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Methodology Report

for the 2012 New Zealand Older People's Oral Health Survey

A Report for the Ministry of Health by CBG Health Research Limited

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1 Introduction

The 2012 New Zealand Older People's Oral Health Survey (2012 OPOHS) is the first nationwide survey to collect information on the oral health status of New Zealand older people aged 65 years and over, either living in aged residential care facilities or in their own homes and receiving personal care assistance. There have been three previous national oral health surveys conducted in New Zealand: the 1976 Survey of Adult Oral Health and Attitudes to Dentistry (Cutress et al 1979); the 1988 Study of Oral Health Outcomes (the New Zealand section of the World Health Organization Second International Collaborative Study) (Hunter et al 1992); and the 2009 New Zealand Oral Health Survey (Ministry of Health 2010).

The 2009 New Zealand Oral Health Survey (NZOHS) (Ministry of Health 2010) provided extremely useful information on the oral health of older people living in the community in permanent private dwellings. The survey did not include older people living in residential care, who may have different oral health status and oral health needs, compared with the rest of the population. The older people who participated in the 2009 NZOHS; those living in the community, may or may not have been receiving home-based personal care. This information was not collected as part of the surveying process, as this was deemed outside the scope of the survey design.

The Ministry of Health commissioned the 2012 OPOHS, in order to gather up-to-date information about the oral health of New Zealand older adults aged 65 years and over, and the oral health services they use. The participants were either living in aged residential care facilities, or in their own homes and receiving personal care assistance. This survey addresses a substantial gap in our knowledge; information about vulnerable older people's oral health. This survey also supplements findings from the 2009 NZOHS by providing national-level information on the oral health status and needs of both residential care-based older adults and those living in the community with personal assistance. The 2012 OPOHS is valuable because it collected information on vulnerable older New Zealanders' oral health that is not available through other means, such as analysis of health system records. This survey can therefore be considered one of the most comprehensive sources of information on the current oral health status of vulnerable older New Zealanders.

The 2012 OPOHS consisted of face-to-face interviews and dental examinations, and was administered from June to December 2012. It is the first nationwide survey that has collected information on the oral health of vulnerable older adults aged 65 years and over living in aged residential care, or in the community with personal care assistance. Findings from the 2012 OPOHS are available in the report: *Our Older People's Oral Health: Key Findings of the 2012 New Zealand Older People's Oral Health Survey* (CBG Health Research 2015).

This methodology report details the procedures and protocols followed to ensure the 2012 OPOHS produced the high-quality and robust data expected of official statistics. A methodology report for the 2009 NZOHS (Ministry of Health 2010) is also available, which provides information on the design of the 2009 survey.

2 Background

The 2012 OPOHS was carried out from June to December 2012, and collected self-reported oral health information by way of an in-depth interview, and clinical information via an oral health examination. In total, 2,218 older people aged 65 years and over participated in the interview, and 1,882 completed a dental examination. The sampling frame for the 2012 OPOHS included two target populations: New Zealanders aged 65 years and over from all residential aged-care facilities in New Zealand with 10 or more residents receiving publicly-funded services, and community-dwelling older New Zealanders aged 65 years and over receiving publicly-funded personal care services at home from a District Health Board (DHB).

The 2012 OPOHS was made up of two major components: a computer-assisted face-to-face interview and a dental examination. The interview questionnaire measured self-reported oral health status, risk and protective factors for oral health outcomes and the use of oral health care services, among the usually resident New Zealand population of older adults aged 65 years and over living in aged residential care facilities, or in the community and receiving personal care assistance. Information on oral disease (particularly dental decay and periodontal disease) was recorded during clinical examinations of the teeth and periodontal tissue, conducted by dental examiners. The questionnaire and dental examination for the 2012 OPOHS were based on the 2009 NZOHS. The 2012 OPOHS dental examination protocols closely followed the protocols used in 2009, including having the same lead examiner train the dental examiners. Several of the dental examiners participated in both surveys. A fundamental difference between the 2009 NZOHS and the 2012 OPOHS dental examinations was that all older people who participated in the interview were invited to participate in the dental examination, irrespective of whether they had natural teeth or not. Only adults who had their natural teeth were examined in the 2009 NZOHS.

To better understand older people's oral health issues, additional information was collected on current services that were being funded, and on services that were being accessed. Data focusing on funded services came from District Health Board (DHB) phone interviews, face-to-face interviews and questionnaires. Questions designed to collect information about access to services were incorporated into the face-to-face interview, and are reported as a section of the key findings report *Our Older People's Oral Health: Key Findings of the 2012 New Zealand Older People's Oral Health Survey* (CBG Health Research 2015). The Funded Services Baseline Report is an unpublished stand-alone document.

The 2012 OPOHS was funded by the Ministry of Health and was a collaborative project involving CBG Health Research Ltd (CBG), the Ministry of Health and an external technical advisory group. CBG designed and managed the survey and collected all data, including undertaking the interviewing and preparing and analysing the datasets. The Oral Health team within the Ministry of Health provided the objectives and specifications of the survey. Qualified and registered dentists specially trained for the survey, carried out the dental examinations.

All results presented in the report *Our Older People's Oral Health: Key Findings of the 2012 New Zealand Older People's Oral Health Survey* (CBG Health Research 2015) were weighted in order to be representative of New Zealand's estimated resident population living in residential aged care facilities, or in the community and receiving personal care support.

2.1 Objectives

The objectives of the 2012 OPOHS were to collect information to:

- Describe the oral health of the Target Populations, and the prevalence and severity of selected oral health conditions
- Estimate the prevalence of risk and protective factors associated with these oral health conditions
- Describe the use of oral health services, including the nature of barriers to accessing oral health services and the extent of any unmet need
- Examine inequalities between subgroups within the Target Populations (as defined by age, gender, ethnicity and socio-economic position), and
- Provide policy-makers with information that can be used to improve oral health and the oral healthcare system.

The 2012 OPOHS supplements the findings of the 2009 NZOHS by identifying:

- The oral health status and clinically defined treatment needs, on a nationally representative basis, experienced by the Target Populations
- A baseline of oral health services currently publicly-funded for the Target Populations, in terms of the nature/description of the oral health services and the quantity of such services, and
- A baseline of oral health services currently accessed by the Target Populations, in terms of the nature/description of the oral health services, whether these services are funded in whole or in part by public expenditure or through private expenditure, and the quantity of such services.

2.2 Ethical approval

The New Zealand Health and Disability Multi-region Ethics Committee granted approval for the 2012 OPOHS (MEC/12/03/034), confirming that the study met the following ethical principles:

- Validity of research
- Minimisation of harm
- Privacy and confidentiality
- Informed consent, and
- Cultural and social responsibility.

The Ethics Committee approved the wording of all public materials for the survey, including the invitation letters, information brochures, consent forms, medical history forms, questionnaires, summary report given to participants at the end of the dental examination, and the use of proxy consents when necessary.

3 Population and Frame

The 2012 OPOHS collected information about two different populations of older people. This section discusses and describes the target population, the survey population and the sample frame for the 2012 OPOHS.

The **target population** is the population the survey aims to represent. All statistics for the survey refer to the target population. The **survey population** is the population covered by the survey. The **sample frame** is the list of areas, and the list of dwellings and people within areas, that were used to select the sample for the survey.

3.1 Target populations

The two target populations for 2012 OPOHS included the usually resident population aged 65 years and over:

1. Who were living in residential aged care facilities (the residential care or "RC" population), and
2. Those who were living in the community and receiving home-based personal care assistance (the home-based or "HB" population).

An aged residential care facility (RCF) was defined as a registered facility providing residential care for the elderly with 10 or more residents receiving publicly-funded services. The RFC might provide only rest home care, or in addition, any of the following: hospital level care, specialist dementia care or specialist psychogeriatric care. The RC target population was all people living in a RCF at the time of the 2012 OPOHS.

The HB target population was defined as only including permanent private dwellings: temporary private dwellings were excluded, including caravans, cabins, and tents in a motor camp, and boats. The HB target population also excluded non-private dwellings: examples such as hotels, motels, guest houses, boarding houses, hostels, motor camps, hospitals, barracks and prisons.

The Ministry of Health estimates of the target populations' living arrangements relating to home-based or residential care, are shown in Table 1. The number of older adults aged 65 years and over living in the community and accessing publicly-funded home-based support is estimated to be 55,000, with 28,800 older people in this age group estimated to live in residential care.

Table 1 Estimated distribution of older people (aged 65 and over) in New Zealand in 2011

Living arrangements		Ethnicity			Total
		Māori	Pacific	European and Other	
Living in the community	Independently	26,500	11,900	457,800	**496,200**
	Accessing publicly-funded home-based support for housework and/or personal care assistance	1,700	800	52,500	**55,000**
	Subtotal	**28,200**	**12,700**	**510,300**	**551,200**

Living arrangements		Ethnicity			Total
		Māori	Pacific	European and Other	
Living in residential care	In rest homes	500	200	15,800	**16,500**
	With hospital level care	300	100	8,900	**9,300**
	With specialist dementia care	100	minimal	2,300	**2,400**
	With specialist psycho-geriatric care	minimal	minimal	600	**600**
	Subtotal	**900**	**300**	**27,600**	**28,800**
Total		**29,100**	**13,000**	**537,900**	**580,000**

Source: Ministry of Health 2012 OPOHS Request for Proposal 2011

People were eligible for inclusion in the survey at their usual residence only. If they were temporarily visiting a RCF, they were not eligible to be selected as part of that target population.

