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Aboriginal and Torres Strait Islander oral health and its impact among adults: a cross-sectional study

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Competing interests

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ABSTRACT

Background: Robust oral health epidemiological information for Aboriginal and Torres Strait Islander adults is scant. Set within a large urban population, this study describes self-reported oral health behaviours, status and impact assessed through computerised Health Checks (HCs), stratified by age groups and sex, and identifies associations with dental appearance satisfaction.

Methods: A cross-sectional study of Aboriginal and Torres Strait Islander adults (aged 20+ years) attending the Southern Queensland Centre of Excellence in Aboriginal and Torres Strait Islander Primary Health Care between 1 January 2014 and 31 December 2015 who had HCs and provided research consent.

Results: There were 945 patients, 466 (49.3%) female, with average age of 41.3 years (range: 20, 82 years). Overall, 97.3% owned a toothbrush and 56.2% brushed 2+ times/day. Despite self-reporting a significant oral health burden, only 28.8% visited a dentist within 12 months - mostly due to problems (84.3%). Surprisingly, only 28.4% reported dental appearance dissatisfaction; likely a result of community normalisation whereby people are resigned to poor oral health.

Conclusions: Under-utilisation of dental services remains problematic for Aboriginal and Torres Strait Islander adults. To close the oral health gap, culturally appropriate, acceptable and safe integrated primary health systems, with co-located dental services, demand consideration.

Keywords: Aboriginal and Torres Strait Islander adults, self-reported oral health, service utilisation, public health dentistry, epidemiology.

INTRODUCTION

Oral health is essential to general health and quality of life,¹ yet it is a complex and challenging issue for health systems and services worldwide.^{2, 3} Neglecting population oral health may result in significant deleterious societal consequences; not least being cost and increased clinical demand.² On an individual level, the impact of poor oral health has potentially many physical and psychosocial sequela,⁴ including pain, discomfort, disfigurement, acute and chronic infections, eating and sleep disruption, speech impairment, feelings of psychological distress and social inadequacy, and racism.⁵⁻

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Prior to the 1970s, several localised studies suggested that Aboriginal and Torres Strait Islander (respectfully referred to as Aboriginal hereafter) children had better oral health than their non-Indigenous peers;⁸⁻¹⁰ although, a nation-wide generalisation of this assertion is not without dispute.¹¹ It is now generally recognised that Aboriginal children and adults have poorer oral health, and poorer access to dental care than their non-Indigenous counterparts.¹²⁻¹⁷ Primary reasons for these inequalities include the legacy of colonisation, ongoing discrimination, increasing urbanisation, dietary changes, and adverse intergenerational social and environmental determinants on health.^{11, 18-20} However, robust national epidemiological information on the oral health of Aboriginal adults is relatively scant, despite having national oral health surveys. Failing to stratify and oversample, coupled with the deployment of a landline participant selection protocol, meant that a mere ~83 Aboriginal adults from 5,505 examined were recruited within Australia's most recent National Survey of Adult Oral Health 2004-06.²¹ A sample of this size lacks meaningful statistical precision or power. Instead, most Aboriginal adult epidemiological information is piecemeal, arising from constrained localised studies or convenience samples which potentially yield importantly biased findings that cannot be generalised beyond that sample.^{11, 15-17}

One explanation for the relative paucity of robust epidemiological information is that Aboriginal adults are frequently labelled "hard-to-reach", implying that researcher access problems are to do with the population itself. Instead, it should be the approach of researchers to ensure easy access for all populations who are supportive of participation. As such, alternative and culturally tailored methods might need to be ascertained and employed, even if inconvenient or more expensive to the researcher. Nuanced utilisation of increasingly digitised routinely collected data may also serve to mitigate this information deficit, while also reducing responder burden.²² Aboriginal health assessments, alternatively known as health checks (HCs), may represent one such vehicle.

Annual Aboriginal HCs are funded by the Australian Government, through the Medicare Benefit Scheme, for all Aboriginal peoples.²³ These HCs were intended to increase preventive health opportunities, detect chronic disease risk factors, and reduce inequities in access to primary care.²⁴ Located in Inala, south-western Brisbane, Australia, the Southern Queensland Centre of Excellence in Aboriginal and Torres Strait Islander Primary Health Care (COE) launched computerised Aboriginal child, adult, diabetic, and antenatal HCs in September 2010.²⁵ Approximately 6% of Inala residents self-identify as being Aboriginal, one of the highest proportions in greater Brisbane,²⁶ but the area is also one of the poorest, sitting in the lowest Australian postal area socioeconomic index decile.²⁷ All Aboriginal HCs include information on demography, resilience factors, health risk factors, socioeconomic factors, examination findings, and health interventions – and information is extracted or collected on several hundred variables.²⁵ An ongoing process of improving the clinical relevance and usefulness of the HCs occurs at the COE, including the addition of oral health variables. In 2011, the COE saw 1,909 Aboriginal adults and 861 Aboriginal children as regular patients (defined as those who have consulted with the service at least three times in the preceding two years).²⁵ The COE aims to deliver a HC to all regular patients each year.

