.8	3.5	4.0	3.6	0.9	2.1	22.1	20.3
>12 months	24	0.6	1.2	2.8	2.3	3.4	2.8	2.7	9.0	19.7	12.8
Government card											
Yes	100	0.3	0.8	3.7	3.4	4.0	3.5	1.4	4.7	21.6	17.9
No	16	0.3	0.7	2.5	2.7	2.8	3.0	0.8	2.5	21.3	25.7
Private health insurance											
Yes	52	0.2	0.7	3.0	2.9	3.2	3.0	0.7	1.7	19.6	18.7
No	64	0.3	0.9	4.0	3.6	4.3	3.7	1.8	5.8	23.2	19.2
Total	**116**	**0.3**	**0.8**	**3.6**	**3.3**	**3.8**	**3.4**	**1.3**	**4.5**	**21.6**	**19.0**

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

Note: not sig. p>0.05 t-test

5.4.4 Correlations of tooth status, coronal caries and root caries with baseline characteristics

Table 4.32 presents non-parametric correlation analyses for tooth status, coronal caries and root caries with baseline participant characteristics for the 232 dementia and non-dementia participants. As MMSE score decreased (worsening of dementia severity), there was an increase in the numbers of decayed crowns, retained roots, decayed coronal surfaces, decayed root surfaces and plaque-covered root surfaces ($p<0.01$). As MMSE score decreased (worsening of dementia severity), there was a decrease in the number of filled tooth crowns, and filled coronal surfaces ($p<0.05$). As GDS score increased (worsening of dementia severity), there was an increase in the numbers of decayed crowns, retained roots, decayed coronal surfaces and decayed root surfaces ($p<0.01$). As GDS score increased (worsening of dementia severity), there was a decrease in the number of filled coronal surfaces ($p<0.05$). As ADL score increased (increased functional dependency), there was an increase in the number of plaque-covered root surfaces ($p<0.01$). As ADL score increased (increased functional dependency), there was a decrease in the numbers of filled tooth crowns, filled coronal surfaces and filled root surfaces ($p<0.05$). As IADL score decreased (increased functional dependency), there was an increase in the numbers of decayed crowns, retained roots, decayed coronal surfaces and decayed root surfaces ($p<0.01$). As IADL score decreased (increased functional dependency), there was a decrease in the numbers of filled tooth crowns and filled coronal surfaces ($p<0.05$). There were no significant differences for number of medications or number of chronic medical conditions. As the number of months since last dental visit increased, the numbers of decayed crowns, decayed coronal surfaces and decayed root surfaces increased ($p<0.01$). As the number of months since last dental visit increased, the numbers of filled crowns, filled coronal surfaces and filled root surfaces decreased ($p<0.01$). Correlation coefficients were low to moderate for these significant relationships.

Table 4.32: Dementia and non-dementia participants—correlations for tooth status and caries with baseline participant characteristics (n=232)

	Characteristic at baseline (n=232)						
	MMSE[a]	GDS[b]	ADL[c]	IADL[d]	Number medications	Number medical conditions	Months since last dental visit[e]
Decayed crowns	–0.3*	0.3*	0.1	–0.3*	–0.1	0.1	0.3*
Filled/crowned crowns	0.2**	–0.1	–0.1**	0.2**	0.1	–0.1	–0.4*
DMFT	–0.05	–0.1	–0.1	0.1	0.1	–0.01	–0.1
Retained roots	–0.2*	0.2*	0.1	–0.2*	–0.1	0.03	0.1
Decayed coronal surfaces	–0.3*	0.3*	0.1	–0.3*	–0.1	0.1	0.3*
Filled coronal surfaces	0.2*	–0.1**	–0.2**	0.2*	0.1	–0.1	–0.4*
Decayed root surfaces	–0.2*	0.2*	0.1	–0.2*	0.1	0.1	0.2*
Filled root surfaces	0.1	–0.1	–0.2**	0.1	0.1	0.1	–0.3*
Plaque-covered root surfaces	–0.2*	0.1	0.2*	–0.1	–0.1	–0.1	0.1

a MMSE scores ranged from 0 (severe dementia) to 30 (normal) and n=225 as 7 participants could not complete the test.
b GDS scores ranged from 1 (normal) to 7 (severe dementia).
c ADL scores ranged from 0 (not dependent for any ADLs) to 6 (dependent for 6 ADLs).
d IADL scores ranged from 0 (not independent for any IADLs) to 8 (independent for 8 ADLs).
e Baseline report of months since last visit adjusted with further one-year dental visit data.

* sig. p<0.01 Spearman correlation
** sig. p<0.05 Spearman correlation

5.5 Normative, rational and perceived needs for dental care

Tables 4.33 and 4.34 present the denture treatment needed and wanted for the upper and lower dentures by dementia and non-dementia participants. The rational treatment need assessed by dentists in this section of the dental inspection considered all of a participant's modifying factors, for example functional status, cognitive status, medical history, medications, social history, financial history, dental history and ethical issues. 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 often under-reported normative dental needs. Rational dental treatment needs were low for both upper and lower dentures in this study, with very few dementia or non-dementia participants requiring new dentures or other denture treatment. Participants' perceived denture treatment needs varied, but many participants did not want the treatment recommended. For example, 40% of dementia participants who were assessed to require a new lower partial denture did not want the new denture. In contrast, nearly all non-dementia participants who required a new full upper denture wanted the new denture.

Table 4.33: Dementia and non-dementia participants—upper denture treatment needed and wanted

	Upper denture treatment wanted (%)					
	Dementia			Non-dementia		
Denture treatment needed*	n	Agreed	Disagreed	n	Agreed	Disagreed
Adjustment	0	n.a.	n.a.	1	100.0	0.0
Reline	0	n.a.	n.a.	1	0.0	100.0
Repair	1	0.0	100.0	0	n.a.	n.a.
Full denture	3	0.0	100.0	7	71.4	28.6
Partial denture	4	75.0	25.0	1	100.0	0.0

* Rational treatment need determined by dentist considered all of a participant's modifying factors, for example functional status, cognitive status, medical history, medications, social history, financial history, dental history and ethical issues.
n.a. not available

Table 4.34: Dementia and non-dementia participants—lower denture treatment needed and wanted

	Lower denture treatment wanted (%)					
	Dementia			Non-dementia		
Denture treatment needed*	n	Agreed	Disagreed	n	Agreed	Disagreed
Adjustment	1	100.0	0.0	1	0.0	100.0
Reline	0	n.a.	n.a.	0	n.a.	n.a.
Repair	2	50.0	50.0	0	n.a.	n.a.
Full denture	1	0.0	100.0	3	100.0	0.0
Partial denture	5	60.0	40.0	3	66.7	33.3

* Rational treatment need determined by dentist considered all of a participant's modifying factors, for example functional status, cognitive status, medical history, medications, social history, financial history, dental history and ethical issues.
n.a. not available

Table 4.35 presents participants' perceived dental need by dentate status from interview. Perceived need for dental treatment was similar for both dementia and non-dementia participants, with approximately one-quarter perceiving a need for dental treatment. The low perceived needs of participants are in contrast to the higher normative treatment needs presented in Table 4.36.

Table 4.35: Dementia and non-dementia participants—perceived dental need from interview (n=232)

	Participants' perceived need for dental treatment		
	Yes	No	Don't know
Dementia (n=116)	25.0	73.3	1.7
Non-dementia (n=116)	24.1	75.9	0.0

Table 4.36 presents participants' normative treatment needs for restorations, extractions and preventive care. Dementia participants required more restorations (mean=1.2 surfaces) than did non-dementia participants (mean=0.8 surfaces) ($p<0.05$). When categorised by type of restoration (for 1–4 surfaces), dementia participants required a 1–surface restoration for a mean of 0.4 teeth, a 2-surface restoration for 0.2 teeth, a 3-surface restoration for 0.1 teeth and a 4-surface restoration for 0.03 teeth. When categorised by type of restoration (for 1–4 surfaces), non-dementia participants required a 1-surface restoration for a mean of 0.2 teeth, a 2-surface restoration for 0.1 teeth, a 3-surface restoration for 0.01 teeth and a 4-surface restoration for 0.1 teeth. Normative need for extractions was low among both groups: 0.3 teeth for dementia and 0.1 for non-dementia participants. Preventive care was determined at tooth level, and was higher for dementia (0.6 teeth) than for non-dementia participants (0.2 teeth) ($p<0.01$).

Table 4.36: Dementia and non-dementia participants—normative treatment needs (n=232)

	Mean number of teeth requiring treatment	
Type of treatment	**Dementia (n=116)**	**Non-dementia (n=116)**
Restorations		
For 1 surface**	0.4	0.2
For 2 surfaces	0.2	0.1
For 3 surfaces**	0.1	0.01
For 4 surfaces	0.03	0.1
Extractions	0.3	0.1
Preventive*	0.6	0.2

* sig. $p<0.01$ t-test
** sig. $p<0.05$ t-test

6 Results—one-year data collection

6.1 Baseline characteristics of one-year participants and non-participants

Table 5.1 presents the baseline general health, functional, cognitive, demographic, dental history and oral hygiene characteristics of one-year participants and non-participants. Dementia non-participants at one-year had a range of baseline dementia severity scores, with more moderate/severe dementia group non-participants at one-year. Higher percentages of dementia non-participants at one-year could perform fewer independent activities (IADLs), and more needed assistance with cleaning their teeth. There were no differences between non-dementia one-year participants and non-participants.

Table 5.1: Baseline general health, functional, cognitive, demographic, dental history and oral hygiene characteristics of one-year participants and non-participants (n=232) (per cent)

	Participants at one-year		Non-participants at one-year	
	Dementia	Non-dementia	Dementia	Non-dementia
Characteristic	(n=103)	(n=113)	(n=13)	(n=3)
Age group				
<79 years	79.6	77.9	69.2	100.0
80+ years	20.4	22.1	30.8	0.0
Sex				
Male	58.3	57.5	46.2	33.3
Female	41.7	42.5	53.8	66.7
Highest educational level				
Primary school	33.0	19.5	15.4	0.0
High school	35.0	57.5	53.8	33.3
Trade school	14.6	14.2	23.1	66.7
University	17.5	8.8	7.7	0.0
Marital status				
Married	86.4	63.7	92.3	0.0
Widowed	12.6	25.7	7.7	66.7
Divorced/Separated	1.0	8.8	0.0	33.3
Never married	0.0	1.8	0.0	0.0
Concession card status				
Pension Concession Card	58.3	61.9	53.8	66.7
Veterans Affairs Card	27.2	23.9	23.1	33.3
Commonwealth Seniors Card	3.9	2.7	0.0	0.0
No cards	10.7	11.5	23.1	0.0
Private health insurance				
Yes	32.0	45.1	38.5	33.3
No	68.0	54.9	61.5	66.7

(continued)

Table 5.1 (continued): Baseline general health, functional, cognitive, demographic, dental history and oral hygiene characteristics of one-year participants and non-participants (n=232) (per cent)

	Participants at one-year		Non-participants at one-year	
Characteristic	Dementia (n=103)	Non-dementia (n=113)	Dementia (n=13)	Non-dementia (n=3)
Number of chronic medical conditions				
0–2	9.7	29.2	7.7	33.3
3+	90.3	70.8	92.3	66.7
Number of medications				
0–2	27.2	44.2	15.4	66.7
3+	72.8	55.8	84.6	33.3
Attend dentist				
For a dental check-up	53.4	55.8	61.5	33.3
For a dental problem	46.6	44.2	38.5	66.7
IADL score (number of independent activities)				
0–2	51.5	0.0	69.2	0.0
3+	48.5	100.0	30.8	100.0
Needs assistance with cleaning teeth				
Yes	22.3	0.0	38.5	0.0
No	77.7	100.0	61.5	100.0
Has difficulties with oral hygiene care				
Yes	78.6	0.0	61.5	0.0
No	21.4	100.0	38.5	100.0

Tables 5.2–5.5 present the baseline coronal and root surface caries data for dementia and non-dementia participants who did or did not participate at one-year. There were no significant differences between those who did or did not participate at one-year for the numbers of decayed, filled, DFS, plaque-covered or attack rates for coronal or root surfaces (not sig. $p>0.05$).