3.2 Sampling frame and respondent selection

Due to the design of the survey, with a focus on elderly individuals, and with an administration period of several months, it was duly recognised that some older people eligible to be selected for the survey, would pass away during the course of the project. Every effort was made to ensure that people eligible for selection had not passed away before their families were contacted and invited to participate in the survey. This was to ensure that no distress was caused to families who had been recently bereaved.

Separate samples were drawn from the two populations.

Residential Care (RC)
A two-stage sampling process with oversampling of Māori and Pacific was employed for older people living in residential care.

Stage 1

An initial random sample of 120 sites was selected from all residential aged-care facilities with 10 or more residents receiving publicly-funded services. At the time of sampling there were 897 such facilities from a total of 1,021 facilities. The sample of residential aged-care facilities was drawn probability proportional to size, with a weighting factor of three given to Māori and Pacific residents. The selection was based on data from December 2011. An extension sample of a further 30 facilities was drawn in September 2012 due to original underestimates of mortality rates and residents moving to other facilities.

The date of surveying at each RCF was set in advance to facilitate liaison. Up-to-date lists of all residents were accessed four weeks before a RCF was due to be surveyed. It was important that the sampling frame was up to date, in order to reduce the chance of the family of a resident who had recently passed away being contacted when the RCF was visited. The lists of residents were sourced from national claims databases.

Stage 2

A random sample of 10 non-Māori, non-Pacific residents was drawn from this list, and eight of those were selected to take part in the Study. If a person declined to participate, the 9th and/or 10th selected residents were invited to take part.

All Māori and Pacific residents at each selected RCF were included in the sample.

There were six cycles of monthly downloads – beginning in May 2012 and going through to October 2012 – for the main surveying period, which started in June 2012 and finished in December 2012.

Home-Based (HB)
A simple random sample was drawn from lists of all people receiving publicly-funded personal care services, at their home, from any District Health Boards (DHBs). Individuals were identified primarily from the national claims database. However, where the DHBs did not submit claims to the national database, lists of older people receiving home-based personal care were obtained directly from the DHB. Māori and Pacific people were assigned an increased probability of selection (three times more likely to be selected). The samples were drawn four weeks before surveying began in each DHB.

To allow for the number of older people who would have passed away by the time they were scheduled to be surveyed, many DHBs were divided into one or more sub regions. A first download of all those receiving services in December 2011, was used to divide DHBs into sub regions with approximately equal populations of older people. The sub regions were based on lists of all meshblocks in a DHB. There were up to six sub regions per DHB. The reason for this procedure was to give all people who receive services an equal chance of being selected without having to adjust selection probabilities due to people appearing on repeated monthly downloads for DHBs. The lists of meshblocks that were set up as sub regions are analogous to the residential care facilities (RCFs) in the RC design.

This sample design ensured that:

- Robust national estimates for key oral health behaviours and outcomes could be produced
- All population groups of interest, in particular Māori, Pacific and Asian were included in sufficient numbers to enable estimates that are accurate for all groups.

4 Questionnaire

The 2012 OPOHS questionnaire was based on the 2009 NZOHS adult questionnaire, but was modified to be relevant to the study population. In consultation with the Ministry of Health and the External Technical Advisory group, a number of questions from the 2009 NZOHS were not included because they were not relevant to older people (for example, questions on the use of mouth guards when playing sport). Additional questions, using validated questionnaires, where possible, were included to collect data on:

- Nutritional status, using the Mini Nutritional Assessment
- Quality of Life, using the EuroQol
- Dementia
- Accessed services
- Previous address and occupation.

4.1 Design

Who answered the questionnaires?
Participants living in their own homes in the community (the HB sample) answered the questionnaire for themselves. Participants living in selected residential care facilities (the RC sample), answered the questionnaire for themselves if they were able to do so independently. Where participants were assessed by residential care facility staff as unable to consent independently, their identified proxy answered the questionnaire. The content of the questionnaire is summarised in Table 2.

Socioeconomic status
In most health surveys, a number of variables are collected that can be used to measure (or infer) socioeconomic status. The "NZDep" score of the meshblock in which the respondent resides is often used to present results in quintiles. The latest available NZDep scores were those derived from census data from the 2006 census.

The NZDep is problematic as a measure of socioeconomic status in the 2012 OPOHS because a participant's current address may not correlate well with their actual socioeconomic status. For residents of residential care facilities, the address of the facility provides minimal information about the socioeconomic status of the responding resident.

To undertake analyses by socioeconomic status, the New Zealand Socioeconomic Index (NZSEI-06) score was used. The NZSEI is an occupation-based measure of individual socioeconomic status derived using Census data, as opposed to the NZDep index which assigns deprivation scores to areas (meshblocks) also using Census data.

The 'returns to human capital' model is a framework used for the New Zealand Socioeconomic Index (NZSEI) (Milne et al 2013). The model was first developed for the International Socioeconomic Index of Occupational Status (ISEI) (Ganzeboom et al 1992), which views occupation as the means by which a person's education is converted into income. Thus, differences in occupation are likely to represent differences in life chances and opportunity, and on this basis occupation can be used to stratify individuals according to socioeconomic status (Milne et al 2013). Furthermore, it is possible to assess the socioeconomic status of older adults who may no longer be working, by asking about their main occupation during their working life.

All respondents were asked questions about their occupation and education, and the occupation and education of their spouse, if applicable. The occupation and education information was used to assign each respondent a NZSEI score. Occupation information was captured in the interview as verbatim responses and later classified using the Australian and New Zealand Standard Classification of Occupations (ANZSCO) to 3 digits. Where occupation information was not available, the NZSEI score was imputed using the respondent's age and education.

Testing of the questionnaires
The questionnaire was tested in the pilot study to ensure the questions were easily understood by participants and were able to produce high-quality data. Where questions appeared to be unclear, instructions for the interviewers were included in the body of the questionnaire. These helped to standardise the delivery of the questions, thereby helping to improve the quality of the data.

4.2 Summary of questions

In total, there were 102 questions, covering 22 topics. The questionnaire consisted of six key modules, shown in Table 2: 1) Self-reported oral health status, which includes a range of topics such as history of tooth loss and orofacial pain; 2) Health status/Quality of Life, including nutritional status; 3) Risk and protective behaviours, with a focus on preventive care and the threats to oral health; 4) Accessed services, which seeks a wide range of information on topics such as the cost of dental care and frequency of check-ups; 5) Attitudes to, and knowledge and opinions about oral health; and 6) Sociodemographic information, such as age, ethnicity and education.

Table 2 Summarised content of the 2012 OPOHS questionnaire (answered by adults aged 65 years and over or by a proxy who held guardianship)

Module	Topics
Self-reported oral health status	Self-reported number of natural teeth History of tooth loss Presence of dentures, bridges, implants Appearance of teeth Assessment of general oral health status Orofacial pain/symptoms Oral health-related quality of life Self-perceived need for dental care
Health status/Quality of Life	EuroQol Nutritional Status, including reported height and weight Dementia assessment
Risk and protective behaviours	Preventive care (tooth brushing, cleaning between the teeth) Use of fluoridated toothpaste Use of mouth rinses Current smoking status

Accessed services	Use of public/private services in last 12 months Cost of services, subsidy/out-of-pocket/insurance Access to services – transport/waiting Dental visits in last 12 months, including reason for visit and reasons for not visiting Tooth extraction in last 12 months Last visit (reason, type of dental provider, dental services by type, choice of dental professional, time taken to get there) Perceived cost barriers Usual provider of dental care Regular dental check-ups Dental anxiety
Attitudes to, and knowledge and opinions about oral health	Perceived importance of oral health (children, adults, general wellbeing, government spend on oral health) Opinions about dental care for adults
Sociodemographic information	Age, ethnicity, education, previous independent living address, personal income, previous occupation and of spouse

5 Dental Examination

Survey respondents who completed the face-to-face interview were invited to participate in a clinical dental examination. Where required, proxies were asked to consent to a dental examination on behalf of the person over whom they held guardianship. In contrast to the 2009 NZOHS, all people surveyed were invited to participate regardless of dental status; that is, people with their own natural teeth and those who did not have any natural teeth (who did or did not wear dentures) were eligible for examination. Additionally, whereas 0.5% percent of dental examinations were conducted in the participant's home in the 2009 NZOHS, all dental examinations in 2012 OPOHS were conducted either in the participant's own home or in the aged care residential facility where they lived.

5.1 Development of the dental examination protocol

Dental examiners followed a standardised protocol to record information about the clinical oral status of the survey participant. These protocols are available in Appendix E of the 2012 OPOHS Key Findings Report: *Our Older People's Oral Health: Key Findings of the 2012 New Zealand Older People's Oral Health Survey* (CBG Health Research 2015). The examination protocol used in the 2012 OPOHS was based on the 2009 NZOHS, which used the protocol from the Australian National Survey of Adult Oral Health 2004–06. There were several differences between the 2009 NZOHS and the 2012 OPOHS dental examinations. Modifications made to the 2012 examination protocols enabled clinical information relevant to this study population to be collected.