Set within the COE, this study aims to describe self-reported oral health behaviours, status and impacts captured through HCs for a relatively large, urban population of Aboriginal adults stratified by age and sex. In an exploratory analysis, this study also aims to identify the relationship between a subset of individuals' demographic, oral health behaviours, and oral health status variables to their dental appearance satisfaction. Dental appearance has significant social and psychological

implications,²⁸ and is an important factor in social interaction, social selection, career aspiration and achievement of individuals.⁴ Perception of dental appearance is influenced by an individual's perception, culture and environment, and is an important determinant of dental treatment seeking behaviour.²⁹ Satisfaction with dental appearance is thus one of the fundamentals of dental care.^{28, 30} This, together with the previous aims, is useful for assessing impact and vital for benchmarking, health promotion, and the appropriate targeting of resources and interventions.

METHODS

Study design

A cross-sectional study.

Participants and setting

Aboriginal adults (aged 20+ years) attending the Inala clinic or the COE satellite clinic in the neighbouring suburb of Carole Park between 1 January 2014 and 31 December 2015 who had at least one HC conducted during the study period, and who consented for their HC records to be used for research purposes.

Instrument

All variables in the computerised HCs are constrained by predetermined parameters including radio buttons, tick boxes, free text, integers or numbers with defined decimal places. A small number of fields, such as age, are automatically calculated from data contained within the practice management software.

Date of birth, sex, and ethnicity are inputted into the patient's medical record by COE administrative staff when the patient is registered on their first visit to the COE. Age is automatically determined by subtracting date of birth from date of visit when the HC is completed. Ethnicity is derived using the single question recommended by the Royal Australian College of General Practitioners, 'Are you of Aboriginal or Torres Strait Islander origin?'³¹ Ethnicity, as elicited by Aboriginal HCs, therefore does not take into account the specific traditional Country or language group with which patients identify. These data automatically populate each new computerised HC for that patient. Education is elicited by the highest level completed, with response options: Year 10 or less, Year 11-12, TAFE; university, not stated, and missing. To enable comparison to Census figures, this was collapsed in the binary categories: Year 11 or more (which included options: Year 11-12, TAFE, university) and Year 10 or less (Year 10 or less). Employment status is elicited over 12 questions (yes, no, missing): employed full-time; employed part-time; voluntary work; unemployed; study full-time; study part-time; carer; home duties; disability pension; other pension; casual; and contract work. Again, to make comparable to Census figures, this was aggregated into four categories: full time employed (if

employed full-time="yes"); part-time employed (if employed part-time="yes" and employed full-time≠"yes"); unemployed (if unemployed="yes" and employed full-time≠"yes" and employed part-time≠"yes") and other (if unemployed≠"yes" and employed full-time≠"yes" and employed part-time≠"yes" and at least one of the remaining variables was indicated with "yes").

Drawing on commonly used definitions, and employed in comparable studies,^{11, 32} two dental service utilisation variables are captured: last visited dental professional (<12 months ago, ≥12 months ago), and reason for visit (check-up, problem). Three dental behaviour variables are captured,^{11, 32} namely: toothbrush ownership (yes, no); usual toothbrush frequency (>1 per day, 1 per day, <1 per day); and usual toothpaste use (>1 per day, 1 per day, <1 per day). Elicited binary (yes, no) self-reported oral health status and impact questions were drawn and adapted from various sources,^{28, 32-34} with the latter partitioned into appearance, pain and function domains. The final satisfaction with appearance of teeth, mouth or dentures question is assessed on a five-point Likert scale, with response options ranging from very satisfied to very dissatisfied.

Procedure

A detailed account of HC procedure and implementation is described elsewhere.²⁵ In brief, when patients present to the COE and are eligible for a HC, they are also invited to consent to the ongoing use of their HC data for research purposes. If they agree, they are asked to sign the paper-based consent form, the research consent box in the computerised HC is checked "Yes" and this populates the relevant "research consent" field in the data extract. Consenting patients do not have to re-sign the consent form each time they return for their annual HC but are asked to give verbal consent. Patients who refuse consent are re-invited at subsequent visits. HCs are conducted by health professionals, and patients are able to seek further elaboration or clarification to questions or wordings that they may be unsure about. Responses are directly entered into a secure electronic database by the person conducting the HC. For research, only patients who have given consent are extracted and included with the research database, with identifying information removed.²⁵ While HC data are inputted by COE clinical staff primarily for clinical purposes, the choice of measured items, digital platform, and accompanying processes were deliberately designed to serve as a dual clinical and research purpose.