Table 5.2: One-year dementia participants and non-participants—coronal caries at baseline (n=116)

One-year participation status	Decayed surfaces		Filled surfaces		Coronal DFS		Plaque surfaces#		Attack rate (%)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Participants (n=103)	0.5	1.2	22.7	21.0	23.2	21.0	0.0	0.0	28.3	21.6
Non-participants (n=13)	0.4	0.9	17.3	15.2	17.7	15.1	0.2	0.6	22.1	13.2

Could not be scored because they were covered in plaque, calculus or other debris.

Note: not sig. p<0.05 t-test

Table 5.3: One-year non-dementia participants and non-participants—coronal caries at baseline (n=116)

One-year participation status	Decayed surfaces		Filled surfaces		Coronal DFS		Plaque surfaces#		Attack rate (%)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Participants (n=113)	0.03	0.2	24.8	20.0	24.8	20.0	0.1	0.9	29.5	17.6
Non-participants (n=3)	0.00	0.0	23.0	16.5	23.0	16.5	0.0	0.0	34.8	27.5

Could not be scored because they were covered in plaque, calculus or other debris.

Note: not sig. p<0.05 t-test

Table 5.4: One-year dementia participants and non-participants—root caries at baseline (n=116)

One-year participation status	Decayed surfaces		Filled surfaces		Root DFS		Plaque surfaces#		RCI (%)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Participants (n=103)	0.8	1.7	3.3	3.6	4.1	3.9	1.3	3.3	19.2	17.8
Non-participants (n=13)	0.5	1.4	2.9	4.1	3.4	4.5	1.7	2.6	14.1	16.1

Could not be scored because they were covered in plaque, calculus or other debris.

Note: not sig. p<0.05 t-test

Table 5.5: One-year non-dementia participants and non-participants—root caries at baseline (n=116)

One-year participation status	Decayed surfaces		Filled surfaces		Root DFS		Plaque surfaces#		RCI (%)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Participants (n=113)	0.3	0.8	3.6	3.3	3.9	3.4	0.9	2.1	21.6	18.7
Non-participants (n=3)	0.0	0.0	2.0	3.5	2.0	3.5	14.7	25.4	20.0	34.6

Could not be scored because they were covered in plaque, calculus or other debris.

Note: not sig. p<0.05 t-test

6.2 One-year characteristics of dementia and non-dementia participants

Tables 5.6–5.9 present various one-year characteristics of the dementia and non-dementia participants. In Table 5.6 participants' demographic, medical, medication, functional and cognitive characteristics are presented. There were no significant differences for dementia and non-dementia groups for sex or age groups, with similar percentages at baseline and one-year in all sex and age categories. The distribution of (and significant differences between groups for each characteristic) country of birth, highest educational level, concession card status, private health insurance, marital status, smoking status and alcohol consumption were also very similar to baseline. For dementia participants, one-year carer characteristics and diagnostic characteristics were similar to baseline. The number of chronic medical conditions was again higher for dementia than non-dementia participants at one-year ($p<0.01$); dementia and non-dementia participants had higher percentages of chronic medical conditions at one-year than baseline. Dementia participants had a mean of 5.7 medical conditions at one-year, compared with 4.0 medical conditions for non-dementia participants (t-test, $p<0.01$). The number of medications taken was again higher for dementia than non-dementia participants at one-year ($p<0.01$). Dementia participants were taking a mean of 5.0 medications at one-year, compared with 3.4 medications for non-dementia participants (t-test, $p<0.01$). Again, more dementia than non-dementia participants were taking acetylcholinesterase inhibitor, sedative/anxiolytic, movement disorder/l-dopa and neuroleptic medication ($p<0.05$). As at baseline, nearly all non-dementia participants were able to do most IADLs and very few were dependent for any ADLs. However, dementia participants were again more dependent and their functional dependency had worsened since baseline, with 37.9% being dependent for three or more ADLs and three-quarters only able to do 0, 1 or 2 independent IADLs ($p<0.01$). At one-year there were no non-dementia participants with cognitive testing scores indicative of dementia (MMSE or GDS). The clock-drawing test was found to be less useful at one-year because of many participants' difficulties with writing and vision. The distribution of MMSE scores and GDS scores indicated that dementia participants were becoming more cognitively impaired, with over 40% now being in the severe dementia and another approximately 30% in the moderate dementia category. Just under one-third (30.1%) of dementia participants were institutionalised between baseline and one-year; only one non-dementia participant was institutionalised. For those dementia participants still living in the community with a family carer, two-thirds (68.4%) of their carers experienced high levels of carer burden.

Table 5.6: Dementia and non-dementia participants—one-year demographic, medical, medication, functional and cognitive characteristics (n=216) (per cent)

	Dementia (n=103)	Non-dementia (n=113)
Sex		
Male	58.3	57.5
Female	41.7	42.5
Age group		
<79 years	79.6	77.9
80+ years	20.4	22.1
Country of birth		
Australia	57.3	69.0
United Kingdom	21.4	15.9
Ireland	0.0	1.8
New Zealand	1.0	0.0
Other country	20.4	13.3
Highest educational level*		
Primary school	33.0	19.5
High school	35.0	57.5
Trade school	14.6	14.2
University	17.5	8.8
Concession card status		
Pension Concession Card	61.2	65.5
Veterans Affairs Card	26.2	21.2
Commonwealth Seniors Card only	1.9	1.8
No cards	10.7	11.5
Private health insurance**		
Yes	32.0	45.1
No	68.0	54.9
Marital status*		
Married	86.4	63.7
Widowed	12.6	25.7
Divorced/Separated	1.0	8.8
Never married	0.0	1.8
Relationship of carer		
Spouse/de facto	86.4	—
Son-/daughter-in-law	12.6	—
Other	1.0	—
Where carer lives		
With the person with dementia	95.1	—
Visits person with dementia regularly	2.9	—
Other	1.9	—
A diagnosed dementia	100.0	0.0
Dementia diagnosis		
Alzheimer's disease	75.7	—
Multi-infarct dementia	10.7	—
Dementia with Lewy Bodies	6.8	—
Mixed dementia	6.8	—

* sig. p<0.01 chi-square test
** sig. p<0.05 chi-square test
— not applicable

(continued)

Table 5.6 (continued): Dementia and non-dementia participants—one-year demographic, medical, medication, functional and cognitive characteristics (n=216) (per cent)

	Dementia (n=103)	Non-dementia (n=113)
Years since dementia diagnosis[a]		
<1	0.0	—
1–2	34.0	—
3–4	32.1	—
5–6	26.2	—
7–8	3.9	—
9–10	3.9	—
Number of chronic medical conditions*		
0	0.0	6.2
1–2	10.7	16.8
3–4	16.5	43.4
5–6	35.0	22.1
7–8	29.1	7.1
9+	8.7	4.4
Currently smokes	8.7	7.1
Currently drinks alcohol	47.6	55.8
Total number of medications*		
0	4.9	10.6
1–2	17.5	36.3
3–4	23.3	24.8
5–6	25.2	14.2
7–8	17.5	8.0
9+	11.7	6.2
Taking aspirin medication	43.7	33.6
Taking acetylcholinesterase inhibitor medication*[b]	28.2	0.0
Taking antihypertensive medication	28.2	38.9
Taking antidepressant medication*	27.2	3.5
Taking steroid medication	9.7	9.7
Taking sedative/anxiolytic medication**	20.4	5.3
Taking movement disorder or l-dopa medication**	7.8	1.8
Taking neuroleptic (traditional) medication*	24.3	0.9
Taking neuroleptic (new generation) medication	2.9	0.0
Taking neuroleptic medication (all types)*	27.2	0.9
ADL score (number of dependent activities)*		
0–2	62.1	97.3
3–4	17.5	1.8
5–6	20.4	0.9
IADL score (number of independent activities)*		
0–2	75.7	4.5
3–5	18.4	6.0
6–8	5.8	89.6

a Person may have had dementia for one or more years prior to formal diagnosis.

b The only acetylcholinesterase inhibitor being taken was Aricept; no participants were taking Tacrine.

* sig. p<0.01 chi-square test

** sig. p<0.05 chi-square test

— not applicable

(continued)

Table 5.6 (continued): Dementia and non-dementia participants—one-year demographic, medical, medication, functional and cognitive characteristics (n=216) (per cent)

	Dementia (n=103)	Non-dementia (n=113)
MMSE score (cognitive decline)*[c]		
<10 (severe)	41.4	0.0
11–20 (moderate)	30.3	0.0
21–25 (mild)	12.1	0.9
26–30 (normal)	16.2	99.1
GDS score (cognitive decline)*		
1–2 (normal/forgetfulness)	3.9	99.1
3 (mild)	11.7	0.9
4 (moderate)	12.6	0.0
5 (moderately severe)	25.2	0.0
6 (severe)	24.3	0.0
7 (very severe)	22.3	0.0
Institutionalised between baseline and one-year	30.1	0.9
Carer burden score[d]	**(n=57)**	
0–30 (low burden)	31.6	—
31–88 (high burden)	68.4	—

c 4 participants could not do the MMSE test as they were deaf and/or refused.
d Only carers of dementia participants living in the community and living with the participant at one-year completed a burden questionnaire.
* sig. p<0.01 chi-square test
** sig. p<0.05 chi-square test
— not applicable

Table 5.7 presents participants' chewing ability, diet type and swallowing problems. The majority of dementia and non-dementia participants could chew two or more of the foods asked about—boiled vegetables, hamburger, meat, carrot and apple. Dementia participants could eat fewer food types than could non-dementia participants ($p<0.01$). Most participants were able to chew boiled vegetables and hamburger. However, fewer dementia participants could chew harder foods such as meat and carrot ($p<0.01$). Similar percentages of dementia and non-dementia participants could eat a piece of apple. An additional question was added at one-year concerning participants' type of diet. More dementia participants (12.6%) ate a soft/vitamised diet. Only one non-dementia participant had parenteral gastric feeding directly into his stomach as a result of a recent stroke and he ate nil by mouth. Participants were also asked if they had any swallowing problems. More dementia participants had swallowing problems (24.3%) ($p<0.05$). Very few non-dementia participants had moderate to severe swallowing problems (1.8%). However, 10.7% of dementia participants had moderate to severe swallowing problems.

Table 5.7: Dementia and non-dementia participants—one-year chewing ability, diet type and swallowing problems (n=216) (per cent)

	Dementia (n=103)	Non-dementia (n=113)
Number of foods can chew*		
0	1.0	0.9
1	1.9	0.0
2	16.5	1.8
3	14.6	11.5
4	8.7	16.8
5	57.3	69.0
Able to chew		
Boiled vegetables	99.0	99.1
Hamburger	97.1	99.1
Firm meat*	77.7	97.3
Piece of fresh carrot*	66.0	85.0
Piece of fresh apple	62.1	69.9
Soft diet*		
Yes	12.6	0.0
No	86.4	99.1
Parenteral gastric feeding (directly into stomach)	0.0	0.9
Swallowing problems**		
Normal	75.7	87.6
Mild	13.6	10.6
Moderate	3.9	0.9
Severe	6.8	0.9

* sig. $p<0.01$ chi-square test
** sig. $p<0.05$ chi-square test

Table 5.8 presents participants' one-year dental history characteristics. The distribution of dementia and non-dementia participants was very similar to that at baseline for dental pain or discomfort, perceived dental need, type of dental attendance, treatment at last visit and location of last visit. Nineteen per cent of dementia and 11.2% of non-dementia participants had dental pain or discomfort at the time of the dental inspection. Perceived dental pain or discomfort did not significantly differ between the two groups, and was low: 25.0% of dementia and 24.1% of non-dementia participants indicated a need for dental treatment. Again, just over 50% of participants were attending the dentist for a regular check-up and just under 50% for a dental problem. As at baseline, more non-dementia participants had a dental visit in the time period between the baseline and one-year dental inspections ($p<0.01$), with 60.2% of dementia and 78.8% of non-dementia participants visiting the dentist.