One of the major differences between the two surveys is the index used to assess periodontal status. Since a full-mouth periodontal assessment (as undertaken in the 2009 NZOHS) was considered burdensome for the survey participants, and potentially the examining dentists, the World Health Organization Community Periodontal Index (CPI) (Ainamo et al 1982) was used to assess periodontal destruction. The Grace and Smales Mobility Index was used to assess tooth mobility (Grace and Smales 1989). The 2012 OPOHS also collected more extensive information on denture use and condition, than the 2009 NZOHS. An additional assessment on the presence of extra-oral (outside the mouth) abnormalities of the head, neck and limbs as well as additional conditions affecting the oral mucosa were also collected.

Information on the presence of extra-oral abnormalities of the head, neck and limbs, intra-oral lesions, tooth loss and the presence of prostheses to replace missing teeth (either dentures or bridges) was collected from all participants. People who had teeth missing were asked whether they owned removable dentures. If they answered yes to this question, and wore dentures to the examination, their dentures were assessed for quality, fit and function. People with one or more teeth were further assessed for: tooth loss; dental decay experience; oral debris and calculus; periodontal status (where not medically contraindicated); tooth mobility; and experience of trauma. The level of difficulty of the examination and the physical location of the participant at the time of examination were also recorded. Treatment need (appropriate to the participants' wishes, a need for treatment and the ability to undergo treatment) was assessed by each dental examiner for (i) prosthetic treatment requirement, including replacement of teeth, repair and reline of dentures, and adjustment and cleaning of dentures; and (ii) restorative treatment for each tooth, or need for tooth extraction.

Survey participants were examined in a seated position which was appropriate for (i) the participant's level of comfort, and physical and cognitive function, and (ii) the dentist's visibility and comfort. Illumination was provided by LED headlamps and an intra-oral mirror, both with their own battery-powered light source. A standard World Health Organization Community Periodontal Index probe (TRS 621) was used both to assess the periodontal health, and to remove debris in

order to improve the visibility of tooth and root surfaces. Sharp explorers typically used for dental examinations were not used, and radiographs ("x-rays") were not taken. Dental loupes were not worn by the dental examiners.

5.2 Extra-oral examination

All participants were assessed for abnormalities of exposed skin on the head, neck and limbs. Participants were visually examined for extra-oral abnormalities including:

- Ulceration, sores, erosion, fissures (affecting the skin)
- Abnormalities of the upper and lower lips
- Swellings of the face and jaw, and
- Enlarged lymph nodes.

The examination was conducted in the following sequence: general overview of the exposed skin areas (head, neck, limbs), perioral skin areas (nose, cheek, chin), lymph nodes (head, neck), cutaneous parts of the upper and lower lips, vermilion borders and commissures (including scars for repair of cleft lip, other surgical or traumatic scarring, or other physical deformity), other swellings of the face and jaws, temporomandibular joint (although not a detailed examination), and the parotid gland region. Up to two abnormalities could be coded for each participant.

5.3 Oral mucosal tissue assessment

All participants were assessed for abnormalities of the oral mucosal tissues. The lips, oral mucosa and tongue were visually examined for abnormalities of the tissues, including:

- Suspected malignant tumours (oral cancer)
- Leukoplakia
- lichen planus
- Ulcerated lesions (aphthous, herpetic, traumatic)
- Acute necrotising gingivitis
- Candidiasis
- Abscess
- Angular cheilitis
- Denture hyperplasia
- Any other oral mucosal lesion.

Up to two abnormalities could be recorded for each participant. Each observed lesion was recorded by its type and location. If no abnormality was detected, the code of 'no abnormal condition' was recorded.

If the dental examiner discovered a suspected malignancy, the participant was referred to the appropriate DHB for further investigation.

5.4 Removable denture assessment and assessment of prosthetic treatment need

All participants were assessed for removable dentures. Participants were recorded as *dentate* (if they had one or more of their own teeth or teeth roots present) or *not dentate* (if they had no natural teeth or teeth roots remaining). The presence of fixed bridges and removable dentures was recorded. Participants who did not wear a denture(s) to the examination were asked whether they owned a denture(s). The type of denture(s) (whether partial or full) and whether the denture(s) was worn, was recorded. Upper and lower arches were coded separately.

If worn to the examination, removable dentures were examined *in situ* (with the participant leaving the denture/s in the mouth). The retention, stability and occlusion of each denture was assessed and coded as satisfactory or unsatisfactory. The dentures were removed and assessed for the presence of defects and material inadequacies, including porosity and staining, and the presence and quality of any temporary lining material.

Assessment of prosthetic treatment need
Following the removable denture assessment participants were assessed for their prosthetic treatment need, if any. In making an assessment of prosthetic need, examining dentists took into account the participant's general health, their ability to function with (or without) their current dentures, their capability to undergo treatment, and their wishes. Prosthetic treatment need included:

- Need for one-unit prosthesis
- Need for multi-unit prosthesis
- Need for a combination of one and/or multi-unit prostheses
- Need for full prosthesis (replacement of all teeth)
- Repair
- Reline/rebase
- Denture cleaning
- Unable to be recorded.

5.5 Tooth loss

All participants were assessed for tooth loss and need for replacement of teeth. The 2012 OPOHS followed the protocol of the 2009 NZOHS in collecting clinical information on tooth loss. In the 2009 NZOHS for adults younger than 45 years, dental examiners distinguished between missing teeth that had been extracted due to decay or periodontal disease, and teeth that were absent for any other reason (i.e. congenitally missing, unerupted or extracted for orthodontics, trauma or impaction). For adults aged 45 years or older, no such distinction was made: an extracted or otherwise absent tooth was recorded as missing. In the 2012 OPOHS, on examination, any absent natural tooth was therefore recorded as missing, regardless of the reason. As in the 2009 NZOHS, root fragments, dental implants and deciduous teeth were coded separately and not counted as missing or absent teeth. A tooth was recorded as present if more than 25% of the coronal tooth structure was present; otherwise, it was recorded as a root. The following codes were assigned:

- Missing due to any reason and replaced by a fixed or removable prosthesis that is worn to the examination
- Missing due to any reason and not replaced by fixed or removable prosthesis

- Root fragment that is decayed
- Root fragment that is not decayed (sound or capped with a restorative material)
- Implant whether or not it has been restored or is serving as an abutment
- Present permanent tooth that is present in the mouth and has none of the preceding conditions. This included teeth with full coronal restorations
- Present deciduous tooth
- Unable to code.

Replacement teeth
All absent teeth were further classified as either not replaced, or replaced by a fixed bridge or by a removable denture which was worn to the examination.

5.6 Tooth decay (dental caries)

Dentate participants (people who had one or more natural teeth) were examined for experience of tooth decay.

5.6.1 Decay experience of coronal tooth surfaces

All natural teeth present were divided into five coronal surfaces, and the status of each tooth was recorded in the following order: incisal (for incisal and canine teeth) or occlusal (for premolar and molar teeth), mesial, buccal, distal and lingual (for lower teeth) or palatal (for upper teeth). Each coronal surface was dried with cotton wool rolls or gauze, and, where required, debris and plaque was gently removed with the CPI periodontal probe. Each surface was assessed using visual criteria (no explorer was used) and assigned one of the following codes:

- Decay: cavitation of enamel or dentinal involvement or both present
- Recurrent caries: visible caries that was contiguous with a restoration
- Filled unsatisfactorily: a filling placed for any reason in a surface that required replacement but has none of the above conditions
- Full crown
- Filling to treat decay: a filling placed to treat decay in a surface that had none of the above conditions
- Filling placed for reasons other than caries: a filling present in a surface that had none of the above conditions (incisors and canines only)
- Fissure sealant: a fissure sealant and none of the above conditions
- Sound: where none of the above conditions were found
- Unable to code.

5.6.2 Decay experience of tooth root surfaces

The roots of all teeth present were divided into four surfaces and coded in the following order: mesial, buccal, distal, lingual or palatal. Each root surface was dried with cotton wool rolls or gauze, and where required, debris and plaque was gently removed with the CPI periodontal probe. A root surface was coded if 1mm or more of root surface was visible. Each surface was

assessed visually, and if necessary, using the periodontal probe. One of the following codes was assigned:

- Decay: a discrete, well-defined or discoloured lesion on the root surface that was soft to exploration using the periodontal probe
- Recurrent caries: detectable caries that was contiguous with a restoration
- Filled unsatisfactorily: a filling placed for any reason in a surface that required replacement but had none of the above conditions
- Filled root surface: one or more permanent restorations placed for any reason but none of the above conditions were found
- Sound root surface: visible surface that had none of the above conditions
- No visible root surface
- Unable to code.

5.7 Treatment need

Dentate participants (people who had one or more natural teeth) were assessed regarding their need for dental treatment, including fillings or extractions. Following the recording of coronal and root caries, each tooth was assessed for possible treatment, taking into account the general health of the participant, their ability to undergo treatment, as well as their wishes. One of the following codes was assigned:

- None
- One-surface filling
- Two- (or more) surface filling
- Crown for any reason
- Veneer or laminate
- Pulp care and restoration
- Extraction
- Need for other care
- Preventing or arresting caries
- Fissure sealant
- Unable to code.

5.8 Periodontal tissue destruction and gingival bleeding

Dentate participants (people who had one or more natural teeth) were assessed for their periodontal status. The periodontal component of the dental examination was only carried out for dentate survey participants who did not have any medical conditions that excluded them from this part of the examination (such as heart disease: see Table 3). One hundred and sixteen respondents living in residential care and 105 respondents living in their own homes, were exempt from the periodontal element of the examination due to one or more of these medical conditions.