Statistical analysis

Our analytic approach and presentation was informed by the STROBE guidelines for cross-sectional studies (www.strobe-statement.org). Computerised HC data were downloaded to Microsoft Excel files by XXX, anonymised and securely transmitted to XXX. These files were imported into the specialist statistical software package SAS version 9.3 (SAS Institute Inc., Cary, NC, USA) for analysis. Data were analysed and presented by age grouping and sex stratifications. In an effort to assess the broad representativeness of the sample, education and employment data from Aboriginal peoples within the greater Brisbane regions captured in the 2011 Australian Census were downloaded from the Australian Bureau of Statistics' TableBuilder website (www.abs.gov.au/websitedbs/censushome.nsf/home/tablebuilder), stratified by the same age and sex grouping, imported into

SAS, and compared. Unadjusted categorical comparisons between groups were made using Fisher's exact test or Pearson's χ^2 test, where appropriate. In the exploratory analysis of satisfaction of dental appearance, bivariable and multivariable main effects ordinal logistic regression models were employed over a suite of demographic, oral health behaviours and oral health status variables. Rather than using the bivariable analyses to screen risk factors, in the spirit of Sun and colleagues³⁵ all candidate variables were included in the multivariable model regardless of their statistical significance. Wald's type III χ^2 test was used to assess variable significance and the maximum-rescaled r^2 estimate was employed to approximate the percent of variance explained. An $\alpha=0.05$ was used to define statistical significance.

Ethics

This study was conducted in accordance with the NHMRC Guidelines for Ethical Conduct in Aboriginal and Torres Strait Islander Health Research³⁶ and the NHMRC National Statement on Ethical Research in Humans.³⁷ Ethical approval was obtained from the Metro South Human Research Ethics Committee (HREC/10/QPAH/242) and community approval was obtained from the Inala Community Jury for Aboriginal and Torres Strait Islander Health Research.³⁸

RESULTS

Participants

Between 1 January 2014 and 31 December 2015, 1,684 Indigenous HCs were conducted at the Inala and Carole Park clinics with adults aged 20+ years. One record was excluded, as the recorded age was erroneously coded as 114 years, leaving 1,683 records. Of these, 1,173 (69.7%) records had consent documented for research use (only 52 (3.1%) records had consent explicitly declined; the remainder had information for this option missing). These 1,173 records were conducted on 945 patients; 717 (75.9%) patients who had one HC and 228 (24.1%) who had two during the study period. The most recent HC data were utilised for this study.

Demographics

Of the 945 consenting patients in the COE sample, ethnic self-identification was Aboriginal for 877 (92.8%), Torres Strait Islander for 29 (3.1%), and both Aboriginal and Torres Strait Islander for 39 (4.1%); 466 (49.3%) were female and 479 (50.7%) male; and average age was 41.3 years (range: 20, 82 years). Stratified by 15-year age groupings and sex, Table 1 gives the number, percentage, and associated 95% confidence interval (CI) of sex, age, and sex by age distributions for the Aboriginal COE sample and those derived from the 2011 Australian Census for the greater Brisbane region.

Compared to Census figures, the COE sample contained a greater proportion of men and women aged 50-64 years and relatively fewer men aged 20-34 years. However, the mean absolute difference between these Census and COE percentages was 3.5%; a difference that is relatively small. Table S1 in the supplementary materials gives education and employment characteristics of

the Aboriginal COE sample and the 2011 greater Brisbane Australian Census respondents, stratified by age and sex. The proportion of female patients with highest educational attainment of Year 11 or higher was greater than that recorded in the Census for all age groups except those aged 65+ years; unlike male patients of all ages, except those aged 20-34 years, who were less likely than their Census counterparts to have attained Year 11 or higher. In terms of employment, both men and women in the COE sample were less likely than their Census counterparts (sometimes considerably less likely) to be in full-time or part-time employment across all age groups, except for men aged 65+ years in part-time employment. Correspondingly, unemployment rates were much higher.

Oral health behaviours

Stratified by age and sex, the distribution of oral health behaviours for the COE sample is presented in Table 2.

In line with oral health recommendations, between 15.4% and 35.5% of patients visited a dental professional within the last 12 month period. Men appeared less likely to attend within this 12 month period (significantly so for those aged 50-64 years; Fisher's exact test $p=0.003$) than their female counterparts. When men did attend, they appeared more likely to consult with a dental problem (significantly so for those aged 35-49 years; Fisher's exact test $p=0.04$) than women. Toothbrush ownership was high across all groups, exceeding 90%, but usage in line with oral health recommendations was more erratic, and a strong sex differential was apparent. Between 41.0% and 71.7% of patients reported a usual toothbrush frequency of >1 per day, with significantly more women reporting this frequency than men in the 20-34 years (Fisher's exact test $p=0.007$), 35-49 years (Fisher's exact test $p=0.003$), and 50-64 years (Fisher's exact test $p<0.001$) age groups. In almost every case of reported usual tooth brushing, tooth paste was invariably used (see Table 2).

Oral health status and impacts

The distribution of self-reported oral health status and impact measures, again stratified by age and sex, appear in Table 3.