Table 5.8: Dementia and non-dementia participants—one-year dental history characteristics (n=216) (per cent)

	Dementia (n=103)	Non-dementia (n=113)
Any dental pain or discomfort currently		
Yes	18.4	11.5
No	81.6	88.5
Need dental treatment at present		
Yes	18.4	23.0
No	81.6	77.0
Attend dentist		
For check-ups	53.4	55.8
For a dental problem	46.6	44.2
Had dental visit in last 12 months*		
Yes	60.2	78.8
No	39.8	21.2
Treatment at last visit[a]	**(n=62)**	**(n=89)**
Check-up	48.4	73.0
Cleaning	22.6	59.6
Filling(s)	53.2	43.8
Crown and bridgework	0.0	4.5
Extraction	21.0	19.1
Denture adjustment	12.9	10.1
New dentures	6.5	14.6
Don't know	1.6	0.0
Location of last dental visit		
Dental surgery/clinic	96.8	98.9
Nursing home	3.2	1.1

a Percentages do not sum to 100 as participants may have had more than one type of treatment.

* sig. $p<0.01$ chi-square test

** sig. $p<0.05$ chi-square test

Table 5.9 presents participants' oral hygiene care characteristics. There were no significant differences in denture cleaning frequency between dementia and non-dementia participants. The great majority of participants who wore dentures had their dentures cleaned once daily or more. Very few non-dementia participants required assistance to clean their dentures, but only 39% of dementia participants did not require such assistance ($p<0.01$). Some assistance was required by 24.4% and total assistance by another 36.6% of dementia participants. All but 1.8% of non-dementia participants cleaned their teeth once daily or more. However, dementia participants cleaned their teeth less frequently ($p<0.01$). Only one non-dementia participant required assistance with teeth cleaning, in comparison with 58.2% of dementia participants ($p<0.01$). Some assistance with teeth cleaning was needed by 29.1% and total assistance by another 29.1% of dementia participants. There were no oral hygiene care difficulties with the non-dementia participants ($p<0.01$). However, dementia carers had difficulties with approximately 56.3% of the dementia participants. Carers had 1–2 difficulties with 30.1%, 3–4 difficulties with 13.6% and 5 or more difficulties with 12.6% of dementia participants. The number of difficulties was higher at one-year than at baseline. The difficulties most frequently reported were people refusing oral hygiene care, forgetting to do/needing to be reminded to do oral hygiene care, not opening their mouth, not understanding carer's directions, not being able to rinse or spit, biting the toothbrush or carer, kicking or hitting out and being abusive/aggressive. These most frequent difficulties were similar to those reported at baseline, but many more dementia participants were forgetting to do/needing to be reminded to do oral hygiene care, refusing oral hygiene care, not opening their mouth and not understanding carer's directions. Although, as at baseline, nearly all participants were using a fluoridated toothpaste, very few were using any other fluoride containing products. Over half of the dementia participants were not drinking fluoridated tap water, and were drinking rain water, filtered water or bottled water.

Table 5.9: Dementia and non-dementia participants—one-year oral hygiene care characteristics (n=216) (per cent)

	Dementia (n=103)	Non-dementia (n=113)
Frequency of denture cleaning	**(n=41 denture wearers)**	**(n=63 denture wearers)**
Twice daily or more	39.0	47.6
Once daily	58.5	50.8
Several times a week	2.4	1.6
Less than once a week	0.0	0.0
Hardly ever	0.0	0.0
Never	0.0	0.0
Assistance needed cleaning dentures*	**(n=41 denture wearers)**	**(n=63 denture wearers)**
Yes – some	24.4	0.0
Yes – total	36.6	1.6
No	39.0	98.4
Frequency of teeth cleaning*		
Twice daily or more	40.8	68.5
Once daily	50.5	28.8
Several times a week	5.8	1.8
Less than once a week	2.9	0.0
Hardly ever	0.0	0.0
Never	0.0	0.9
Assistance needed cleaning teeth*		
Yes – some	29.1	0.0
Yes – total	29.1	0.9
No	41.7	99.1
Number of difficulties carer has with oral care*		
0	43.7	100.0
1–2	30.1	0.0
3–4	13.6	0.0
5+	12.6	0.0
Person refuses oral hygiene care	29.1	0.0
Person does not open their mouth	24.3	0.0
Person bites toothbrush/swab/nursing staff	10.7	0.0
Person kicks or hits out during oral care	8.7	0.0
Person does not understand carer's directions about oral care	14.6	0.0
Person cannot not rinse/spit	15.5	0.0
Person spits when trying to clean teeth	1.0	0.0
Person uses offensive language/is aggressive	7.8	0.0
Person's dentures can't be taken out of the mouth or can't be put back into mouth	3.9	0.0
Person moves their head or body around (excessively)	1.0	0.0
Person's head faces down toward their chest so staff can't get to their mouth	1.9	0.0
Person is tired/sleepy	1.9	0.0
Person forgets/needs reminding to do oral care	25.2	0.0

* sig. p<0.01 chi-square test
** sig. p<0.05 chi-square test

(continued)

Table 5.9 (continued): Dementia and non-dementia participants—one-year oral hygiene care characteristics (n=216) (per cent)

	Dementia (n=103)	Non-dementia (n=113)
Person uses a fluoride toothpaste when brushing teeth	97.0	99.1
Person uses fluoride toothpaste but doesn't drink fluoridated water[a]	53.9	n.a.
Person uses a mouthrinse (cosmetic, not containing fluoride)	1.0	21.3
Person uses a mouthrinse (therapeutic, containing fluoride)	2.0	0.0

a Many dementia participants were not drinking tap water and drank bottled water or used water filters on their taps.

* sig. p<0.01 chi-square test

** sig. p<0.05 chi-square test

n.a. not available

6.3 Oral diseases incidence and increments

6.3.1 Coronal and root caries incidence and increments

Coronal and root caries incidence and increments over the one-year period between the baseline and one-year dental inspections were analysed for the 103 dementia and 113 non-dementia participants who again participated at one-year. Tables 5.10 and 5.11 provide details of the numbers of coronal (Table 5.10) and root (Table 5.11) 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. This comparison was made for 31,968 coronal surfaces (Table 5.10) and 27,648 root surfaces (Table 5.11). 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 when coronal surfaces coded as decayed/recurrent/filled/filled unsatisfactory at baseline were coded as sound at one-year. Examiner reversals (Rev) were determined when root surfaces coded as decayed/recurrent/filled/filled unsatisfactory at baseline were coded as sound or not exposed 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 surfaces that were decayed at one-year were also determined to be a caries increment.

Tables 5.10 and 5.11 also provide some other interesting information concerning oral diseases for all of the participants. For example, of the coronal surfaces coded as decayed at baseline, nearly all remained decayed at one-year. Of the root surfaces coded as decayed at baseline, more than half remained decayed or were covered in plaque at one-year. Retained roots were not being extracted during the period from baseline to one-year. In addition, nearly half of the sound retained roots were decayed at one-year.

Table 5.10: Dementia study – number of coronal caries surface increments and reversals, and decision making from baseline and one-year coding (total surfaces = 31,968) (n=216 dementia and non-dementia participants)

		One-year coronal surface coding									
Baseline 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)**	**Missing (M)**
Sound	**(S)**	**10,695** [a]	+106	+12	+368	24 [a]	3 [a]	29 [a]	+13 *	31 [a]	202 [a]
Decayed	**(D)**	(3)	**20** [b]	+1	–	1 [b]	–	–	1 [b]	1 [a]	4 [a]
Recurrent	**(R)**	–	–	**9** [b]	2 [b]	1 [b]	–	–	5 [a]	–	4 [a]
Filled	**(F)**	(24)	+2 *	+19	**3,661** [b]	51 [b]	7 [a]	12 [b]	+14 *	11 [a]	72 [a]
Filled unsatisfactory	**(U)**	(2)	+4	+6	30 [a]	**21** [b]	–	2 [b]	–	–	9 [a]
Crown	**(C)**	–	–	–	–	–	**1,176** [a]	5 [a]	–	–	10 [a]
Retained root sound	**(Rs)**	–	–	–	5 [a]	–	–	**65** [a]	55 [a]	–	22 [a]
Retained root decayed	**(Rd)**	–	–	–	8 [a]	–	–	–	**92** [a]	–	28 [a]
Plaque covered	**(P)**	–	–	–	6 [a]	–	–	–	–	**5** [a]	–
Missing	**(M)**	–	–	–	–	–	5 [a]	–	–	–	**15,004** [a]

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

– blank cells – these code changes were not present in this dataset
* each individual case re-checked and decision made

\+ = 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

Table 5.11: Dementia study—number of root caries surface increments and reversals, and decision making from baseline and one-year coding (total surfaces = 27,648)(n=216 dementia and non-dementia participants)

		One-year root surface coding							
Baseline root surface coding		**Not exposed (N)**	**Sound (S)**	**Decayed (D)**	**Recurrent (R)**	**Filled (F)**	**Filled unsatisfactory (U)**	**Plaque covered (P)**	**Missing (M)**
Not exposed	**(N)**	**6,787** [a]	1,544 [a]	52 [a]	9 [a]	52 [a]	1 [a]	669[a]	151 [a]
Sound	**(S)**	361 [a]	**2,535** [a]	+57	+7	+98	+2	355 [a]	125 [a]
Decayed	**(D)**	(5)	(9)	**40** [b]	–	11 [b]	–	13 [a]	22 [a]
Recurrent	**(R)**	–	–	1 [b]	**7** [b]	2 [b]	–	2 [a]	2 [a]
Filled	**(F)**	(13)	(15)	+2 *	+22	**610** [b]	11 [b]	15 [a]	32 [a]
Filled unsatisfactory	**(U)**	(1)	(1)	+2 *	+1	6 [b]	**6** [b]	1 [a]	3 [a]
Plaque covered	**(P)**	51 [a]	66 [a]	+3 *	–	2 [a]	1 [a]	**112** [a]	5 [a]
Missing	**(M)**	–	–	–	–	–	–	–	**13,748** [a]

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

– blank cells – these code changes were not present in this dataset
* each individual case re-checked and decision made

\+ = 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

Table 5.12 presents the coronal and root caries increments for decayed and filled surfaces (DFS) for dementia and non-dementia participants. For all three caries increment analyses, dementia participants had higher caries increments than did non-dementia participants ($p<0.01$). For coronal caries, the crude caries increment (CCI) was 3.7 surfaces for dementia and 1.5 for non-dementia participants, the net caries increment (NCI) was 3.5 surfaces for dementia and 1.4 for non-dementia participants, and the adjusted caries increment (ADJCI) was 3.6 surfaces for dementia and 1.4 for non-dementia participants. For root caries, the crude caries increment (CCI) was 1.9 surfaces for dementia and 0.9 for non-dementia participants, the net caries increment (NCI) was 1.7 surfaces for dementia and 0.8 for non-dementia participants, and the adjusted caries increment (ADJCI) was 1.8 surfaces for dementia and 0.9 for non-dementia participants. The ADJCI was used in further longitudinal coronal and root surface caries analyses.

Table 5.12: Dementia and non-dementia participants—coronal and root caries increments for DFS (n=216)

	Coronal and root caries increments (mean (SD))			
	Coronal		Root	
	Dementia (n=103)	Non-dementia (n=113)	Dementia (n=103)	Non-dementia (n=113)
Crude caries increment (CCI)*	3.7 (4.4)	1.5 (2.2)	1.9 (2.7)	0.9 (1.6)
Net caries increment (NCI)*[a]	3.5 (4.4)	1.4 (2.2)	1.7 (2.8)	0.8 (1.6)
Adjusted caries increment (ADJCI)*[b]	3.6 (4.3)	1.4 (2.2)	1.8 (2.6)	0.9 (1.5)

a NCI = CCI – examiner reversals (Rev).

b ADJCI = 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 5.10 and 5.11 for more details).