The level of periodontal destruction and gingival bleeding was measured using the Community Periodontal Index (CPI). The CPI Index was used in 2012 OPOHS as the Expert Technical Advisory Group considered a full-mouth periodontal assessment would be too burdensome for survey participants and survey dentists.

In the CPI Index, the mouth is divided into sextants defined by tooth number: 18–14, 13–23, 24–28, 38–34, 33–43 and 44–48. A sextant was only examined if there were more than two teeth present which were not indicated for extraction. The buccal and lingual/palatal surfaces of index teeth (16 and 17, 11, 26 and 27, 36 and 37, 31, and 46 and 47) were probed using a lightweight probe with a 0.5mm ball tip, a black band between 3.5 and 5.5mm and rings at 8.5 and 11.5mm from the ball tip. One score per sextant was recorded. When the index teeth were absent, all remaining teeth in the sextant were assessed, and the worst score recorded.

Three indicators were used: gingival bleeding on gentle probing; presence of calculus; and periodontal pocket depth. The worst score per index tooth was recorded using the following hierarchy:

- Healthy
- Bleeding observed after probing
- Calculus detected during probing, but all of the black band on the probe visible
- Pocketing (4–5mm) (gingival margin within the black band)
- Pocketing 6+mm (black band not visible)
- Excluded sextant (less than two teeth present)
- Unable to code.

5.9 Dental trauma

Dentate participants were examined for signs of any dental trauma. If present, the upper six anterior teeth (upper right canine to upper left canine) were assessed for dental trauma. Dental examiners questioned participants about any history of trauma to the upper front teeth and then assessed the teeth for visual signs of trauma. One of the following codes was assigned to each tooth:

- No trauma
- Treated trauma: any size or involvement (usually with composite filling material)
- Trauma limited to enamel and not treated
- Trauma involving at least dentine (treatment required but not yet treated)
- Tooth discoloured after trauma (verified by participant)
- Avulsed, luxated because of trauma (verified by participant)
- Unable to code.

5.10 Simplified Debris Index and Mobility Index

Dentate participants were examined to assess their oral hygiene status and mobility of natural teeth.

The Simplified Debris Index of the Simplified Oral Hygiene Index (Greene and Vermillion 1964) was used to assess the level of food debris, plaque and calculus on six index teeth (if present). Four posterior and two anterior were selected. In the posterior portion of the mouth, the teeth selected for assessment were the first fully erupted teeth posterior to the second premolar in each quadrant, usually the first molar. The buccal surfaces of the upper molars, and the lingual surfaces of the lower molars were examined. In the anterior portion of the mouth, the labial surfaces of the upper right (11) and lower left (31) central incisors were examined. If the index teeth were missing, the anterior central incisor on the opposite side of the midline was used.

For debris and plaque, one of the following codes was assigned:

- No debris or stain present
- Soft debris covering not more than one-third of the tooth surface, or presence of extrinsic stains without other debris regardless of surface area covered
- Soft debris covering more than one third, but not more than two-thirds, of the exposed tooth surface
- Soft debris covering more than two-thirds of the exposed tooth surface
- Unable to code.

For calculus, one of the following codes was assigned:

- No calculus present
- Supragingival calculus covering not more than one-third of the exposed tooth surface
- Supragingival calculus covering more than one third but not more than two-thirds of the exposed tooth surface, or the presence of individual flecks of subgingival calculus around the cervical portion of the tooth, or both
- Supragingival calculus covering more than two-thirds of the exposed tooth surface or a continuous heavy band of subgingival calculus around the cervical portion of the tooth, or both
- Unable to code.

Tooth mobility was assessed using the Grace and Smales Mobility Index using the same index teeth as the Simplified Oral Hygiene Index. One code per index tooth was assigned as follows:

- No apparent mobility
- Mobility was perceptible, but less than 1mm buccolingually
- Mobility was between 1mm and 2mm
- Mobility exceeded 2mm buccolingually or vertically
- Unable to code.

5.11 Difficulty and location of examination

Examiners rated the level of difficulty of examination, based on how well the participant tolerated the oral examination, and whether the examination was able to be completed. One of the following codes was assigned:

- Easy: cooperative patient, easy to complete examination
- Manageable: needed to be mindful of breaks, but participant cooperative
- A few aspects difficult: some parts of the examination were challenging for the participant, but examination completed
- Difficult: examination difficult, some parts not completed
- Very difficult: unable to complete most of the examination.

The seating location where the participant was examined was also recorded, with one of the following codes assigned:

- Reclined portable dental chair
- Upright portable dental chair
- Bed
- Dining chair
- Lounge chair
- Wheelchair
- Other.

6 Data Collection and Quality Control

The 2012 OPOHS interview team consisted of 19 interviewers from CBG Health Research Ltd (CBG). Interviews were conducted in participants' places of residence, at a time which suited them. Participants were also invited to take part in the dental examination. Participation in the 2012 OPOHS was voluntary, relying on the goodwill of participants, their proxies and residential care facilities. Consent was obtained without coercion or inducement.

6.1 Face-to-face interview

Interviews were conducted in participants' places of residence, with the interviewer entering responses directly into a laptop computer using The Survey System computer-assisted personal interview (CAPI) software. Large print show cards with predetermined response categories were used to assist respondents, where appropriate.

Aged residential care participants
The 120 aged residential care facilities randomly selected by CBG to take part in the 2012 OPOHS, were first contacted by CBG management to provide an introduction to the survey, and to respond to any concerns or questions. This was often followed by a personal visit to the facility, during which time the procedural details of the survey and the eligibility of selected participants within that facility was discussed. Facilities were also provided with a Study Information Pack and samples of the invitation letters and information pamphlets. Any facility-specific considerations were also discussed during this time, and dates for access negotiated.

During these consultations, staff of each selected residential care facility were asked about the selected residents' ability to consent and participate in the survey, including (1) those residents who would be able to consent independently; (2) those who would be able to consent independently, but who might require the presence of a support person; and (3) those who would not be able to consent independently and who would require a proxy to complete the interview on their behalf.

The preliminary information that CBG sent to the selected participant and/or their support person/proxy depended on the selected participant's ability to consent for themselves. Those participants who could consent independently were sent the invitation letter from the Ministry of Health, along with the information pamphlet. If a support person was identified, they were sent the same information, along with an information sheet relating to the dental examination and a covering letter from CBG introducing the study and extending an invitation for them to attend. For participants who could not consent independently, CBG sent their identified proxy the Ministry invitation, information pamphlet and dental examination information sheet, proxy consent forms and a covering letter from CBG.

CBG management coordinated the responses to the invitation letters and scheduled the interview and dental examination dates accordingly.

Home-based participants
Older people selected for the survey as part of the home-based (HB) sample were sent an invitation letter from the Ministry of Health (accompanied by an information leaflet) prior to the start of the survey. Interviewers from CBG then visited the households, fully explained the survey, and invited each participant to take part in the survey. If they agreed to take part, the CBG interviewer made an appointment to visit the participant at their home (or another venue if requested by the participant) to complete the interview. On their arrival, the interviewer gave the selected participant an information sheet regarding the dental examination. Participants were then

asked to sign an electronic consent form which included a request for an interpreter, if required. Once consent was obtained, the interview commenced.

Interview duration
In the RC sample, interviews conducted with the participants directly took an average of 23.0 minutes, with a median of 22.0 minutes and a range of 5.3 to 80.0 minutes. Interviews conducted with a proxy took an average of 19.6 minutes, with a median of 18.0 minutes and a range of 4.8 to 61.9 minutes.

In the HB sample, interviews conducted with the participants directly took an average of 26.4 minutes, with a median of 23.9 minutes and a range of 5.1 to 98.7 minutes. Interviews conducted with a proxy took an average of 26.1 minutes, with a median of 23.4 minutes and a range of 8.4 to 72.2 minutes.

6.1.1 Interviewer training

CBG interviewers received specialised training on how to conduct the 2012 OPOHS. The training comprised self-directed learning, online assessments and two days of face-to-face training. All interviewers received a copy of the 2012 OPOHS manual, and they were specifically trained on how the manual was to be utilised in order to achieve the required results. Interviewers also completed general survey training and online training modules centred on public policy surveying techniques and interviewing older people. Additionally, they completed a one-on-one oral examination for each survey module, which tested comprehension of the survey.

6.1.2 Call pattern

The ‘call’ refers to one visit on one day at a particular time. CBG conducted a total of up to 10 calls at each selected dwelling in the HB sample, at different times of the day and on different days of the week, before accepting a particular dwelling as a non-contact. Calls were recorded as unique events only if they occurred at least two hours apart. Interviewers were also required to attempt to make contact with participants by telephone where available. In the RC sample, interview and examination dates were pre-arranged by CBG management by taking into account facility preferences and the availability of interviewers and dentists.

6.1.3 Pilot study

A pilot study was carried out in May 2012 in order to test the survey interview and dental examination. Fifty participants took part in the interview: 26 participants from three residential care facilities in the Wellington region, and 24 participants living at home in the Hutt Valley area. Forty-five participants in the pilot also took part in the dental examination. The pilot study tested both the interview and the dental examination elements of the survey. As a result of the pilot study, scripting problems in the survey were identified and fixed, and processes were developed for scheduling the survey interviews and examinations. The 50 pilot study participants were not eligible to be selected for the main survey, however their survey data was included in the analysis for the 2012 OPOHS report.