Self-reported dental caries experience ranged between 49.2% and 76.4% for the age and sex subgroups investigated. A significant differential was noted in the 20-34 years (Fisher's exact test $p=0.02$) and 35-49 years (Fisher's exact test $p=0.03$) age groups, with women reporting caries more frequently than men. Self-reported dental problems (reported by between 29.6% and 64.6% of patients) and gum problems (reported by between 11.1% and 25.5% of patients) were common, and no significant sex differences within age-groups were noted (all Fisher's exact tests $p>0.05$). Dentures use was significantly associated with age-groups (Fisher's exact test $p<0.001$), but not between sexes within age-groups except for those aged 50-64 years where women reported higher utilisation than men (Fisher's exact test $p=0.01$).

Pain or discomfort in teeth/mouth in the last 6 months was age related (Fisher's exact test $p<0.001$) with those in the 20-34 years age group having the highest proportion indicated (42.1%) and those aged 65+ years having the lowest indication (13.2%). Sex differences within age-groups were also

evident across age-groups (significantly so for those 35-49 years, Fisher's exact test $p < 0.001$; and 50-64 years, Fisher's exact test $p = 0.004$) with females more likely to indicate pain or discomfort than males. Identical patterns were observed when investigating both eating discomfort and sleep disruption due to pain or discomfort variables (except that the latter was non-significant between sexes in the 50-64 years age group, Fisher's exact test $p = 0.13$).

Despite the relatively high level of reported dental problems and pain, only 226 (28.4%) reported being dissatisfied or very dissatisfied with the appearance of their teeth, mouth or dentures. There was no significant difference in the distribution of satisfaction with appearance responses across age groups ($\chi^2_{12} = 17.2$, $p = 0.14$), between sexes (Fisher's exact test $p = 0.31$), or between sexes within age-groups (all Fisher's exact tests $p > 0.05$).

Factors associated with dental appearance satisfaction

Complete valid data were available for 451 (47.7%) patients for variables: sex, age, education, employment status, last visited dental professional, usual toothbrush frequency, dental caries status, dental problem status, denture status, and pain or discomfort in teeth/mouth in last 6 months. A significant difference in the distribution of dental appearance satisfaction was found between those with complete data and those having at least one variable with missing data (Fisher's exact test, $p < 0.001$). Those who were satisfied or very satisfied with their dental appearance were significantly more likely to have missing data than those with very dissatisfied, dissatisfied or neutral responses.

Limiting the COE sample to those with complete data for all candidate explanatory variables, Table 4 includes the estimated odds ratios (ORs) and adjusted odds ratios (aORs), together with associated 95% confidence intervals (95% CIs) from bivariable and multivariable ordinal logistic regression models, respectively, of satisfaction with appearance of teeth, mouth or dentures. Based on Wald's type III χ^2 tests, sex ($p = 0.007$), education complete ($p = 0.009$), usual teeth brush frequency ($p = 0.004$), dental caries ($p < 0.001$), dental problems ($p < 0.001$), and pain or discomfort in teeth/mouth in the last 6 months ($p < 0.001$) were all significant in bivariable analyses, whereas age ($p = 0.63$), employment status ($p = 0.08$), last visit a dental professional ($p = 0.16$) and dentures ($p = 0.09$) were not. However, in the multivariable analysis only, age ($p = 0.03$), education complete ($p = 0.04$), dental caries ($p < 0.001$), dental problems ($p < 0.01$), and pain or discomfort in teeth/mouth in the last 6 months ($p = 0.05$) were significant. This multivariable model explained 32.7% of the variance in dental appearance satisfaction.

DISCUSSION

Within the Aboriginal adult community attending the COE, many engaged in recommended oral health behaviours; although significant sex and age differences were noted, with males and older adults generally less likely to meet these recommended levels. Compared to a similarly aged (mean: 41.3 vs. 39.6 years) and sex distributed (percent female: 49.3% vs 44.2%) convenience sample of 312 Aboriginal adults in the Northern Territory (aged 20+ years),¹¹ the rate of toothbrush ownership was higher in this COE sample, and the daily toothbrush frequency and toothpaste use similar. While room for improvement exists, these observed oral health behaviour rates are encouraging,

particularly amongst younger females, a feature noted previously.²⁸ However, the self-reported oral health status of many COE patients was poor. Consistent with that observed elsewhere,^{21, 34} higher rates of problems were paradoxically reported by women despite their reporting of more protective oral health behaviours. This may reflect adult men's more likely reticence to seek primary health care until it is necessary.³⁹ These statistics represent a large and significant oral health burden for many within the COE population; although it must be noted that the level of missing data was relatively high for some of these variables (ranging from 0.8% to 39.9%). As those who were satisfied or very satisfied with their dental appearance were significantly more likely to have missing data, these missing data may reflect a responder bias – with COE clinicians perhaps less likely to ask the oral health questions asked if patients indicated that they did not have any dental problems.