* sig. $p<0.01$ t-test between dementia and non-dementia participants for coronal or root surfaces

Table 5.13 presents the participants' coronal and root caries distribution and incidence. Coronal caries incidence occurred in 71.8% of dementia and 48.7% of non-dementia participants. There were 44.7% of dementia and 42.5% of non-dementia participants with 0.1–5 decayed coronal surfaces, and 18.4% of dementia and 6.2% of non-dementia participants with 5.1–10.0 decayed coronal surfaces. Root caries incidence occurred in 62.1% of dementia and 44.2% of non-dementia participants. There were 53.4% of dementia and 40.7% of non-dementia participants with 0.1–5 decayed root surfaces, and 5.8% of dementia and 3.5% of non-dementia participants with 5.1–10.0 decayed root surfaces. Only dementia participants had more than 10 adjusted coronal or root surface increments—8.7% had more than 10 coronal and 2.9% had more than 10 adjusted root surface increments.

Table 5.13: Dementia and non-dementia participants—coronal and root caries distribution and incidence (ADJCI) (n=216)

	Coronal surfaces* (%)		Root surfaces** (%)	
	Dementia (n=103)	Non-dementia (n=113)	Dementia (n=103)	Non-dementia (n=113)
Increment distribution				
0 surfaces	28.2	51.3	37.9	55.8
0.1–5 surfaces	44.7	42.5	53.4	40.7
5.1–10 surfaces	18.4	6.2	5.8	3.5
10+ surfaces	8.7	0.0	2.9	0.0
Incidence	**71.8**	**48.7**	**62.1**	**44.2**

* sig. p<0.01 chi-square test
** sig. p<0.05 chi-square test

Table 5.14 presents dementia participants' coronal caries increment by root caries increment (ADJCI). Of the 103 dementia participants at one-year, only 14.6% had no coronal or root surface increment. There were 23.3% who had coronal surface increment but no root surface increment, and 13.6% with no coronal surface increment but root surface increment. The remaining 48.6% of dementia participants had both coronal and root surface increments. There was 1.9% of participants with dementia who had more than 10 coronal and more than 10 root surface increments.

Table 5.14: Dementia participants—coronal caries increment by root caries increment (n=103) (per cent)

	Coronal and root caries increment (ADJCI)			
	Root surfaces (%)			
Coronal surfaces (%)	0	1–5	5–10	10+
0	14.6	13.6	0.0	0.0
1–5	16.5	24.3	2.9	1.0
5–10	4.9	11.7	1.9	0.0
10+	1.9	3.9	1.0	1.9

Table 5.15 presents non-dementia participants' coronal caries increment by root caries increment (ADJCI decayed/filled surfaces). Of the 113 non-dementia participants at one-year, 33.6% had no coronal or root surface increment. There were 22.1% who had coronal surface increment but no root surface increment, and 17.8% with no coronal surface increment but root surface increment. The remaining 26.6% of non-dementia participants had both coronal and root surface increments. There were no participants without dementia who had more than five coronal and more than five root surface increments.

Table 5.15: Non-dementia participants—coronal caries increment by root caries increment (n=113) (per cent)

	Coronal and root caries increment (ADJCI)			
	Root surfaces (%)			
Coronal surfaces (%)	0	1–5	5–10	10+
0	33.6	15.9	1.8	0.0
1–5	21.2	19.5	1.8	0.0
5–10	0.9	5.3	0.0	0.0
10+	0.0	0.0	0.0	0.0

6.3.2 Tooth loss and retained roots

Tables 5.16–5.18 present data for tooth loss and retained roots for the one-year participants. Dementia participants had a mean of 14.0 missing teeth at baseline, and 18.4% lost one or more teeth during the one-year study period; mean number of teeth lost was 0.5 teeth. Non-dementia participants had a mean of 14.8 missing teeth at baseline, and 15.0% lost one or more teeth during the one-year study period; mean number of teeth lost was 0.3 teeth.

Table 5.16: Mean numbers of teeth and percentage of participants losing 1+ teeth during one-year study period (n=216)

	Number missing teeth at baseline		Number missing teeth at one-year		Mean number of teeth lost		% participants losing 1+ teeth
	Mean	SD	Mean	SD	Mean	SD	%
Dementia (n=103)	14.0	6.8	14.5	7.1	0.5	1.6	18.4%
Non-dementia (n=113)	14.8	7.8	15.1	8.2	0.3	0.9	15.0%

Table 5.17 presents data concerning retained roots. Dementia participants had a mean of 0.5 retained roots at baseline, and 20.4% had one or more retained roots present. Non-dementia participants had a mean of 0.1 retained roots at baseline, and 8.8% had one or more retained roots present. At one-year, dementia participants had a mean of 0.5 retained roots present, and 23.3% had one or more retained roots. At one-year, non-dementia participants had a mean of 0.2 retained roots present, and 10.6% had one or more retained roots. This resulted in no overall increase in numbers of retained roots per participants during the study period. However, as seen in Table 5.18, more dementia participants had roots removed and had more retained roots at one-year than did non-dementia participants.

Table 5.17: Mean numbers of retained roots present and percentage of participants with 1+ retained roots during one-year study period for existing participants (n=216)

	Number retained roots at baseline		% of participants with 1+ retained roots at baseline	Number retained roots at 1-year		% of participants with 1+ retained roots at 1-year	Change in mean number of retained roots	
	Mean	SD	%	Mean	SD	%	Mean	SD
Dementia (n=103)	0.5	1.9	20.4	0.5	1.9	23.3	0.0	0.4
Non-dementia (n=113)	0.1	0.6	8.8	0.2	0.7	10.6	0.0	0.3

Table 5.18: Change in mean number of retained roots during one-year study period for existing participants (n=216)

	% of participants	
Change in mean number of retained roots during study period	**Dementia (n=103)**	**Non-dementia (n=113)**
-2 retained roots	1.0	0.0
-1 retained root	4.9	1.8
Same number of retained roots (possibly 0)	85.4	93.8
+1 retained root	8.7	4.4

6.4 Participants' characteristics associated with coronal and root caries increments

6.4.1 Coronal and root caries increments

Table 5.19 presents coronal and root caries increments (ADJCI) by participants' characteristics. Within the dementia and non-dementia groups, a higher coronal caries increment was found for dementia participants who had visited a dentist since the baseline dental inspection and whose carer had a high carer burden score ($p<0.01$). Within the dementia and non-dementia groups, a difference in root caries increment was only found for dementia participants who needed assistance with oral hygiene care and who gave carers difficulties with oral hygiene care ($p<0.05$).

Table 5.19: Dementia and non-dementia participants—coronal and root caries increments (ADJCI) by characteristics (n=216) (mean (SD))

	Coronal ADJCI		Root ADJCI	
	Dementia (n=103)	Non-dementia (n=113)	Dementia (n=103)	Non-dementia (n=113)
Sex				
Male	4.1	1.1	1.8	1.0
Female	3.0	1.9	1.9	0.7
Age				
<79 years	3.3	1.4	1.7	0.8
80+ years	5.0	1.5	2.6	1.1
Number of medical conditions				
0–3	3.0	1.4	2.1	0.7
4+	3.8	1.4	1.8	1.1
Number of medications				
0–2	3.9	1.3	1.7	0.9
3+	3.6	1.6	1.9	0.9
Taking neuroleptic medication				
Yes	3.0	n.a.	1.2	n.a.
No	3.8	1.4	2.1	0.9
Taking acetylcholinesterase inhibitor medication				
Yes	3.8	n.a.	1.4	n.a.
No	3.6	1.4	2.0	0.9
Taking antihypertensive medication				
Yes	3.7	1.3	1.8	0.9
No	3.6	1.5	1.9	0.9
Taking antidepressant medication				
Yes	3.3	1.7	1.1	1.5
No	3.8	1.4	2.1	0.9
Visited dentist since baseline examination				
Yes	**4.4	1.6	1.8	0.9
No	2.5	1.0	1.9	0.7
Government card				
Yes	3.3	1.3	1.8	1.0
No	5.9	2.3	2.5	0.5
Private health insurance				
Yes	5.2	1.8	1.9	0.6
No	2.9	1.1	1.8	1.2

* sig. p<0.01 t-test within dementia or non-dementia group

** sig. p<0.05 t-test within dementia or non-dementia group

n.a. not available

(continued)

Table 5.19 (continued): Dementia and non-dementia participants—coronal and root caries increments (ADJCI) by characteristics (n=216) (mean (SD))

	Coronal ADJCI		Root ADJCI	
	Dementia (n=103)	Non-dementia (n=113)	Dementia (n=103)	Non-dementia (n=113)
ADL score (no. of dependent activities)				
0–2	4.2	1.5	1.5	0.9
3–6	2.6	0.3	2.3	0.3
IADL score (no. of dependent activities)				
0–2	3.4	1.7	1.8	1.3
3–8	4.3	1.4	1.9	0.9
MMSE score				
0–20 (severe/mod)	3.4	n.a.	1.9	n.a.
21–30 (mild/normal)	4.0	1.4	1.7	0.9
Dementia type				
Alzheimer's	3.8	—	1.9	—
Other	2.7	—	1.7	—
GDS score				
1–3 (normal/mild)	4.0	1.4	1.6	0.9
4–7 (mod/severe)	3.6	n.a.	1.9	n.a.
Years since dementia diagnosis				
<3 years	4.2	—	1.7	—
3+ years	3.4	—	1.9	—
Number of foods can eat				
0–3	3.1	1.0	2.0	1.4
4–5	3.9	1.5	1.8	0.8
Has difficulties with oral hygiene				
Yes	4.0	n.a.	**2.3	n.a.
No	3.2	1.4	1.3	0.9
Needs assistance with cleaning teeth				
Yes	3.7	n.a.	**2.2	n.a.
No	3.6	1.4	1.3	0.9
Swallowing problems				
Yes	3.3	0.8	2.2	0.8
No	3.8	1.5	1.7	0.9
Institutionalised between baseline and one-year				
Yes	2.8	n.a.	1.8	n.a.
No	4.0	1.4	1.8	0.9
Carer burden score				
0–30 (low burden)	*2.6	—	1.6	—
31–88 (high burden)	4.7	—	1.8	—
Total	3.6	1.4	1.8	0.9

* sig. p<0.01 t-test within dementia or non-dementia group
** sig. p<0.05 t-test within dementia or non-dementia group
— not applicable
n.a. not available

Table 5.20 presents non-parametric correlation analyses of coronal and root caries increments (ADJCI) with one-year participant characteristics for the 216 dementia and non-dementia participants. As MMSE score decreased (worsening of dementia severity), coronal ADJCI and root ADJCI increased ($p<0.01$). As GDS score increased (worsening of dementia severity), coronal ADJCI and root ADJCI increased ($p<0.01$). As ADL score increased (increased functional dependency), there was an increase in root ADJCI ($p<0.05$). As IADL score decreased (increased functional dependency), there was an increase in coronal ADJCI and root ADJCI ($p<0.01$). As the number of chronic medical conditions increased, coronal ADJCI and root ADJCI increased ($p<0.05$). Correlation coefficients were low for these significant relationships. There were no significant differences for caries increments and the number of medications taken, the number of foods eaten and months since last dental visit.