6.1.4 Field dates

Interviews for the 2012 OPOHS were conducted between 4 June and 16 December 2012. As with the HB sample, dental examinations were conducted in residential care facilities, usually within two weeks of the initial interview.

6.2 Dental examination

At the completion of the survey interview, participants were invited to take part in the dental examination. For those who agreed (or for those requiring a proxy, where the proxy agreed) the interviewer provided an information sheet which explained the dental examination in more detail. If the participant or the proxy was still willing to take part in the dental examination after reading the information sheet, CBG staff scheduled a return visiting time for the dental examination, convenient to the participant (and proxy where required), usually within two weeks of the interview date.

Dental examinations were usually completed on a different day to the face-to-face interview. Seventy-one percent of examinations were completed within two weeks of the interview. The mean time between the survey and the dental examination was 13 days. The appointment schedules for the dental examinations were emailed to the dentists and the recorders the day prior to the examination day, and detailed the location(s) of the examinations; number of participants; and the contact details of the surveyor who would serve as the dental exam recorder. Home-based participants were also contacted by CBG staff following the interview in order to confirm the examination date; they were called again the day before the examination as a reminder. In total, only 20 home-based participants who had agreed to participate in the dental examination and had been given an appointment time for the examination, did not participate at that first appointment. In these cases, the participant was re-contacted by the interviewer to establish a new examination date. In some circumstances, it was not possible to re-contact the participant due to the participant being in hospital or having passed away.

During the field work, a number of residential care facilities were 'locked-down' due to viral outbreaks. Where this occurred, CBG management worked with the affected facilities to contact participants and their proxies, and if required, to arrange alternative dates. Examinations were conducted during week days, and occasionally on Saturdays, usually between the hours of 9am and 5pm. In making appointments for the dental examinations, the scheduling of participant's usual routine care and their meal times were taken into account.

6.2.1 Training of dental examiners

The 2012 OPOHS dental examination team comprised of a lead examiner and 21 dental examiners, including the gold standard examiner. All dentists (including the lead examiner) were fully qualified and registered, and held current Annual Practising Certificates. All examining dentists also held Core Level 4 Resuscitation Certificates. Twelve dentists had also been dental examiners for the 2009 NZOHS.

The principal course presenter and lead examiner for OPOHS was Professor Kaye Roberts-Thomson, Director of the Australian Research Centre for Population Oral Health (ARCPOH) at the University of Adelaide (and Director of the Dental Practice Education Research Unit). Professor Roberts-Thomson has notable experience in training and calibrating examiners for oral health surveys and for designing data collection instruments, including her roles as the lead trainer for the Australian Survey of Adult Oral Health 2004–06 and for other national oral health surveys in Vietnam (1999), East Timor (2001) and Papua New Guinea (2008). She has also trained examiners for the New South Wales Child Dental Health Survey (2007), Queensland Child Oral Health Survey (2010), and for a number of research studies including a clinical trial in the management and prevention caries in adults in residential care (2011). Professor Roberts-Thomson was also the lead trainer and examiner for, and conducted the calibration of, the dental examiners for the 2009 NZOHS.

Support for Professor Roberts-Thomson during the clinical training sessions was provided by Drs. Robyn Haisman-Welsh and Moira Smith. Dr. Haisman-Welsh (Chief Dental Officer, Ministry of

Health) was the course convenor, clinical support trainer and Gold Standard Examiner for the 2009 NZOHS. Dr Haisman-Welsh provided clinical and support training for the first two groups of dental examiners. Dr. Smith (Research Fellow, University of Otago, and Wellington) was a dental survey examiner for the 2009 NZOHS. She was the gold standard examiner for the 2012 OPOHS, and conducted the oral examinations for, and evaluation of, the 2012 OPOHS pilot study. Dr. Smith's role was to conduct replicate examinations for about six survey participants per examiner, in order to ensure consistency among the dental examiners. Dr. Smith attended all training sessions and provided hands-on training in the second training session, closely monitored by the lead examiner.

All dental examiners undertook a one-and-a-half day training and calibration course led by the lead examiner. Three training sessions, comprising seven dentists each, were held from 16 to 20 April 2012 at the Oral Hygiene Clinic at the Auckland University of Technology (Auckland). The training courses were timed to precede the start of the data collection phase and coincide with the availability of the lead examiner and the training facility. One dentist, who was also a dental examiner on the 2009 NZOHS, but who could not attend the scheduled training session, was trained one-on-one and calibrated by Drs. Haisman-Welsh and Smith at the time of the pilot study. The structure of each training course is outlined below.

First half day

- An overview of the origin and purpose of the 2012 OPOHS.
- An explanation of oral epidemiological methods and the role of the attendees in the data collection process.
- Examination procedures, diagnostic criteria, instrumentary, DVD viewing and NIDR slides.

Second and third half days

- Examination of volunteer participants which focused on the order of examination, instrumentary, defining examination sites, index teeth, tooth surfaces, periodontal probing sites, finding the cementoenamel junction and testing protocol rules.
- The oral examination of volunteer participants at the Oral Hygiene Clinic (part of the Akoranga Integrated Health Clinic), Auckland University of Technology. This allowed the attendees to familiarise themselves with the examination protocol in ideal and familiar surroundings ('clinical training').
- The oral examination of volunteer participants and application of the OPOHS protocol in actual field conditions (in a local residential care facility not used for the main data collection) ('field training').

Given the time lapse between the training sessions and the first data collection examinations, each dental examiner was mentored individually by the Gold Standard Examiner at his/her first data collection session. The purpose of these sessions was to update the examiners on the changes to the protocol which had been implemented as a result of the pilot, confirm calibration, and provide support for each dentist on the practical aspects of the examination procedures.

Each dental examiner received a trolley suitcase which contained the equipment and supplies required to complete a dental examination in a domiciliary setting. In addition, each dentist received an Aseptico AseptiChair (ADC-01) portable dental chair, with its own carry-case.

6.2.2 Dental recorders

CBG interviewers were trained as dental recorders for the purposes of the 2012 OPOHS; 14 had been interviewers and recorders on the 2009 NZOHS. Dental recorders attended the training course, received instruction on oral epidemiological field procedures, and the anatomy of the mouth, and were trained in (and provided with) a manual on the use of the computer system for collecting data. Dental recorders also attended the clinical and field training, working in pairs with the dental examiners to record the information provided by them during the training examinations.

6.2.3 Procedures prior to the examination

On arrival at a residential care facility, the dentist and the recorder reviewed the list of the day's examinations, in order to provide the dental examiner with information about the general health and cognitive and physical abilities of each participant, determine whether the participant would have a proxy present or require a carer from the residential care facility, and to assess the location of the examination and need for the portable dental chair. Often, the dental examination team met with the care manager or registered nurse to discuss any special requirements of the participants. The dental team were given a room or work area within the facility, where the full examination kit could remain while examinations took place. In some cases, the portable dental chair was erected in this room (or occasionally in a participant's room, if space permitted).

Prior to commencing the dental examination, the dental recorder checked that the examination consent form had been signed by the participant or their proxy and the examining dentist. The dentist confirmed that the participant (or their proxy) understood the purpose of the survey and the procedure, and (if necessary) provided further information and clarification. The dentist reviewed the participant's medical history, and an electronic form was signed by the dentist and the participant (or their proxy). Whenever possible, the dental recorder was the CBG interviewer who conducted the questionnaire prior to the exam. The medical history questionnaire asked about conditions that, if present, would preclude the participant from undergoing a periodontal assessment. It also included questions about the participant's general medical condition. The first question asked, in the medical history questionnaire, was a filter question used to ascertain the dental status of the participant. For participants with no natural teeth remaining, questions about their risk of endocarditis were skipped and only questions relevant to their general medical health (including current prescribed medications) were asked.

Table 3 presents the medical conditions which were asked about in the medical history questionnaire, which if present, would preclude the participant from undergoing a periodontal assessment.

Table 3 Medical conditions precluding periodontal examinations

- Participants who have been advised that they must always take antibiotics before routine dental care
- Joint replacement (hip or knee) during the last six months
- Rheumatic fever
- Congenital or acquired heart murmur
- Heart valve problems
- Congenital heart disease
- Bacterial endocarditis
- Congestive heart failure
- Bleeding disorders
- Immuno-suppression or being on immuno-suppression therapy

Procedures for participants who were examined in their own home were similar to those followed for rest home participants. Prior to examination, each participant, and their home, was assessed to determine the optimum location for examination. Procedures regarding consent and medical history, and examination, were the same as for participants in residential care facilities.

6.2.4 Procedures following the examination

At the end of the dental examination, participants (or their proxies, or facility staff where appropriate) were provided with a written report outlining the general findings of the dental examination. The report included information on any oral conditions (including tooth decay and gum disease) which were discovered, and general advice and recommendations about seeking treatment. If the dental examiner discovered a suspected malignancy, severe infection or acute dental pain which required immediate attention, the examining dentist referred that participant to Professor Murray Thomson, who referred the participant for further investigation at the relevant DHB.

All participants who completed a dental examination received a small gift of a toothbrush, fluoride toothpaste and denture cleaning tablets.