Dental services appeared under-utilised, and this under-utilisation is likely to contribute to the significant burden. Barriers preventing timely dental treatment lead to a burden of pain, tooth loss and disfigurement. For this COE population, 28.8% visited a dentist within the last 12 months, and the reason for the last visit was a problem for 84.3%; somewhat similar to the 26.8% and 71.1%, respectively, reported in the convenience sample,¹¹ but considerably worse than the 55.2-70.1% and 24.2-46.8%, respectively, reported in the general Australia adult population aged 15+ years.⁴⁰ Identified barriers, such as cost and access, are likely to be primary drivers for these relatively poor utilisation rates.^{18, 19, 28, 40} Only Centrelink Health Care Card holders and Pension Concession Card holders are eligible for public dental services, provided by Queensland Government's Metro South Health (see: metrosouth.health.qld.gov.au/oral-health/eligibility). Otherwise, private payment is required. Such payments can be partially off-set by private health insurance; although few COE patients are likely to have insurance coverage or policy. The Aboriginal and Torres Strait Islander Community Health Service (ATSICHS) located in Woolloongabba (30 minutes by car from Inala, medical transport is not available although accessible via public transport close by) provides a dental service which can be accessed by Aboriginal peoples from anywhere (see: www.atsichsbrisbane.org.au/dental/). However, fees are charged for treatment, even to concession card holders. It is only with pain and discomfort that many Aboriginal adults appear to visit a dental practitioner.

It is surprising that despite the high level of dental issues reported that only 28.4% (30.7% for those aged 20-34 years) of adults here reported being dissatisfied or very dissatisfied with the appearance of their teeth, mouth or dentures. This is higher than the general Australian population, where 22% were "uncomfortable with appearance" of their teeth despite have a considerably better oral health profile.²² In a cohort of 442 Aboriginal young adults (aged 16-20 years), 63.8% were similarly dissatisfied.²⁸ One potential reason for the relatively low levels of dissatisfied or very dissatisfied teeth appearance reported here is the 'community norm' phenomenon, whereby many people have poor teeth and dental appearance and it becomes normalised within that group. Identified risk factors for increased dissatisfaction with dental appearance in our study included adults with dental caries, dental problems, pain or discomfort, and those who completed education of Year 10 or less, but not sex, employment status, last visited dental professional, usual toothbrush frequency, or denture status – factors which have been identified elsewhere.^{28, 29}

While this study had many salient strengths, including its size, population coverage within a defined geographical area, and its associated benefits through the utilisation of computerised HCs,²⁵ it also has important weaknesses. Threats to the study's external and internal validity, together with the

reliance on self-reported oral health information, are arguably the three areas of most potential concern. In terms of external validity, eligible adults were comprised of those who attended the Inala and Carole Park clinics of the COE. While no other Indigenous primary health care service operates in this region, the sampling frame will ignore those who do not seek these primary care services.³⁹ In an attempt to understand this potential bias, comparisons were made to the 2011 Australian Census. The fact that the age and sex distributions were broadly comparable, yet unemployment rates were much higher in the COE sample compared to the greater Brisbane Census figures, suggests that the biases associated with using a COE sampling frame may be relatively small. The internal validity threat arises from the relatively large proportion of missing values for some variables, and that patterns of missing values did not appear to be “missing completely at random”.⁴¹ No doubt through good intentions, some clinicians may be endeavouring to reduce the HC completion burden by skipping questions, after a ‘screening question’. However, this differential question elicitation strategy poses difficulties for the population research purpose of the computerised database at the COE.²⁵ Extra caution may need to be exercised in the interpretation of the results for variables with high-levels of missing data, and for the complete-case multivariable analysis. Lastly, the lack of reliable measures of dental caries experience is a notable limitation. Self-report of these experiences is subject to recall and social desirability biases, and misclassification. Adults may forget or report histories and behaviours in a way they believe to be socially acceptable or appropriate rather than accurate. Misclassification may occur, in particular, with adults with caries being misclassified as being caries-free if they had never visited a dental service and had undiagnosed and untreated caries, had incomplete treatments, or had caries develop since their most recent dental visit. In attempt to mitigate these biases, the COE HC employs standardised questions, where possible. Nonetheless, non-standardised questions, with unknown psychometric properties, are used at times which may introduce important bias. The question ‘do you have dental caries’ is one such example, and would benefit from validation against clinical data. However, the fact that these questions are asked by a health professional, who is able to clarify meaning and wordings, and that the resultant profiles seen here were not dissimilar to those reported elsewhere serves to somewhat alleviate this concern.