Table 5.20: Dementia and non-dementia participants—correlations of coronal and root caries increments (ADJCI) with one-year participant characteristics (n=216)

	Characteristic at one-year (n=216)								
	MMSE[a]	GDS[b]	ADL[c]	IADL[d]	Number medica-t ions	Number medical condi-ti ons	Number foods can eat	Swallowing problems[e]	Months since last dental visit[f]
Coronal ADJCI	-0.2*	0.2*	0.1	-0.2*	0.1	0.2*	0.1	0.0	-0.1
Root ADJCI	-0.2*	0.2*	0.1**	-0.2*	0.1	0.2**	-0.1	0.1	0.1

a MMSE scores ranged from 0 (severe dementia) to 30 (normal) and n=211 as 4 participants could not complete the test.
b GDS scores ranged from 1 (normal) to 7 (severe dementia).
c ADL scores ranged from 0 (not dependent for any ADLs) to 6 (dependent for 6 ADLs).
d IADL scores ranged from 0 (not independent for any IADLs) to 8 (independent for 8 ADLs).
e Swallowing problems ranged from 0 (none) to 4 (severe).
f Baseline report of months since last visit adjusted with further one-year dental visit data.

* sig. $p<0.01$ Spearman correlation
** sig. $p<0.05$ Spearman correlation

6.5 Neuroleptic medication and coronal and root caries in dementia participants

In all previous analyses in this study neuroleptic medication status was categorised as taking neuroleptics or not taking neuroleptics. To further investigate the results concerning neuroleptic medications, this section of analyses were conducted for dementia participants only, in which neuroleptic medication status was re-categorised into taking neuroleptic(s) with the most anticholinergic adverse effects (chlorpromazine, thioridazine, pericyazine), taking neuroleptic(s) with low/very low adverse effects (haloperidol, trifluoperazine, fluphenazine, lithium carbonate, olanzapine, risperidone), and not taking any neuroleptic medication. Neuroleptic medications with the most anticholinergic adverse effects will include the oral effect of reduced saliva flow, which is perceived by the person as xerostomia or dry mouth. Table 5.21 presents dementia participants' neuroleptic medication status (categorised by severity of anticholinergic adverse effects) at baseline and at one-year. At baseline 13.8% of the dementia participants were taking neuroleptic medications with the most anticholinergic adverse effects. Another 8.6% were taking neuroleptic medications with low or very low anticholinergic adverse effects. The remaining 77.6% of baseline dementia participants were not taking neuroleptics. At one-year, 15.5% of the dementia participants were taking neuroleptics with the most anticholinergic adverse effects. Another 9.5% were taking neuroleptic medications with low or very low anticholinergic adverse effects. The remaining 63.8% of one-year dementia participants were not taking neuroleptic medication.

Table 5.21: Dementia participants—neuroleptic medication status at baseline and one-year (n=116 baseline and 103 one-year) (per cent)

	Baseline (n=116)	One-year (n=103)
Taking neuroleptic(s) with the most anticholinergic effects (chlorpromazine, thioridazine, pericyazine)	13.8	15.5
Taking neuroleptic(s) with low/very low anticholinergic effects (haloperidol, trifluoperazine, fluphenazine, lithium carbonate, olanzapine, risperidone)	8.6	9.5
Not taking any neuroleptic medication	77.6	63.8

Table 5.22 presents dementia participants' neuroleptic medication status changes from baseline to one-year. Many participants commenced or ceased neuroleptic medication in the one-year period. Of the 14 participants taking neuroleptic medication with the most anticholinergic adverse effects at baseline, 64.3% were taking neuroleptic medication with the most anticholinergic adverse effects, 14.3% had changed and were taking neuroleptic medication with low/very low anticholinergic adverse effects, and 21.4% were not taking any neuroleptic medication at one-year. Of the nine participants taking neuroleptic medication with low/very low anticholinergic adverse effects at baseline, 66.7% were taking neuroleptic medication with low/very low anticholinergic adverse effects and 33.3% were not taking any neuroleptic medication at one-year. At one-year, 11.3% of baseline participants who had not been taking any neuroleptic medication were taking neuroleptic medication with the most anticholinergic adverse effects, another 3.8% were taking neuroleptic medication with low/very low anticholinergic adverse effects and 85.0% were again not taking any neuroleptic medication.

Table 5.22: Dementia participants—neuroleptic medication status changes from baseline to one-year (n=103) (per cent)

	One-year neuroleptic status		
Baseline neuroleptic status	**Taking neuroleptic(s) with the most anticholinergic effects** (chlorpromazine, thioridazine, pericyazine) **(n=18)**	**Taking neuroleptic(s) with low/very low anticholinergic effects** (haloperidol, trifluoperazine, fluphenazine, lithium carbonate, olanzapine, risperidone) **(n=11)**	**Not taking any neuroleptic medication (n=74)**
Taking neuroleptic(s) with the most anticholinergic effects (chlorpromazine, thioridazine, pericyazine) **(n=14)**	**64.3**	14.3	21.4
Taking neuroleptic(s) with low/very low anticholinergic effects (haloperidol, trifluoperazine, fluphenazine, lithium carbonate, olanzapine, risperidone) **(n=9)**	0.0	**66.7**	33.3
Not taking any neuroleptic medication (n=80)	11.3	3.8	**85.0**

Dementia participants' neuroleptic medication status by other medications at baseline is presented in Table 5.23. There were no significant differences in the percentages of participants who took Aricept (acetylcholinesterase inhibitor), antihypertensive or sedative/hypnotic among the neuroleptic medication categories. Only one-fifth of participants taking Aricept were taking neuroleptics. However, there were significantly more participants taking antidepressants or Cogentin/l-dopa (for movement disorders) in the low/very low adverse effects neuroleptic category ($p<0.05$). One-third of those taking antidepressants were also taking neuroleptics. One half of those taking Cogentin/l-dopa were also taking neuroleptic medication with low/very low anticholinergic effects (Note that the neuroleptics with the low anticholinergic effects have the highest movement disorder effects). Few of those taking aspirin were also taking the neuroleptics with the most anticholinergic adverse effects ($p<0.05$).

Table 5.23: Dementia participants—neuroleptic medication status by other medications at baseline (n=116) (per cent)

	Baseline neuroleptic status		
Medication type	**Taking neuroleptic(s) with the most anticholinergic effects** (chlorpromazine, thioridazine, pericyazine) **(n=16)**	**Taking neuroleptic(s) with low/very low anticholinergic effects** (haloperidol, trifluoperazine, fluphenazine, lithium carbonate, olanzapine, risperidone) **(n=10)**	**Not taking any neuroleptic medication (n=90)**
Aricept			
Yes (n=41)	14.6	7.3	78.0
No (n=75)	13.3	9.4	77.3
Antidepressant**			
Yes (n=24)	12.5	20.9	66.7
No (n=92)	14.1	5.5	80.4
Antihypertensive			
Yes (n=34)	11.8	8.8	79.4
No (n=82)	14.6	8.5	76.8
Aspirin**			
Yes (n=43)	2.3	11.6	86.0
No (n=73)	20.5	6.8	72.6
Cogentin/l-dopa*			
Yes (n=6)	0.0	50.0	50.0
No (n=110)	14.5	6.4	79.1
Sedative/hypnotic			
Yes (n=10)	0.0	10.0	60.0
No (n=106)	12.3	8.5	79.2

* sig. $p<0.01$ chi-square test
** sig. $p<0.05$ chi-square test

Dementia participants' neuroleptic medication status by other medications at one-year is presented in Table 5.24. There were no significant differences in the percentages of participants who took Aricept (acetylcholinesterase inhibitor), antihypertensive or aspirin among the neuroleptic medication categories. One-quarter of participants taking Aricept were also taking neuroleptics. However, there were significantly more participants taking antidepressants in the low/very low adverse effects neuroleptic category ($p<0.05$). Nearly 40% of participants taking antidepressants were also taking neuroleptics. Nearly all of the participants taking Cogentin/l-dopa (for movement disorders) were also taking neuroleptics ($p<0.01$). Over half of those taking sedative/hypnotic medication were also taking the neuroleptics ($p<0.05$).

Table 5.24: Dementia participants—neuroleptic medication status by other medications at one-year (n=103) (per cent)

	Baseline neuroleptic status		
Medication type	**Taking neuroleptic(s) with the most anticholinergic effects** (chlorpromazine, thioridazine, pericyazine) **(n=18)**	**Taking neuroleptic(s) with low/very low anticholinergic effects** (haloperidol, trifluoperazine, fluphenazine, lithium carbonate, olanzapine, risperidone) **(n=11)**	**Not taking any neuroleptic medication (n=74)**
Aricept			
Yes (n=29)	13.8	10.3	75.9
No (n=74)	18.9	10.8	70.3
Antidepressant**			
Yes (n=28)	14.3	25.0	60.7
No (n=75)	18.7	5.3	76.0
Antihypertensive			
Yes (n=29)	6.9	10.3	82.8
No (n=74)	21.6	10.8	67.6
Aspirin			
Yes (n=45)	11.1	11.1	77.8
No (n=58)	22.4	10.3	67.2
Cogentin/l-dopa*			
Yes (n=8)	37.5	37.5	25.0
No (n=95)	15.8	8.4	75.8
Sedative/hypnotic**			
Yes (n=21)	28.6	23.8	47.6
No (n=82)	14.6	7.3	78.0

* sig. $p<0.01$ chi-square test
** sig. $p<0.05$ chi-square test

Table 5.25 presents caries experience at baseline for dementia participants by their neuroleptic medication status. The only significant difference in caries experience at baseline was found for the numbers of plaque-covered root surfaces, with those taking neuroleptics with the most anticholinergic adverse effects having more plaque-covered root surfaces ($p<0.05$).

Table 5.25: Caries experience at baseline for dementia participants by neuroleptic medication status (n=116) (mean (SD))

	Neuroleptic medication status at baseline (n=116)		
Caries experience (mean (SD))	**Taking neuroleptic(s) with the most anticholinergic effects** (chlorpromazine, thioridazine, pericyazine) **(n=16)**	**Taking neuroleptic(s) with low/very low anticholinergic** effects (haloperidol, trifluoperazine, fluphenazine, lithium carbonate, olanzapine, risperidone) **(n=10)**	**Not taking any neuroleptic medication (n=90)**
Decayed crowns	0.4 (0.8)	0.2 (0.4)	0.3 (0.8)
Missing teeth	12.9 (7.0)	14.9 (8.3)	14.1 (6.7)
Filled/crowned crowns	9.6 (6.9)	9.0 (7.5)	8.7 (6.1)
DMFT	22.9 (5.7)	24.1 (4.3)	23.2 (5.8)
Retained roots	0.2 (0.4)	0.4 (1.3)	0.5 (2.1)
Decayed coronal surfaces	0.5 (1.0)	0.3 (0.7)	0.5 (1.2)
Filled coronal surfaces	23.8 (22.0)	25.4 (26.6)	21.4 (19.6)
DFS coronal	24.3 (22.3)	25.7 (26.5)	21.9 (19.5)
Coronal attack rate	26.6 (18.6)	27.9 (19.9)	27.8 (21.6)
Decayed root surfaces	1.1 (2.4)	0.8 (1.3)	0.7 (1.5)
Filled root surfaces	3.2 (3.5)	2.8 (2.3)	3.3 (3.9)
DFS root	4.3 (4.4)	3.6 (3.0)	4.0 (4.1)
Root attack rate (RCI)	16.7 (17.8)	15.9 (12.1)	19.3 (18.2)
Plaque-covered root surfaces**	2.4 (2.9)	0.9 (1.2)	1.2 (3.4)

** sig. $p<0.05$ Kruskal-Wallis test

Table 5.26 presents caries experience at one-year and caries increments for dementia participants by their neuroleptic medication status. Significant differences in caries experience at one-year were found for the numbers of decayed crowns and decayed coronal surfaces, with those taking neuroleptics with the most anticholinergic adverse effects having more caries ($p<0.05$). The coronal adjusted caries increment (ADJCI) was lower for participants who were taking neuroleptics with low anticholinergic adverse effects ($p<0.01$).