6.2.5 Ensuring consistency among dental examiners

In order to minimise the potential for variation among multiple examiners in their diagnostic and coding criteria and recording of oral health indices, the following strategies were adopted:

- All examiners were given a survey manual describing the examination protocols, with simple and clear codes for each component of the examination
- All examiners attended a one-and-a-half day training and calibration course run by the lead examiner, and
- The gold standard examiner recalibrated each dentist on their first day of data collection.

To measure the consistency among the dental examiners, the gold standard examiner conducted replicate examinations for 4–5 participants per examiner, in order to check the consistency of their examinations.

6.2.6 Replicate examinations

The gold standard examiner conducted 'masked replicate' dental examinations of participants. Participants were examined on two separate occasions, once by the dental examiner and once by the gold standard examiner, so as to (i) reduce the burden on the participant, and (ii) ensure the gold standard examiner recorded her findings without being aware of the findings recorded by the examining dentist. A trained recorder worked with the gold standard examiner throughout the replicate examinations. Replicate dental examinations were conducted with all dental examiners. The complete examination procedure was followed for the replicate examinations with the exception of the debris coding of the Simplified Debris Index. Where the gold standard examiner thought the participant was becoming overburdened, only one arch or quadrant was examined.

Inclusion criteria for replicate dental examination participants:

- Dentate with a minimum of five teeth
- Ability to consent for themselves (that is, they did not require proxy consent), and
- They had been examined by the survey dentist within one month prior to the replicate examination.

Eligible participants were contacted and asked whether they would consider participating in another dental examination. Participants were offered a $30 gift voucher for participating in a second exam. Replicate dental examinations were conducted according to the examination procedure and protocol described previously. Prior to the examination, the gold standard examiner explained the reasons for conducting another dental examination, thanked the participant for agreeing to be re-examined, obtained their full medical history, and the participant's written consent.

6.2.7 Dental examiner reliability

The reliability of each dental examiner, relative to the gold standard examiner, was measured by calculating the intra-class correlation coefficient (ICC) and kappa statistics. The ICC is a measure of how well the dental examiner's results match the gold standard examiner's results. Guidelines for interpreting the resulting kappa statistic propose that values of 0.8–1.0 represent 'almost perfect' agreement, 0.6–0.8 show 'substantial' agreement, 0.4–0.6 show 'moderate' agreement, and 0.2–0.4 show 'fair' agreement (Landis and Koch 1977).

Replicate pairs of examinations were conducted with 107 survey participants in order to assess the reliability of the 21 original examiners. The number of replicate pairs of examinations ranged from three to seven per examiner. Every effort was taken to obtain at least four replicate dental examinations per examining dentist. Reliability data for most aspects of the examination were based on person-level summary indicators (such as the number of missing teeth). Additionally, reliability was measured for coding of decayed, missing or filled status of 2,376 teeth.

The highest levels of agreement were found for the following indicators: number of teeth present, number of teeth missing due to pathology, and number of decayed, missing and filled teeth, per person (Table 4). There was very good agreement for all other indicators measured (reflected in ICCs of 0.78 or greater). Overall, these data showed high levels of agreement between the team of examiners as a whole, and the gold standard examiner.

Table 4 presents the differences in means between the examiner team collectively and the gold standard examiner. If the examiner team was biased (that is, they tended to under-report issues of dental concern), then the differences would be large and would tend to be either all positive or all negative. Instead, the differences in means show that, on some measures (root decay/fillings), the team reported marginally more dental issues, and, on other measures (coronal decay),

marginally fewer. In all cases, the differences were small, indicating that the examination team was not over- or under-reporting to any great extent relative to the gold standard examiner.

Table 4 also presents the percentage of cases where the pairs of results matched exactly, and where the pairs of results were close (i.e. within 1 tooth/surface of each other). The measures with lower corresponding levels were decayed and filled coronal surfaces; and decayed, missing or filled teeth. However, the discrepancies were generally small. Overall, the findings show that the dental examiners' data closely matched those of the gold standard examiner.

Table 4 Inter-examiner reliability

Index	Number of examiners evaluated	Number of replicate pairs evaluated	Overall team reliability score	% of pairs where exact match with gold standard examiner	% of pairs where difference <=1	Difference in pair means	Relative difference (as % of gold standard mean)
Number of teeth present per person	18	107 people	1.00	96%	96%	-0.09	-0.3
Number of missing teeth due to pathology per person	18	107 people	1.00	90%	95%	-0.01	-0.3
Number of filled coronal surfaces per person	18	107 people	0.98	54%	87%	0.17	2.4
Number of decayed, missing or filled teeth per person	18	107 people	0.99	63%	85%	-0.04	-0.3
Number of decayed coronal surfaces per person	17	107 people	0.89	71%	90%	-0.20	-16.0
Number of decayed root surfaces per person	15	62 people	0.98	91%	93%	0.02	4.7
Number of filled root surfaces per person	15	62 people	0.78	86%	100%	0.04	11.3
Decayed, missing or filled status of teeth	19	2,376 teeth	0.94[a]	96%	–	–	–

a Reliability refers to intra-class correlation coefficients (ICC), except for decayed, missing and filled status, where the kappa statistic is presented.

7 Response Rates

The main measure used to assess the overall quality of a survey is the final response rate. The response rate is a measure of how many people who were selected to take part in the survey actually participated. A high response rate means that the survey findings are more representative of the New Zealand population.

A total of 1,120 people living in residential care and 1,098 people receiving home-based personal care completed the 2012 OPOHS interview. This translates to an unweighted interview response rate of 70.0% in the RC sample and 80.4% in the HB sample. The interview response rate is expressed as the number of older adults who completed the interview, divided by the number of eligible older adults selected for the survey. The main reasons for the lower interview response rate in the RC sample were: (i) the difficulty in obtaining consent for the Study when the potential participant was unable to provide informed consent for him/herself; and (ii) the burden of the study procedures for often very frail older people (who were more likely to be living in a residential care facility than to be living in their own home).

A total of 987 people living in residential care and 895 people receiving home-based personal care took part in the follow-up dental examination. This translates to an unweighted exam response rate of 88.1% in the RC sample and 81.5% in the HB sample. The exam response rate is expressed as the number of older adults who took part in a dental examination, divided by the number of older adults who completed the interview.

Table 5 depicts the unweighted interview and exam response rates, and the interview decline and non-contact rates, for each population group within residential care and home-based settings.

Table 5 Response rates by demographic group

Population Subgroup		*Setting*							
		Residential Care				*Home-Based*			
		Interview response rate (%)	*Interview decline Rate (%)*	*Interview non-contact rate (%)*	*Exam response rate (%)*	*Interview response rate (%)*	*Interview decline Rate (%)*	*Interview non-contact rate (%)*	*Exam response rate (%)*
All		70.0	20.4	9.6	88.1	80.4	12.9	6.7	81.5
Sex	*Women*	68.9	21.5	9.5	88.6	79.8	13.5	6.7	78.9
	Men	72.6	17.8	9.6	87.2	81.7	11.6	6.7	86.8
Age group	*65–74*	73.9	18.3	7.7	86.8	87.6	8.1	4.3	80.0
	75–84	74.9	16.5	8.6	88.1	74.2	16.1	9.7	83.6
	85+	65.7	23.6	10.6	88.4	83.4	11.7	4.9	80.3
Ethnic group	*Māori*	73.6	14.7	11.7	88.4	80.4	11.0	8.6	80.2
	Pacific	69.7	23.6	6.8	90.3	70.5	15.8	13.7	82.6
	Asian	93.5	3.2	3.2	80.0	90.0	4.0	6.0	87.0
	Other	69.2	21.1	9.7	88.2	80.8	13.3	5.9	81.6

Population Subgroup		Setting							
		Residential Care				Home-Based			
		Interview response rate (%)	*Interview decline Rate (%)*	*Interview non-contact rate (%)*	*Exam response rate (%)*	*Interview response rate (%)*	*Interview decline Rate (%)*	*Interview non-contact rate (%)*	*Exam response rate (%)*
NZSEI	*1 (least deprived)*					92.5	6.2	1.4	83.2
	2					85.4	9.5	5.0	82.6
	3					84.8	11.3	3.9	74.9
	4					85.4	11.0	3.6	81.2
	5 (most deprived)					83.5	11.4	5.1	83.5

8 Weighting

Survey 'weights' are used in analyses so that estimates of population totals, averages and proportions can be said to be representative of the total population that is being investigated. Survey weights can be thought of as the number of population members represented by each survey participant. Using weights in analyses ensures that no population group is under- or over-represented in estimates from the survey.

All data presented in the report *Our Older People's Oral Health: Key Findings of the 2012 New Zealand Older People's Oral Health Survey* (CBG Health Research 2015) were weighted in order to be representative of the two populations – older people aged 65 years and over living in residential care, or older people aged 65 years and over living in the community and receiving home-based personal care.

The procedure to calculate the survey weights for the 2012 OPOHS was different for each of the two target populations. Weights were not calibrated to the demographic profile of the two populations of respondents. The weights were simple selection weights.

8.1 Residential care facilities

The weight assigned to participants living in RCFs was calculated as the reciprocal of the product of two selection probabilities:

The first probability was the probability that a residential care facility would be selected as a 2012 OPOHS study site. The sample of residential care facilities was drawn "probability proportional to size", so this probability was the number of residents in the facility divided by the total number of residents in facilities having 10 or more residents. The "size" variable was constructed with a weighting of 3 for people of Māori of Pacific ethnicity.