Conclusions

Oral health behaviour rates seen within the COE, particularly for the younger adults, are encouraging, but service utilisation and the corresponding oral health burden is concerning – especially if poor oral health and teeth appearance have been normalised as being acceptable. Cost is likely to be a significant barrier, particularly for an economically disadvantaged group with high unemployment levels. However, availability and access to culturally appropriate services is also likely to be a significant contributor. Integration of the health care system, with dental services co-located on-site with other primary health services is seen as ideal,⁴² especially for low-income and uninsured populations.⁴³ Such co-location enhances the opportunity to provide whole-person and integrated care, already seen within this COE with in-house retinal screening,⁴⁴ and psychologist and social worker staff.⁴⁵ Fundamental to this is having a culturally appropriate, acceptable and safe environment.⁴⁶ Results from this, and other localised studies, challenge primary health care organisations, politicians and funders to consider such co-location, together with the infrastructure,

equipment and expertise needs in order to close the oral health gap between Aboriginal adults and their non-Indigenous peers.

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Table 1. Number (n), percentage (%) and associated 95% confidence interval (CI) of sex, age, and sex by age distributions of the Aboriginal COE sample (n=945) and those derived from the greater Brisbane region in the 2011 Australian Census (n=21,643).

	Aboriginal COE			Census		
	n	(%)	(95% CI)	n	(%)	(95% CI)
<i>Sex</i>						
Female	466	(49.3)	(46.1, 52.6)	11,361	(52.5)	(51.8, 53.2)
Male	479	(50.7)	(47.4, 53.9)	10,282	(47.5)	(46.8, 48.2)
<i>Age (years)</i>						
20-34	364	(38.5)	(35.4, 41.7)	9,329	(43.1)	(42.4, 43.8)
35-49	294	(31.1)	(28.2, 34.2)	7,246	(33.5)	(32.9, 34.1)
50-64	226	(23.9)	(21.2, 26.8)	3,803	(17.6)	(17.1, 18.1)
65+	61	(6.5)	(5.0, 8.2)	1,265	(5.8)	(5.5, 6.2)
<i>Female by age (years)</i>						
20-34	183	(39.3)	(34.8, 43.9)	4,670	(41.1)	(40.2, 42.0)
35-49	137	(29.4)	(25.3, 33.8)	3,847	(33.9)	(33.0, 34.7)
50-64	113	(24.2)	(20.4, 28.4)	2,087	(18.4)	(17.7, 19.1)
≥65	33	(7.1)	(6.2, 7.1)	757	(6.7)	(6.2, 7.1)
<i>Male by age (years)</i>						
20-34	181	(37.8)	(33.4, 42.3)	4,659	(45.3)	(44.3, 46.3)
35-49	157	(32.8)	(28.6, 37.2)	3,399	(33.1)	(32.1, 34.0)
50-64	113	(23.6)	(19.9, 27.7)	1,716	(16.7)	(16.0, 17.4)
≥65	28	(5.8)	(3.9, 8.3)	508	(4.9)	(4.5, 5.4)

Note: (95% CI) gives the exact binomial 95% confidence interval for the percentage (%).

Table 2. Distribution of oral health behaviours for the Aboriginal COE sample, stratified by age and sex.