Table 5.26: Caries experience and increments at one-year for dementia participants by neuroleptic medication status (n=103) (mean (SD))

	Neuroleptic medication status at baseline (n=103)		
Caries experience and increments (mean (SD))	**Taking neuroleptic(s) with the most anticholinergic effects** (chlorpromazine, thioridazine, pericyazine) (n=18)	**Taking neuroleptic(s) with low/very low anticholinergic effects** (haloperidol, trifluoperazine, fluphenazine, lithium carbonate, olanzapine, risperidone) **(n=11)**	**Not taking any neuroleptic medication (n=74)**
Caries experience			
Decayed crowns**	2.4 (3.6)	0.3 (0.7)	1.2 (2.4)
Missing teeth	15.6 (7.4)	18.6 (8.3)	13.5 (6.6)
Filled/crowned crowns	6.4 (6.1)	7.5 (6.6)	9.5 (6.5)
DMFT	24.3 (6.2)	26.3 (3.9)	24.2 (5.5)
Retained roots	1.4 (4.5)	0.1 (0.3)	0.3 (0.6)
Decayed coronal surfaces**	3.0 (4.1)	0.3 (0.7)	1.5 (2.9)
Filled coronal surfaces	16.2 (18.3)	19.5 (24.1)	26.5 (22.7)
DFS coronal	19.2 (18.2)	19.7 (24.2)	27.9 (22.4)
Coronal attack rate	32.4 (25.4)	26.3 (18.0)	33.1 (22.2)
Decayed root surfaces	0.9 (1.5)	1.5 (1.9)	1.8 (2.7)
Filled root surfaces	2.4 (2.8)	2.4 (2.0)	3.9 (4.3)
DFS root	3.3 (3.0)	3.8 (3.5)	5.7 (4.7)
Root attack rate (RCI)	11.5 (11.0)	15.0 (14.7)	19.1 (16.7)
Plaque-covered root surfaces	15.2 (25.1)	10.4 (16.9)	7.2 (13.9)
Caries increments			
Adjusted coronal caries increment (ADJCI)*	4.1 (4.5)	0.3 (0.5)	4.1 (4.4)
Adjusted root caries increment (ADJCI)	1.4 (2.2)	1.0 (1.7)	2.1 (2.8)

* sig. $p<0.01$ Kruskal-Wallis test
** sig. $p<0.05$ Kruskal-Wallis test

6.6 Participants' characteristics associated with plaque accumulation

Table 5.27 presents mean Plaque Index (PI) Scores (possible range 0–3) for all participants at one-year. For non-dementia participants, there was only one significant difference in mean PI scores for number of foods able to eat ($p<0.01$). For dementia participants, those with higher PI scores were those who had not visited a dentist since the baseline dental inspection, were dependent for 3–6 ADLs, were independent for only 0, 1 or 2 IADLs, had moderate to severe dementia (MMSE and GDS scores), could eat fewer food types, whose carers had high carer burden, who needed assistance with oral hygiene care, whose carers had difficulties with oral hygiene care, who had swallowing problems, and who had been institutionalised and were living in a nursing home ($p<0.01$).

Table 5.27: Dementia and non-dementia participants—Mean Plaque Index Scores at one-year and associated characteristics (n=206)

	Mean PI Score[a]	
	Dementia (n=101)	**Non-dementia (n=105)**
ADL score (no. of dependent activities)		
0–2	*0.9	0.7
3–6	1.9	0.0
IADL score (no. of independent activities)		
0–2	*1.5	0.3
3–8	0.5	0.7
MMSE score		
0–20 (severe/mod)	*1.6	n.a.
21–30 (mild/normal)	0.6	0.7
Dementia type		
Alzheimer's	1.2	—
Other	1.6	—
GDS score		
1–3 (normal/mild)	*0.6	0.7
4–7 (moderate/severe)	1.4	n.a
Carer burden score		
0–30 (low burden)	**0.6	—
31–88 (high burden)	1.1	—
Visited dentist since baseline examination		
Yes	*1.0	0.7
No	1.7	0.8
Number of foods can eat		
0–3	*1.7	*1.1
4–5	1.1	0.6
Has difficulties with oral hygiene		
Yes	*1.7	n.a.
No	0.8	0.7
Needs assistance with cleaning teeth		
Yes	*1.7	n.a.
No	0.8	0.7
Swallowing problems		
No	*1.1	0.7
Yes	1.9	0.9
Institutionalised between baseline and one-year		
Yes	*2.0	n.a.
No	1.0	0.7
Total	**1.3**	**0.7**

* sig. p<0.01 t-test
** sig. p<0.05 t-test
— not applicable
n.a. not available
a 11 participants without any of the six key teeth for scoring of the plaque index were not included

7 Discussion

Precise quantification of all cognitively impaired older Australians' oral disease experience cannot be provided by this study. The paucity of population-level epidemiological medical, dental and other health data concerning older Australians with dementia restricted both the sampling sources for this study and the ability to weight the data. Many possible sources for sampling of community-dwelling older adults with dementia were investigated and evaluated in the planning stage of this study, including the electoral roll, government carer pension lists, government and private domiciliary health care services, general medical practitioners, geriatric medical clinics in hospitals, specialised dementia clinics/research centres and The Alzheimer's Association of South Australia. Accessing older adults with dementia and their carers is indeed a great challenge for community-based health services and community-groups in Australia. Recent international research in this field has utilised either hospital-based/long-term care sources of older adults with dementia, or participants from larger medical epidemiological studies who have a diagnosed dementia (Akiyama 1993; Jones et al. 1993; Ship & Puckett 1994; Warren et al. 1997). Only small numbers of oral epidemiological studies have been conducted with neurologically impaired older adults; this fact in itself highlights the sampling challenges involved in accessing community-dwelling older adults with neurological conditions.

The choice of The Alzheimer's Association of South Australia carer database was made not only for methodological but for ethical reasons. This database enabled the researchers to directly access the primary carers of older adults with dementia, to have a reliable source for the sampling of dementia participants, to discuss study participation with all the necessary people involved in the care of the person with dementia, and to ensure that consent was obtained from the correct source for each participant. Preliminary investigations revealed that the database also contained carers from diverse social, economic and cultural backgrounds. Although many of the people cared for had a diagnosis of Alzheimer's disease, there were also other older adults with a range of dementia diagnoses. Even with the large carer database provided by The Alzheimer's Association of South Australia, obtaining a random sample of dentate, community-dwelling older adults with dementia was indeed a challenge. There were a large number of out-of-scope contacts, with many of the people with dementia being edentulous, deceased or institutionalised, or not having a formal dementia diagnosis. Over 90% of those in-scope did agree to participate in the study, and the one-year follow-up participation rates were also high; the main reason for non-participation was that the person had deceased. The mortality projections in sample calculations were very similar to those that occurred between baseline and one-year. In addition, sample size was limited by the numbers of available comparison participants without dementia from The South Australian Dental Longitudinal Study, and by the available funding for the research. Considering these sampling limitations, this study does succeed in providing important oral epidemiological data concerning older adults with dementia—it is as comprehensive and as representative as was able to be achieved. The study also provides an age–sex matched comparison group without dementia and is one of only a few geriatric dental studies to follow a group of community-living older adults with dementia over time as they move into institutional care.

The dementia and non-dementia comparison groups in this study remained distinctively different over time for many of their general health and other characteristics, but continued to have similar age and sex distributions, as a result of the matched sampling at baseline. Also, both dementia and non-dementia groups had a distribution of

government-card-holder status, over time, that closely reflected that presented for the Australian 65+ population in 1999 (AIHW 1999). There were slightly higher percentages of Department of Veterans Affairs (DVA) cardholders in both the dementia and non-dementia groups than reported for the Australian 65+ population in 1999 (AIHW 1999). However, the profile of DVA cardholders is substantially older than that of aged pension-cardholders, and the mean age of the dementia study sample was closer to 75+ than 65+ years. The distribution of non-dementia participants' demographic, medical, medication, functional, cognitive, nutritional, dental history and oral hygiene care characteristics did not change from baseline to one-year. None of the comparison group participants were diagnosed with dementia or had cognitive testing scores indicative of dementia during the one-year period. One distinct difference occurring between the groups over time that must be considered was the higher institutionalisation rate of the dementia group as the study progressed, with the great majority of the non-dementia group remaining living in the community.

Baseline characteristics of the non-dementia participants were compared to data from the South Australian Dental Longitudinal Study sample at five years in 1996 (Thomson et al. 2001). As determined by the sampling, non-dementia comparison participants were slightly older (mean=76.8 years) than the 1996 SADLS participants (mean=69.4 years) (sampling accounted for their increase in age from 1996 to 1999), and approximately 43% of both samples were female (dementia study comparison participants=43.5% and 1996 SADLS participants=43.1%). The non-dementia comparison participants had been participating in the SADLS study for 8–9 years at the time of the baseline dementia study data collection. Thus, a survivor effect was in place within this sample of community-dwelling older adults; they were long-term study participants who were the younger, less medicated, better dental attenders, and who had better dental service-use patterns than the overall baseline SADLS sample (Thomson et al. 2001). However, by being so, they provided an excellent source of generally healthy and functionally independent community-dwelling older adults for comparison with the dementia participants in this study. The non-dementia comparison participants were becoming more medically compromised as they aged; they did have more chronic medical conditions (mean=3.6 conditions) than did 1996 SADLS participants (mean=1.7 conditions); they also took more medications (mean=3.3 medications) than did 1996 SADLS participants (mean=1.5 medications). However, there were lower percentages of non-dementia comparison participants who were currently smoking or drinking alcohol. The survivor effect is exemplified in the caries experience data; non-dementia comparison participants had fewer decayed coronal and root surfaces (decayed coronal=0.03 surfaces; decayed root=0.3 surfaces) than did 1996 SADLS participants (decayed coronal=0.3 surfaces; decayed root=0.39 surfaces). However, non-dementia comparison participants had more decayed/filled coronal and root surfaces (DFS coronal=24.8 surfaces; DFS root=3.8 surfaces) than did 1996 SADLS participants (DFS coronal=21.8 surfaces; DFS root=3.2 surfaces). These data reflect the earlier description by Thomson et al. (2001) of the long-term SADLS participants as being those with better dental attendance; they had less caries experience and increased numbers of filled teeth.

As was expected, dementia participants' general health and other characteristics did decline from baseline to one-year. Dementia participants' profiles became more complex; they became more functionally dependent (ADL and IADL scores) and more cognitively impaired (GDS, MMSE scores) from baseline to one-year. The distribution of participants among the dementia diagnostic categories remained the same from baseline to one-year, with three-quarters of participants diagnosed with Alzheimer's disease. Just under one-third of dementia participants were institutionalised between baseline and one-year. At one-year there were higher percentages of dementia participants taking

antidepressant, neuroleptic and sedative/anxiolytic medications, and fewer participants taking anticholinesterase inhibitor medication. There were very few of the dementia participants taking newer neuroleptic medications with low or very low anticholinergic adverse effects; the great majority of those taking neuroleptics were taking traditional neuroleptics with high anticholinergic adverse effects. Dementia participants could eat fewer food types at one-year, 12.6% were eating a soft diet and one-quarter had swallowing problems. However, dental history characteristics did not dramatically change from baseline to one-year for dementia participants, with similar distributions for participants' perceived dental needs and dental attendance pattern. However, significantly fewer dementia participants had attended the dentist in the previous 12 months at both baseline and one-year. Many more dementia participants required assistance with oral hygiene care by one-year, and more than double the percentage of participants' carers had various oral hygiene care difficulties; at one-year, one-quarter of dementia participants were forgetting to do their oral hygiene care or needed reminding to do so. Dementia participants' resistive and combative behaviours during oral hygiene care had also increased by one-year, with one-quarter to one-third refusing oral hygiene care and not opening their mouth for oral hygiene care. Of concern were the decreasing fluoride sources among dementia participants; almost no dementia participants (at either baseline or one-year) were using either a cosmetic or a therapeutic mouthrinse, and at one-year more than half of the dementia participants were using a fluoride toothpaste but not drinking fluoridated water. Many participants were using bottled or rain water. Interestingly, there were few differences among dementia participants' characteristics when categorised by dementia severity, with the exceptions that those with more severe dementia were more functionally dependent, taking more neuroleptic medications, able to chew fewer food types, needed more assistance with oral hygiene care and gave carers many more difficulties with oral hygiene care. These were also many of the characteristics that were associated with caries experience and increments.