The second probability was the probability that a person would be selected in each facility. As all Māori and Pacific residents were selected, the probability of selection for these groups was 1. For the residents of other ethnicity, the probability of selection was calculated as the number of residents of "Other" ethnicity that were selected, divided by total number of residents of "Other" ethnicity.

8.2 Home-based

For the home-based sample, weights were the reciprocal of the probability of selection. The probability of selection was calculated from the single list of all recipients of home-based personal care. This list was updated monthly.

9 Sample Size Design Effects

A total of 2,218 older New Zealanders participated in the interview component of the 2012 OPOHS, and 1,882 were dentally examined. Using total response ethnicity, the sample included 226 Māori, 141 Pacific, 76 Asian and 1,813 European/Other adults aged 65 years and over. A total of 1,120 people living in residential care participated in an interview, and 987 had a dental examination. A total of 1,098 people receiving home-based personal care completed an interview, and 895 participated in a dental examination.

The samples and the demographic profile of the sampling frames are shown in Tables 6 and 7, in addition to the "design effect" (DEFF) measures. The design effect is a measure of the net effect of a complex survey design, and is explained in more depth following the tables. The DMFT: decayed (D), missing due to pathology (M), and filled (F), teeth (T), is an example of a design effect in this Study. This measure is known as the DMFT index (World Health Organization 1997). The index is cumulative, which means that an individual's DMFT score cannot decrease over time. The number of decayed, missing or filled teeth (or surfaces of teeth) reflects a person's lifetime experience of dental decay.

Table 6 Sample size numbers and design effects for older adults aged 65 years and over living in aged residential care facilities, for the 2012 OPOHS, by demographic group

Location: Residential Care	Number interviewed	Number dentally examined	Example design effects (DEFFs)		
			Number of teeth	Usually visit dentist for check-up	DMFT
All	1,120	987	1.5	1.9	1.2
Women	761	674	1.3	1.7	1.2
Men	359	313	1.4	1.2	1.0
65–74 years	129	112	1.2	1.5	1.2
75–84 years	446	393	1.1	1.4	1.1
85+	545	482	1.3	1.4	1.1
Māori	95	84	1.2	0.7	2.4
Pacific	72	65	2.3	1.3	1.8
Asian	30	24	1.1	1.3	1.4
European/Other	936	826	1.3	1.6	1.1
NZSEI					
1 (least deprived)	223	193	1.5	1.4	1.2
2	237	208	1.1	1.2	1.1
3	158	132	1.4	1.3	1.4
4	201	179	1.3	1.6	1.0
5 (most deprived)	204	184	1.8	1.3	1.2
NA	97	91	-	-	-
Dependency status					
Hospital care	491	429	1.1	1.7	1.3
Nursing home	436	397	1.2	1.9	1.0
Psychogeriatric/Dementia	193	161	1.8	1.4	1.5

Table 7 Sample size numbers and design effects for older adults aged 65 years and over living in the community and receiving home-based support, for the 2012 OPOHS, by demographic group

Location: Home Based	Number interviewed	Number dentally examined	Example design effects (DEFFs)		
			Number of teeth	Usually visit dentist for check-up	DMFT
All	1,098	895	1.3	2.8	1.2
Women	733	578	0.8	2.4	1.1
Men	365	317	1.0	1.5	1.8
65–74 years	205	164	1.5	1.3	1.5
75–84years	415	347	1.0	1.9	0.8
85+	478	384	0.6	2.0	0.8
Māori	131	105	0.6	1.9	1.6
Pacific	69	57	1.0	0.7	1.8
Asian	46	40	1.5	2.1	0.9
European/Other	877	716	1.3	2.2	0.9
NZSEI					
1 (least deprived)	226	188	0.7	0.8	1.2
2	270	223	1.2	1.4	0.6
3	191	143	1.5	1.9	0.5
4	207	168	1.1	2.3	1.3
5 (most deprived)	188	157	1.7	1.8	1.1
NA	16	16	-	-	-

The “design effect” (DEFF) is the ratio of the variance (a measure of precision) of an estimate achieved by a complex design, relative to the variance of the same estimate that would be achieved by using a simple random sample of the same size. The closer the design effect is to 1, the closer the design is to simple random sampling. Design effects of between 2 and 4 are typical in population health studies; these mean that the variance is larger than would have been obtained using a simple random sample. Even though the design effect is greater than 1, it does not mean that a simple random sample should be used, because this design would be prohibitively expensive and inefficient. A complex design is less precise than a simple random sample with the same sample size, but it is much more precise than could be achieved by a simple random sample with the same budget.

Nevertheless, design effects should not be too large. In particular, it is appropriate for weights to differ across the sample; for example, to increase the chance of selecting Māori, Pacific and Asian peoples in the sample. However, if the variation in weights is too extreme, the design effect will be very large, which would be counter-productive for all statistics (even for Māori and other sub-population groups). The best statistical methods available for sampling sub-populations were used to ensure that the designs of the 2012 OPOHS were appropriate for achieving adequate precision for national population estimates within the survey budget.

10 Sampling and Non-sampling Errors

As a signatory to the Protocols of Official Statistics (Statistics New Zealand 2007), The Ministry of Health and CBG Health Research Ltd have used best-practice survey techniques throughout the 2012 OPOHS. Many steps have been taken to ensure the data collected are of high quality and robust to the greatest extent possible. One of these steps was to establish an external technical advisory group to direct questionnaire and dental examination content.

Peer review of the sample design and this report was undertaken by the Health and Disability Intelligence unit at the Ministry of Health and has contributed to the high quality of the survey.

However, readers should be aware that errors can arise due to sampling (selection of only some people in a population) and for other reasons (referred to as non-sampling errors). The quantification of sampling errors and the prevention of non-sampling errors are discussed below.

10.1 Sampling error

Sampling error results from selecting a sample to represent the entire population, and is influenced by the complex design of the survey (with the result that some people have a higher chance of selection than others). That is, the estimates in this survey may differ from those results that would have been produced if all the information had been obtained for all people in the population.

If multiple survey samples were obtained, even at the same time, they would provide results that differed. The 95% confidence interval is the interval that would be expected to contain the true population value 95% of the time if many samples were taken. The difference between two estimates is said to be statistically significant at the 0.05 level if the difference is of a magnitude that would be unlikely to occur by chance (5% probability or less). When the confidence intervals of two groups do not overlap, the difference in rates between the groups is statistically significant at the 5% level (p-value < 0.05).

It should be noted that the confidence interval is influenced by the sample size of the group: when the sample size is small, the confidence interval is wider.

Sampling errors were calculated using SAS proc surveyfreq and Sudaan procedures for estimating rate differences and rate ratios. Estimates and sampling errors were also checked independently using an alternative estimation technique (Generalised Estimating Equations).

10.2 Non-sampling errors

Non-sampling errors may occur in any enumeration, regardless of whether it is a sample or a full enumeration. Possible non-sampling errors include coverage errors, response bias and measurement errors. Although these elements cannot be measured, it is useful to be aware of them when interpreting the results of the survey. Significant effort has been made to reduce non-sampling errors by carefully designing and testing the survey, questionnaire and processes, and ensuring quality control of procedures and data.

Response bias may have occurred if there was differential non-response; that is, if the survey was less likely to be answered by certain people, such as a certain population group (e.g., males) or people who are not often home. The interview introduction was an important part of trying to ensure that all people who were selected, took part in the survey.

Measurement errors might also have occurred in this survey. Some of the analyses in this report used self-reported information, which may be inaccurate. Measurement errors include recall error, under and over-reporting (which may be influenced by the participant's perception of what is socially desirable) and item non-response (if the participant does not answer certain questions). Many of the survey findings are based on the assumption that participants could accurately recall previous events and that they provided correct information.

In some cases, the survey was completed with assistance from a proxy. It is possible that their recall and knowledge about the person they were answering on behalf of, also lead to reporting errors.

A range of steps were taken to try to minimise recall and other reporting errors, including pre-testing, and the use of questions that had been validated elsewhere.

As discussed in Section 6, the inter-examiner reliability in the 2012 OPOHS was shown to be sufficient, and therefore there is unlikely to be a large amount of measurement bias in the clinical analyses.

10.3 Small sample sizes

Small sample sizes can affect both reliability and confidentiality of findings. Problems with reliability generally arise when the denominator (the number of people in the sample for a population group) is small, and consequently random variation is high, resulting in estimates that might differ substantially if the survey was repeated. Problems with confidentiality can occur when it becomes possible to identify an individual, usually someone in a sub-group of the population within a small geographic area.

To ensure that the survey data presented were reliable, and to protect the confidentiality of the participants, data has been presented only when the sample size in the denominator was at least 30. In most cases, this meant presenting the data in a sufficiently aggregated form, and in a small number of cases, this meant suppressing results for some cells in individual tables. Care was taken to ensure that no participant can be identified in the results.

11 Analysis and Interpretation

The report *Our Older People's Oral Health: Key Findings of the 2012 New Zealand Older People's Oral Health Survey* (CBG Health Research 2015) presents key findings from the 2012 OPOHS. This section outlines some of the techniques used to analyse the survey data for the report and also provides some notes that may be of use to readers when interpreting the findings. Wherever possible, the methodology of the 2009 NZOHS has been followed in analysing the findings from 2012 OPOHS.