	Total		20-34 years		35-49 years		50-64 years		65+ years	
	female	male	female	male	female	male	female	male	female	male
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
<i>Last visited dental professional^a</i>										
<12 mth ago	1 (3)	1 (2)	5 (33)	4 (3)	4 (3)	3 (2)	3 (3)	1 (1)	4 (1)	5 (2)
≥12 mth ago	3 (3)	0 (4)	5 (.5)	8 (0)	1 (3)	4 (5)	5 (6)	7 (7)	5 (4)	0 (0)
Never	5 (1)	4 (7)		2 (6)	2 (6)	2 (5)	1 (7)	4 (4)	2 (6)	0 (0)
<12 mth ago	2 (6)	3 (7)	1 (62)	1 (6)	7 (6)	9 (7)	6 (6)	8 (8)	2 (8)	2 (8)
≥12 mth ago	6 (4)	0 (2)	0 (.8)	0 (6)	9 (4)	8 (2)	0 (2)	3 (1)	2 (4)	0 (0)
Never	4 (7)	6 (7)	3 (3)	5 (0)	8 (8)	6 (6)	5 (5)	4 (4)	6 (6)	0 (0)
Never	9 (2)	1 (2)	6 (3)	6 (3)	2 (1)	3 (2)	1 (1)	2 (2)	0 (0)	0 (0)
<i>Reason for visit^b</i>										
Check-up	7 (1)	5 (1)	3 (22)	2 (1)	2 (1)	1 (9)	1 (1)	1 (1)	3 (1)	2 (8)
Problem	1 (9)	1 (2)	3 (.9)	5 (6)	1 (8)	2 (1)	4 (6)	2 (2)	1 (1)	0 (0)
Other	3 (8)	3 (8)	1 (77)	1 (8)	9 (8)	1 (9)	7 (8)	8 (8)	2 (8)	2 (9)
Other	0 (0)	5 (7)	1 (.1)	2 (3)	3 (1)	2 (0)	3 (3)	5 (7)	4 (8)	3 (2)
Other	1 (9)	5 (4)	1 (1)	7 (6)	6 (6)	0 (9)	9 (9)	6 (6)	9 (9)	0 (0)
<i>Own a toothbrush^c</i>										
Yes	3 (9)	3 (9)	1 (10)	1 (9)	1 (9)	1 (9)	8 (9)	9 (9)	2 (9)	2 (9)
No	7 (8)	8 (6)	5 (5)	5 (8)	1 (7)	2 (7)	7 (7)	0 (2)	3 (2)	0 (0)
Other	6 (2)	7 (5)	5 (5)	3 (7)	1 (4)	4 (6)	8 (8)	8 (8)	0 (0)	9 (9)
Other	7 (1)	1 (3)	0 (0)	2 (1)	3 (2)	3 (2)	2 (2)	7 (7)	2 (8)	2 (9)
Other	8 (8)	4 (5)	0 (0)	3 (3)	6 (6)	4 (4)	2 (2)	2 (2)	0 (0)	1 (1)
<i>Usual teeth brushing frequency^d</i>										
>1 per day	2 (6)	1 (4)	1 (67)	8 (5)	7 (6)	6 (4)	6 (7)	4 (4)	1 (5)	1 (4)
1 per day	6 (6)	9 (6)	0 (.7)	1 (0)	8 (5)	0 (4)	6 (1)	1 (1)	3 (0)	0 (7)
<1 per day	4 (7)	2 (2)	7 (7)	3 (3)	0 (0)	8 (8)	7 (7)	0 (0)	0 (0)	6 (6)
>1 per day	1 (2)	1 (3)	3 (24)	5 (3)	3 (2)	5 (3)	2 (2)	3 (3)	1 (5)	1 (4)
1 per day	0 (7)	6 (8)	9 (.7)	9 (6)	3 (7)	2 (8)	3 (5)	9 (9)	3 (0)	0 (7)
<1 per day	8 (3)	0 (5)		6 (6)	5 (5)	8 (8)	0 (0)	0 (0)	0 (0)	6 (6)
>1 per day	2 (6)	6 (1)	1 (7)	2 (1)	9 (7)	2 (1)	3 (3)	2 (2)	0 (0)	1 (4)
<1 per day	4 (1)	4 (5)	2 (6)	1 (3)	5 (5)	2 (6)	3 (3)	0 (0)	0 (0)	8 (8)
Other		4 (4)		0 (0)		4 (4)		0 (0)		
<i>Usual toothpaste use^e</i>										
>1 per	2 (6)	1 (4)	1 (68)	8 (5)	7 (6)	6 (4)	6 (7)	4 (4)	1 (5)	1 (4)
<1 per	6 (7)	9 (5)	0 (.6)	0 (0)	8 (5)	0 (5)	6 (1)	1 (1)	3 (0)	0 (5)

day	6	0)	1	9)	9		0)	0)	1)	7)	0)	0)	5)							
1	1	(2	1	(3	3	(23	5	(3	3	(2	5	(3	2	(2	3	(3	1	(5	1	(5
per	0	7.	6	8.	8	.9)	9	6.	3	7.	2	9.	3	5.	9	9.	3	0.	1	0.
day	7	0)	1	7)			9)		5)		1)		0)		0)		0)		0)	
<1	2	(6.	6	(1	1	(7.	2	(1	9	(7.	2	(1	3	(3.	2	(2	0	(0.	1	(4.
per	4	0)	4	5.	2	5)	1	3.		5)	2	5.		3)	0	0.		0)		6)
day			4)				1)				8)				0)					

^aMissing data for 106 (11.2%) and 10 (1.1%) who were not sure when their last visit was; ^bmissing data for 41 (5.0%) from n=819 who reported visiting a dental professional; ^cmissing data for 160 (16.9%) and 1 (0.1%) reported not applicable as they had dentures; ^dmissing data for 132 (14.0%); ^emissing data for 133 (14.1%); 'mth' denotes months.

Table 3. Distribution of oral health status and impact for the Aboriginal COE sample, stratified by age and sex.

	Total		20-34 years		35-49 years		50-64 years		65+ years	
	female	male	female	male	femal	male	femal	male	femal	male
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
<i>Do you have any dental caries?^a</i>										
No	8 (3.8)	1 (4.7)	2 (2.6)	5 (3.4)	3 (3.4)	6 (5.8)	2 (4.2)	2 (3.4)	5 (5.0)	2 (2.8)
Yes	1 (6.8)	2 (5.0)	9 (7.4)	9 (6.0)	5 (6.6)	6 (4.4)	2 (5.8)	4 (6.6)	5 (5.0)	5 (7.1)
<i>Do you have any dental problems?^b</i>										
No	2 (4.0)	2 (4.8)	6 (3.7)	6 (3.4)	5 (4.0)	8 (5.2)	5 (5.5)	5 (4.6)	2 (6.0)	1 (7.0)
Yes	2 (5.6)	2 (5.2)	1 (6.3)	1 (6.6)	7 (5.0)	7 (4.4)	5 (4.5)	6 (5.4)	1 (3.0)	8 (29.6)
<i>Do you have any gum problems?^c</i>										
No	1 (7.9)	2 (8.7)	8 (7.5)	1 (7.7)	6 (7.9)	9 (8.1)	3 (7.4)	4 (8.7)	8 (8.0)	7 (87.5)
Yes	5 (29.3)	5 (18.8)	2 (2.5)	2 (2.7)	2 (2.4)	1 (1.4)	1 (2.5)	1 (1.8)	1 (1.0)	1 (12.5)
<i>Do you have any dentures?^d</i>										