The changing denture status of the dementia group from baseline to one-year was not evident in the non-dementia group. There was a marked decrease in the use of dentures over the one-year period in the dementia group. There was an increase in the percentages of dementia participants who owned a denture but did not wear it from 2.6% (upper and lower dentures) at baseline to 7.8% (upper denture) and 6.8% (lower denture). Concurrently, there was a decrease in the percentages of dementia participants who were wearing a partial denture—from 23.3% at baseline to 13.6% at one-year for the maxilla, and from 14.7% to 11.7% for the mandible. A slight increase in the percentages of full denture wearers was evident in both dementia and non-dementia groups. Among the denture wearers in the dementia group, the most obvious change in denture problems from baseline to one-year was the doubling of the percentage of participants with unsatisfactory retention for the lower denture. There was also an increase in the percentage of dementia participants with upper denture defects (such as broken teeth or denture material fractures) and material inadequacies (such as staining or debris accumulation), as well as unsatisfactory occlusion. These results reflect dementia participants' less frequent dental visits and their abundant oral hygiene care problems. Data concerning oral mucosal lesions and conditions also reflect dementia participants' less frequent dental visits and oral hygiene care problems; dementia participants had more than double the prevalence of maxillary denture stomatitis, and many times higher prevalence of angular cheilitis at both baseline and one-year.

This study is one of a few international studies to date to follow the oral health of a large group of community-dwelling older adults with dementia over time, as they became more cognitively impaired and functionally dependent, and many moved into institutional long-term care. The two previous longitudinal dementia studies conducted by

Jones et al. (1993) and Ship & Puckett (1994) provided invaluable methodological and oral epidemiological data to assist with the design, sampling and methodologies used for this Adelaide dementia study. The trends in caries experience reported in these studies, together with caries experience trends from the study by Warren et al. (1997), although not statistically conclusive, provided data to assist with the development of the hypotheses for this study. The small sample sizes used in these previous studies limited the significant differences found for caries experience between dementia and comparison non-dementia groups. However, in this Adelaide dementia study, accurate sample size calculations based on the previous study findings have ensured that the sample selected was large enough to detect significant differences between the dementia and non-dementia groups for coronal and root caries experience, both at baseline and one-year, at the tooth level and surface level. A comprehensive understanding of the cross-sectional caries data at baseline and one-year in this study, together with the longitudinal caries data, is essential to help identify when the onset of severe caries is occurring in older adults with dementia, and which older adults with dementia are at the highest risk for developing severe dental caries.

A review of complete tooth status and tooth surface data, together with data concerning plaque accumulation in this study, highlights a distinctive caries trend in older adults with dementia. Within the constraints of interpreting oral epidemiological caries data, and the reasons for missing and filled surfaces, it was clear that the majority of dementia participants had caries experience during the study period. As hypothesised, in this one-year study period, dementia participants had significantly higher numbers of decayed teeth and coronal and root surfaces than non-dementia participants. However, numbers of missing teeth, filled teeth, plaque-covered teeth, retained roots and overall DMFT did not significantly differ between the two groups. At the surface level, again, numbers of filled surfaces, decayed/filled surfaces (DFS) and caries attack rates did not significantly differ between the two groups. Coinciding with higher coronal and root caries experience at one-year were significantly higher numbers of plaque-covered root surfaces that could not be scored because of gross plaque/debris accumulation, and significantly higher one-year Plaque Index scores of dementia participants. Incidence data revealed that both coronal and root caries progressed at high levels in some of the dementia participants. Of great concern was the high coronal caries experience and increments, in addition to high root caries experience and increments, in many of these dementia participants. The high levels of coronal caries found quantitatively in this geriatric population have confirmed the clinical observations of severe or rampant caries throughout the oral cavity in many older adults with dementia. Caries experience values at baseline were markedly lower than at one-year in the dementia group and, together with the longitudinal data, revealed that the onset of severe dental caries did occur in many of the dementia participants between baseline and one-year in this study.

The distribution of coronal and root caries prevalence data revealed that dental caries was present in participants from both dementia and non-dementia groups at both baseline and one-year. However, at baseline, coronal and/or root caries was present in just under half of participants in the dementia group, compared with 15.5% of the non-dementia group. At one-year, coronal and/or root caries was present in just under 60% of participants in the dementia group, compared with 28.3% of the non-dementia group. The distribution of caries experience on coronal and root surfaces differed markedly between the dementia and non-dementia groups. At baseline, the 42.2% of dementia participants with caries were distributed among the three surface combinations: 11.2% had decayed coronal surfaces only, 19.8% had decayed root surfaces only and 11.2% had both decayed coronal and root surfaces. Nearly all non-dementia participants at baseline with caries had decayed root surfaces only. At one-year, caries distribution had consolidated in both

groups, with nearly all those with caries having both decayed coronal and root surfaces: 49.5% of dementia and 21.2% of non-dementia participants had decayed coronal and root surfaces at one-year. At baseline there were approximately similar percentages of participants in both groups with caries on one surface versus multiple surfaces. However, at one-year there were higher percentages with multiple surfaces affected. The DFS distribution was similar among dementia and non-dementia participants at both baseline and one-year, with just under 20% of participants having 41+ decayed/filled surfaces. The differences between the groups' levels of untreated decay and restorations would appear to reflect dementia participants' less frequent dental visits in the one-year period.

Caries incidence rates indicated that 71.8% of dementia participants had occurrence of coronal caries, as measured by the adjusted caries increment which quantified both decayed and filled surfaces from baseline to one-year. Caries incidence rates indicated that 62.1% of dementia participants had occurrence of root caries, as measured by the adjusted caries increment which quantified both decayed and filled surfaces from baseline to one-year. As hypothesised, these percentages were significantly higher than those for non-dementia participants, which were under 50%. The distribution of numbers of surfaces with caries increments occurring revealed that non-dementia participants had increments on fewer coronal and root surfaces than did dementia participants. There were only 14.6% of the dementia participants who did not have a coronal or root caries surface increment from baseline to one-year. One-third of non-dementia participants had no coronal or root caries increment from baseline to one-year. In addition, only 9.8% of non-dementia participants had five or more coronal and/or root caries increments, compared to a figure of 31.1% for dementia participants.

The caries occurring in these participants was in many cases being restored and, if not, had not progressed sufficiently at one-year to obliterate the tooth crown and result in the presence of a retained root. However, there was a distinct subgroup of dementia participants who had retained roots present at baseline (20.4%), who had increased numbers of retained roots present at one-year (8.7%) and who had retained roots extracted between baseline and one-year (5.9%). A small subgroup of non-dementia participants also had retained roots present at baseline (8.8%), had increased numbers of retained roots present at one-year (4.4%) and had retained roots extracted between baseline and one-year (1.8%). Interestingly, tooth loss distribution was similar for both dementia and non-dementia groups, with 18.4% of dementia and 15.0% of non-dementia participants losing one or more teeth between baseline and one-year. Anecdotally, there were several dementia participant carers who were concerned about tooth loss in those they cared for, as the dementia participants had definitely not had a tooth extraction by a dentist! One daughter had to watch her mother chewing on her self-extracted lower incisor teeth and swallow them!

It was hypothesised in this study that: the baseline and one-year experience of coronal and root caries, retained roots and plaque accumulation was higher in participants with moderate to severe dementia, but not in participants with mild dementia, when compared to participants without dementia; and that caries experience was related to dementia severity and not to specific dementia diagnoses. The first of these hypotheses was confirmed by the baseline and one-year data. At baseline, although numbers of decayed teeth and surfaces were not significantly different, there were some significant caries relationships with dementia severity. Dementia participants with moderate to severe dementia (as assessed by the MMSE) did have fewer filled teeth, fewer filled coronal surfaces, lower coronal DFS, fewer filled root surfaces and more plaque-covered root surfaces at baseline. Dementia participants with 3+ years since dementia diagnosis had significantly more plaque-covered root surfaces at baseline. Baseline correlation analyses

revealed significant relationships (with low to moderate correlation coefficients) between increasing dementia severity (MMSE score and GDS score) and numbers of decayed teeth, retained roots, decayed coronal and root surfaces, and plaque-covered root surfaces. However, when caries experience at one-year was analysed by dementia severity, numbers of decayed teeth, decayed coronal surfaces and decayed root surfaces were all significantly higher in dementia participants with an MMSE score indicative of moderate to severe dementia, when compared with dementia participants with an MMSE score indicative of mild dementia or a normal score. At one-year dementia participants with moderate to severe dementia (as assessed by MMSE score and/or GDS score) again had fewer filled coronal surfaces, lower coronal DFS, fewer filled root surfaces and more plaque-covered root surfaces. One-year correlation analyses revealed significant relationships (with low to moderate correlation coefficients) between increasing dementia severity (MMSE score and GDS score) and numbers of decayed teeth, retained roots, decayed coronal and root surfaces, and plaque-covered root surfaces. Correlation analyses also revealed significant relationships (with low correlation coefficients) for MMSE score and GDS score with coronal adjusted caries increment and root adjusted caries increment.

The baseline and one-year data did not strongly support a relationship between dementia diagnosis and caries experience; thus, the study hypothesis concerning dementia diagnosis and dental caries was confirmed. There were some significant caries relationships by dementia diagnosis, but not for untreated decay; those with an Alzheimer's disease diagnosis had higher numbers of filled teeth, more filled coronal surfaces and higher coronal DFS. At one-year there were again some significant caries relationships by dementia diagnosis, but not for untreated decay; those with an Alzheimer's disease diagnosis had higher numbers of filled coronal surfaces and higher coronal DFS. There were no significant relationships for coronal or root caries increments by dementia diagnosis.

The final study hypothesis was that coronal and root caries experience was higher in dementia participants with moderate to severe dementia, those who were socioeconomically disadvantaged (government-cardholders, no private health insurance), those who were more functionally dependent, those who were taking neuroleptic medications with high anticholinergic adverse effects, those with eating and swallowing problems, those who were not attending the dentist regularly, those who needed assistance with oral hygiene care, those who were behaviourally difficult for carers during oral hygiene care, those whose carers were burdened and those who were institutionalised between baseline and one-year. Tests of significance for individual participant characteristics revealed some significant relationships with coronal and root caries experience. Caries relationships with dementia severity have been discussed above. Bivariate relationships for untreated coronal and/or root caries were found for those participants who: were government-cardholders, were more functionally dependent (ADL and IADL scores), were taking neuroleptic medications with the most anticholinergic adverse effects, were not taking anticholinesterase inhibitor medication, had swallowing problems, had not visited the dentist in the previous 12 months, needed assistance with oral hygiene care; and those whose carer had difficulties with oral hygiene care and whose carer burden was high. Bivariate relationships for fewer filled teeth/surfaces and/or fewer decayed/filled surfaces (DFS) were found for those participants who: were male, were government-cardholders, were without private health insurance, were more functionally dependent (ADL and IADL scores), were not taking anticholinesterase inhibitor medication, could eat fewer food types, had swallowing problems, had not visited the dentist in the previous 12 months; and those whose carer had difficulties with oral hygiene care. In addition to the dementia severity relationships described above, bivariate relationships for higher coronal adjusted caries increments

were found for those who had visited the dentist in the previous 12 months, whose carer burden was high, who were taking neuroleptic medications with the most anticholinergic adverse effects, who were independent for fewer IADLs and who had more chronic medical conditions. In addition to the dementia severity relationships described above, bivariate relationships for higher root adjusted caries increments were found for those whose carers had difficulties with oral hygiene care, who needed assistance with oral hygiene care, who were independent for fewer IADLs, who were dependent for more ADLs and who had more chronic medical conditions.