11.1 Introduction to prevalences and means

As in the 2009 NZOHS, many key findings are presented as prevalence estimates and means. Prevalence estimates provide estimates of the proportion of people with a defined outcome, within a defined population. Means are generally presented as the mean number per person; for example, the mean number of decayed teeth per person.

Prevalence and mean estimates are provided for the total population of older adults aged 65 years and over living in residential care, or in the community and receiving home-based personal care. These estimates are also provided for both RC and HB samples by age group, and for other population groups, including ethnic group, and SES quintiles. Additionally, for older people living in residential case, prevalence and mean estimates are provided for dependency status. These unadjusted prevalences and means, give an indication of the burden of oral health outcomes in these population groups and subgroups.

When interpreting the findings in *Our Older People's Oral Health: Key Findings of the 2012 New Zealand Older People's Oral Health Survey* (CBG Health Research 2015) report, it is important to note the denominator – that is, the population for which the indicator is presented. For example, in the report, dental examination results were reported in some indicators for all adults, whether they had natural teeth or not, and for other indicators, results were only reported for older adults who had at least one natural tooth (i.e. dentate older adults). Additionally, periodontal results were estimated only for adults who were periodontally examined. Therefore, these results do not represent older people with existing health conditions, including people who must always take antibiotics before they visit a dentist, people who have ever been told they have a heart problem (excluding a heart attack), people who have ever had rheumatic fever, people who have had a hip or knee replacement in the six months prior to the survey, and people who are immune-suppressed or who are on immune-suppressant therapy.

11.2 Comparative measures

To help answer comparative questions such as, 'Do men have a higher prevalence of untreated decay than women?' two types of measures were presented in *Our Older People's Oral Health*: rate ratios and rate differences (and the equivalent measures for means, that is, ratios of means and differences of means). Rate ratios give a measure of relative difference in burden for the group of interest, while rate differences give a measure of the absolute difference in burden. These measures were adjusted for possible confounding factors, discussed in Section 11.5.

Rate ratios and rate differences complement each other and give different perspectives on the difference between the two groups with respect to the outcome measure. For example, a 20% rate difference (men = 40%, women = 20%, difference = 40% – 20% = 20%) can be interpreted as placing a much higher burden on men than a 1% rate difference (men = 2%, women = 1%,

difference = 1%), even though in both examples the risk is twice as high for men as it is for women (that is, the same rate ratio of 2.0).

11.3 Rate ratio and ratio of means

A **rate ratio** is a ratio of the prevalence estimates between two population groups. Similarly, the **ratio of means** is the ratio of the means of two population groups.

Rate ratio = (prevalence in group of interest) ÷ (prevalence in reference group)

Ratio of means = (mean in group of interest) ÷ (mean in reference group)

All the comparisons in this report refer to a 'group of interest' compared with a 'reference group'. For example, men are compared with women, and Māori are compared with non-Māori. Rate ratios (and ratios of means) can be interpreted in the following ways:

1. A value of 1 shows that there is no difference between the group of interest (e.g. men) and the reference group (e.g. women)
2. A value higher than 1 means that the result is higher for the group of interest than for the reference group
3. A value lower than 1 means that the result is lower for the group of interest than for the reference group.

11.4 Rate difference and difference in means

The **rate difference** is a measure of the difference in prevalence estimates between the group of interest and the reference group. It can be referred to as the **percentage point difference***.* Similarly, the **difference in means** is a measure of the difference in estimates of the means for two groups.

Rate difference = (prevalence in group of interest) – (prevalence in reference group)
Difference in means = (mean in group of interest) – (mean in reference group)

It should be noted that in a few cases the rate difference is statistically significant (noted with an asterisk *), while the rate ratio is not, for a particular comparison. This situation may arise when both the rate difference and rate ratio are close to the cut-off of statistical significance.

11.5 Adjustment

A further consideration is the selection of possible confounding factors to adjust for in comparisons. Confounding can occur when two population groups have different distributions of other factors (such as age), which are themselves associated with the health outcome but are not on the causal pathway. Adjusting for potential confounding factors makes comparisons more accurate and meaningful, because the adjustment removes their effect.

Confounding factors include age and sex, which are important and fundamental determinants of health. Populations with different age structures (such as men and women, whose age structure differs because women have a longer life expectancy) may have differences in rates simply because of their age differences. Hence, when comparing population groups such as men and women, it is useful to remove (or adjust for) the effect of age, to be able to see whether the differences between men and women go beyond what can be explained by age effects. Similarly,

the Māori population is generally younger than the total New Zealand population, and it is therefore important to adjust for age when comparing Māori and non-Māori.

Both comparative measures in this report are based on adjusted prevalences (or means) for the group of interest and reference group. They are a form of direct adjustment, which is calculated in two steps, described below.

1. A model is fitted to the data (a logistic model for indicator variables, and a log-linear regression model for count variables, such as the counts of teeth).
2. The parameters of the model are used to estimate a prevalence (or mean) for a population that matches the target population with respect to the other adjustment factors in the model (for example, age), except that everyone belongs to the group of interest (for example, everyone is male).

Once the adjusted prevalences (for the group of interest and the reference group) are estimated, the ratio or difference between them is calculated to provide the comparative measures. When these are presented in the report, the adjustment factors that have been used in the model are always listed.

In the report *Our Older People's Oral Health,* in terms of the comparison presented between men and women (which is adjusted for age), the resulting rate ratio is essentially an age-standardised rate ratio (SRR). The rate ratios are presented in this more general framework so that it is easy to adjust for more than one factor at a time.

11.5.1 Choice of adjustment factors

The comparisons and adjustment factors used in this report are presented in Table 8.

Table 8 Adjustment factors used in analyses

Comparisons	Adjustment factors
Residential care and home-based	Age group, sex and ethnicity
Men and women	Age group
Māori and non-Māori	Age group and sex
Pacific peoples and non-Pacific peoples	Age group and sex
Asian and non-Asian	Age group and sex
Age 85+ and age <85	Sex and ethnicity
Lower SES and higher SES	Age group, sex and ethnicity
Dental visit in previous year and no dental visit in previous year	Age group, sex, ethnicity and SES
Highest dependency level and other	Age group, sex, ethnicity and SES

The choices of adjustment factors used in the comparative analysis in this report are relatively consistent with standard practice for the descriptive analysis of national health-related surveys. However, it is noted that a variety of possible approaches to the selection of adjustment factors could be taken; the availability of the survey unit record dataset for researchers means that other approaches can always be explored in subsequent projects.

The selection of adjustment factors used in this report is based on the following logic:

- Results generally adjust for age group and sex, because these are such fundamental determinants related to most health outcomes.
- When assessing the impact of socioeconomic status, SES (using NZSEI), results are also adjusted for ethnic group. Generally, the strength of the association between ethnicity and NZSEI means that ethnicity will act as a confounding factor when assessing the effect of NZSEI on health outcomes. Hence, to compare low and high socioeconomic deprivation, results are adjusted for age group, sex and ethnic group. Although ethnic groups based on total response were used as the basis for reporting ethnicity in the report, a prioritised ethnic group variable was used as an adjustment variable in models because it was simpler to include in the regression model, and is a very good approximation of using a full set of total response ethnic group indicators as adjustment factors in a regression model.
- For the two final groups compared in this report, results were adjusted for age, sex, ethnicity and NZSEI.

12 Data Processing

This section outlines the processes used to collect, check and output the data for the 2012 OPOHS. This includes how the data was coded, and how the privacy of the participants' information is secured.

12.1 Capture

The 2012 OPOHS questionnaire was developed by CBG as a Microsoft Word document. This was then converted into a series of web pages using CBG's survey software, based on modified output from the 'The Survey System' survey software package. The survey was administered as a series of web pages linked to a survey database unique to each tablet computer.

The completion date of the survey and survey timing data were recorded automatically in the survey database, as was the duration of the time spent answering each survey question.

Examination findings were recorded directly into a Microsoft Access database application supplied by Adelaide Research and Innovation, Adelaide University. This was a modified version of the application used for recording examination findings in the 2009 NZOHS.

At the end of each day, or more frequently in some cases, study data were encrypted and uploaded to the CBG datacentre. Uploaded data files were decrypted and checked as soon as they were received.

All data processing, cleaning and subsequent analysis was undertaken in SAS 9.3.

12.2 Coding

Most of the questions used single-response options. However, some questions allowed for multiple responses to be selected. For these questions, all responses were retained, with each response shown as a separate variable in the data file.

In the dental examinations, codes were called by the dental examiner and were recorded by the dental recorder.

12.3 Security of information

Any information collected in the survey that could be used to identify individuals has been treated as strictly confidential. Data were transferred from each interviewer's tablet computer to the CBG datacentre by a secure Internet upload facility.

Names and addresses of people and households who participated in the survey were not stored with response data. Unit record data were stored in a secure area and were accessible only on a restricted basis.

12.4 Checking and editing

CBG undertook routine checking and editing of the data throughout the field period of the 2012 OPOHS. In addition, the final unit record datasets provided to the Ministry of Health have been edited for range and logic.

12.5 Imputation

No explicit unit record or item imputation was used in the survey to deal with either unit or item non-response.

12.6 Creation of derived variables

A number of derived variables have been created in the 2012 OPOHS dataset. Where possible, standard definitions have been used.

For more information on the derived variables in the 2012 OPOHS, refer to the confidentialised unit record file (CURF) documentation, including the data dictionary, which describes all variables in the dataset.

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