Thus, the final study hypothesis was confirmed for most of the listed characteristics in bivariate analyses. A characteristic that was not found to be significantly related to any caries measures was institutionalisation between baseline and one-year—this was significant in bivariate analyses only for plaque-covered root surfaces. The investigation of participants' characteristics further adds to the previous discussion concerning a distinctive caries trend—dementia participants at high risk for developing further caries were those with previous caries experience, especially coronal decay. In this dementia population with such high levels of caries, the significant characteristics for decay in the bivariate analyses need also to be considered as possible caries risk factors—government-cardholders, the more functionally dependent (ADL and IADL scores), taking neuroleptic medications with the most anticholinergic adverse effects, not taking anticholinesterase inhibitor medication, having swallowing problems, not visiting the dentist in the previous 12 months, needing assistance with oral hygiene care, carers having difficulties with oral hygiene care, and where carer burden is high.

Bivariate relationships were also found between plaque accumulation (plaque-covered tooth surfaces and Plaque Index (PI) scores) for participants who: were more functionally dependent (ADL and IADL scores), were institutionalised between baseline and one-year, had not visited the dentist in the previous 12 months, needed assistance with oral hygiene care, could eat fewer food types, were 3+ years since their dementia diagnosis and were taking neuroleptic medications with the most anticholinergic adverse effects; and whose carer had difficulties with oral hygiene care. At one-year, the highest mean PI scores were in dementia participants who: had been institutionalised between baseline and one-year (PI=2.0), were dependent for 3–6 ADLs (PI=1.9), had not visited the dentist in the previous 12 months (PI=1.7), and needed assistance with oral hygiene care and who could eat fewer food types; and whose carer had difficulties with oral hygiene care (PI=1.6). These high plaque levels are of great concern in these dependent and medically compromised individuals, as the accumulation of plaque over time on natural teeth and dentures places them at high risk for developing aspiration pneumonia (Loesche & Lopatin 1998; Taylor et al. 2001). The group at even higher risk for aspiration pneumonia was those participants in this study with dementia who had high plaque levels and swallowing problems and/or were institutionalised. Some participants in this subgroup had several of the recognised risk factors for aspiration pneumonia, including: reduced functional status, institutionalisation, swallowing disorder, assistance needed with eating, chronic lung diseases, prolonged hospitalisation or surgical procedure, mechanical airway interventions, reduced pulmonary clearance, immunocompromise, history of smoking, recent antibiotic therapy, supine positioning and older age (Loesche & Lopatin 1998; Taylor et al. 2001).

This was one of the few geriatric oral epidemiological studies to use a carer burden scale for the carers of dementia participants; its use was trialled in one previous study with carers of older adults with dementia (Blanco et al. 1997). Carers were very compliant with completing the burden scale. Unfortunately, the carer burden scale was not used in this study at baseline, and was only collected at one-year. However, it is again being collected

at two-years. As only a subgroup of carers are appropriate to complete the burden scale as the study progresses over time, it is important in future research to ensure sample size is adequate to effectively use data from the scale in more complex data analyses. The study findings support the use of the burden scale in future geriatric dental research.

The successful use of cognitive and functional assessment tools was achieved in the dementia study. With adequate training, these assessment tools are easily administered by interviewers and examiners, and provide invaluable information concerning important characteristics that are related to oral health status. As discussed in the background section of this study, the appropriate use of these tools in various geriatric populations is critical. As was found in the nursing home study, the clock-drawing test was the least flexible cognitive assessment tool, and was best suited for use in a generally healthy and functionally independent older adult population. Non-completion of the clock-drawing test for many reasons related to sensory and physical problems made it difficult to use in more functionally dependent geriatric populations. The MMSE test was a very useful cognitive assessment tool in both the dementia and comparison groups. It took a short time to administer, and the great majority of participants were happy to do the MMSE test. Researchers must be prepared that there will be a small number of geriatric participants who refuse to do the MMSE, as well as a group who have sensory and physical problems which limit its use. However, the variety of items in the MMSE ensures that these limitations are not as extensive as for the clock-drawing test. The easiest and shortest cognitive assessment tool used in this study was the GDS scale. As it was completed by the dental examiner, the GDS could be used for all participants, thus assisting the maximum use of data in statistical analyses. Future geriatric dental research with dementia populations requires the use of a variety of cognitive assessment tools; ideally, the use of both the GDS and MMSE will provide researchers with comprehensive cognitive data for all participants.

This study was not able to fully elucidate the complexities involved in the onset and progression of oral diseases in older adults with dementia. Although it used a bigger sample size than in similar previous longitudinal geriatric oral epidemiological research, the sample size was insufficient to enable adequate investigative statistical modelling of the large number of participants' characteristics that were influencing oral health status. The results have identified some important relationships and risk predictors, but further research is needed to investigate the influence of characteristics such as swallowing problems, behavioural problems, specific co-morbid medical conditions, carer characteristics such as carer burden or change in carer status (e.g. with institutionalisation), saliva flow and xerostomia, medication history, current use of medications, and the breakdown of medications into subgroups with varying levels of anticholinergic adverse effects. Results from this study have highlighted the importance of precise knowledge of medications and their adverse effects. Dental researchers must be more judicious when analysing medication data, to ensure that within a medication classification group, those drugs with the highest oral adverse effects are delineated from others within the group with lower oral adverse effects. The many risk factors for aspiration pneumonia evident in this dementia population should encourage geriatric dental researchers to further investigate the relationships among aspiration pneumonia and these risk factors, such as plaque accumulation, oropharyngeal secretions, swallowing problems and medication use. Future research is also required to investigate the possible causal relationship between dental problems, dental pain and aggressive and problematic behaviours in older adults with dementia. Discussion of oral epidemiological and statistical problems encountered in this study have provided important information to assist with future research to identify not only the onset and progression of coronal and root caries, but distinctive caries patterns that may be occurring in this high risk

population. The ongoing two-year data collection for this study will provide further insights into the onset and progression of oral diseases in older adults with dementia, as they become more cognitively impaired and more functionally dependent, and many move into institutional care.

8 Conclusions

- Dementia participants' general health and other characteristics declined from baseline to one-year. Dementia participants' profile became more complex; they became more functionally dependent (ADL and IADL scores), more cognitively impaired (GDS, MMSE scores), more medically compromised and more nutritionally compromised. Dementia participants could eat fewer food types at one-year, 12.6% were eating a soft diet and one-quarter had swallowing problems. Just under one-third of dementia participants were institutionalised between baseline and one-year.
- At one-year higher percentages were taking antidepressant, neuroleptic and sedative/anxiolytic medications; and fewer participants were taking anticholinesterase inhibitor medication. The great majority of those taking neuroleptics were taking traditional neuroleptics with high anticholinergic adverse effects.
- Dental history characteristics did not dramatically change from baseline to one-year for dementia participants, with similar distributions for participants' perceived dental needs and dental attendance pattern. However, significantly fewer dementia participants had attended the dentist in the previous 12 months at both baseline and one-year.
- Many more dementia participants required assistance with oral hygiene care by one-year, and more than double the percentages of participants' carers had various difficulties with oral hygiene care; at one-year, one-quarter of dementia participants were forgetting to do their oral hygiene care or needed reminding to do so. Dementia participants' resistive and combative behaviours during oral hygiene care had also increased by one-year, with one-quarter to one-third refusing oral hygiene care and not opening their mouth for oral hygiene care.
- Of concern was the decreasing fluoride sources among dementia participants; almost no dementia participants (at either baseline or one-year) were using either a cosmetic or a therapeutic mouthrinse, and at one-year more than half of the dementia participants were using a fluoride toothpaste but not drinking fluoridated water. Many participants were using bottled or rain water.
- Mean number of teeth present was 16.5 for dementia and 15.7 for non-dementia participants.
- There was a marked decrease in the use of dentures over the one-year period in the dementia group. Dementia participants had more than double the prevalence of maxillary denture stomatitis, and many times higher prevalence of angular cheilitis at both baseline and one-year.
- The overall dental treatment need perceived at interview by participants in both dementia and non-dementia groups was low—approximately 20% of participants. Many of the dementia participants with high levels of caries and their carers appeared to be unaware of the severity of their oral problems.
- At one-year the highest mean PI scores were in dementia participants who: had been institutionalised between baseline and one-year (PI=2.0), were dependent for 3–6 ADLs (PI=1.9), had not visited the dentist in the previous 12 months (PI=1.7), needed assistance with oral hygiene care, could eat fewer food types; and whose carer had difficulties with oral hygiene care (PI=1.6). These high plaque levels are of great concern in these dependent and medically compromised individuals, as the accumulation of plaque over time on natural teeth and dentures places them at high risk for developing aspiration pneumonia.

- There was a distinctive caries trend in the older adults with dementia, with the majority of dementia participants having caries experience during the study period. At baseline coronal and/or root caries was present in just under half of participants in the dementia group, compared with a figure of 15.5% for the non-dementia group. At one-year coronal and/or root caries was present in just under 60% of participants in the dementia group, compared with a figure of 28.3% for the non-dementia group. Dementia participants had significantly higher numbers of decayed teeth and coronal and root surfaces. However, numbers of missing teeth, filled teeth, plaque-covered teeth, retained roots and overall DMFT did not significantly differ between the two groups. At the surface level, again, numbers of filled surfaces and decayed/filled surfaces (DFS) and caries attack rates did not significantly differ between the two groups.
- There was a caries pattern for dementia participants involving more coronal surface decay. At baseline the 42.2% of dementia participants with caries were distributed among the three surface combinations: 11.2% had decayed coronal surfaces only, 19.8% had decayed root surfaces only, and 11.2% had both decayed coronal and root surfaces. Nearly all non-dementia participants with caries at baseline had decayed root surfaces only. At one-year caries distribution had consolidated in both groups, with nearly all those with caries having both decayed coronal and root surfaces.
- Coronal and root caries increments were higher in participants with dementia compared to participants without dementia. Caries experience was markedly lower at baseline than at one-year in the dementia group and, together with the incidence and increment data, revealed that the onset of severe dental caries occurred in many of the dementia participants between baseline and one-year in this study. Caries incidence rates indicated that 71.8% of dementia participants had occurrence of coronal caries, and 62.1% of dementia participants had occurrence of root caries. These percentages were significantly higher than those under 50% for non-dementia participants. The distribution of numbers of surfaces with caries increments occurring revealed that non-dementia participants had increments on fewer coronal and root surfaces than did dementia participants. There were only 14.6% of the dementia participants who did not have a coronal or root caries surface increment from baseline to one-year. One-third of non-dementia participants had no coronal or root caries increment from baseline to one-year.
- At baseline and one-year, coronal and root caries experience was higher in participants with moderate to severe dementia, but not in participants with mild dementia, when compared to participants without dementia. This was supported by bivariate analyses of cross-sectional and longitudinal data.
- Caries experience was related to dementia severity and not to specific dementia diagnoses.
- Coronal and root caries experience was higher in dementia participants with moderate to severe dementia, those who were socioeconomically disadvantaged (government-cardholders, no private health insurance), those who were more functionally dependent, those who were taking neuroleptic medications with high anticholinergic adverse effects, those with eating and swallowing problems, those who were not attending the dentist regularly, those who needed assistance with oral hygiene care, those who were behaviourally difficult for carers during oral hygiene care and those whose carers were burdened. This was supported by bivariate analyses of cross-sectional and longitudinal data.

- There was a distinct subgroup of dementia participants who had retained roots present at baseline (20.4%), who had increased numbers of retained roots present at one-year (8.7%) and who had retained roots extracted between baseline and one-year (5.9%). A small subgroup of non-dementia participants also had retained roots present at baseline (8.8%), had increased numbers of retained roots present at one-year (4.4%), and had retained roots extracted between baseline and one-year (1.8%). Interestingly, tooth loss distribution was similar for both dementia and non-dementia groups, with 18.4% of dementia and 15.0% of non-dementia participants losing one or more teeth between baseline and one-year.

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