No	2 (7 7 4. 0 6)	3 (8 3 2. 8 6)	1 (9 3 7. 1 8)	1 (9 4 7. 2 3)	8 (8 4 2. 4)	1 (8 1 7. 6 2)	4 (4 5 7. 9)	7 (6 0 6. 0)	1 (3 0 1. 3)	1 (41 0 .7)
Yes	9 (2 2 5. 4)	7 (1 1 7. 4)	3 (2. 2)	4 (2. 7)	1 (1 8 7. 6)	1 (1 7 2. 8)	4 (5 9 2. 1)	3 (3 6 4. 0)	2 (6 2 8. 8)	1 (58 4 .3)

Pain or discomfort in teeth/mouth in last 6 months^e

No	2 (6 3 0. 6 1)	3 (7 2 4. 4 5)	8 (5 4 3. 8)	1 (6 0 1. 2 8)	7 (5 1 9. 7)	1 (7 1 8. 0 6)	5 (6 9 5. 6)	8 (8 8 3. 8)	2 (7 2 8. 6)	2 (96 4 .0)
Yes	1 (3 5 9. 7 9)	1 (2 1 5. 1 5)	7 (4 2 6. 2)	6 (3 3 8. 2)	4 (4 8 0. 3)	3 (2 0 1. 4)	3 (3 1 4. 4)	1 (1 7 6. 2)	6 (2 1 1. 4)	1 (4. 0)

Uncomfortable to eat because of problems with teeth/mouth in last 6 months^f

No	2 (6 4 2. 2 4)	3 (7 2 5. 3 5)	8 (5 6 5. 1)	1 (6 0 6. 8 3)	7 (6 2 1. 5)	1 (7 0 6. 5 6)	6 (6 1 9. 3)	8 (8 8 4. 6)	2 (8 3 5. 2)	2 (91 2 .7)
Yes	1 (3 4 7. 6 6)	1 (2 0 4. 5 5)	7 (4 0 4. 9)	5 (3 5 3. 7)	4 (3 5 8. 5)	3 (2 2 3. 4)	2 (3 7 0. 7)	1 (1 6 5. 4)	4 (1 4 4. 8)	2 (8. 3)

Pain or discomfort in teeth/mouth disrupts sleep in last 6 months^g

No	2 (7 6 6. 6 2)	3 (8 2 5. 9 9)	9 (6 9 8. 8)	1 (7 1 7. 2 2)	7 (7 6 5. 2)	1 (8 1 8. 3 3)	6 (8 7 4. 8)	7 (9 9 2. 9)	2 (9 4 6. 0)	2 (10 5 0.0)
Yes	8 (2 3 3. 8)	5 (1 4 4. 1)	4 (3 5 1. 3)	3 (2 3 2. 8)	2 (2 5 4. 8)	1 (1 5 1. 7)	1 (1 2 5. 2)	6 (7. 1 1) 0)	1 (4. 0 0)	0 (0. 0)

Satisfaction with appearance of teeth, mouth or dentures^h

Very satisfied	1 (3. 3 4)	1 (3. 3 1)	4 (2. 6)	4 (2. 5)	4 (3. 5)	3 (2. 2)	4 (4. 7)	4 (3. 9)	1 (3. 6)	2 (8. 3)
Satisfied	1 (4 5 0. 2 2)	1 (4 9 7. 9 5)	5 (3 9 9. 1)	7 (4 0 4. 3)	4 (3 0 5. 4)	6 (4 1 5. 2)	3 (4 8 4. 2)	5 (5 2 1. 0)	1 (5 5 3. 6)	1 (66 6 .7)
Neither	9 (2 6 5. 4)	9 (2 8 3. 4)	4 (2 1 7. 2)	3 (2 6 2. 8)	2 (2 8 4. 8)	3 (2 1 3. 0)	2 (2 0 3. 3)	2 (2 7 6. 5)	7 (2 5 0)	4 (16 .7)
Dissatisfied	8 (2 7 3. 0)	7 (1 8 8. 6)	3 (2 2 1. 2)	3 (2 5 2. 2)	3 (2 0 6. 5)	2 (2 9 1. 5)	2 (2 1 4. 4)	1 (1 4 3. 7)	4 (1 4 3. 3)	0 (0. 0)
Very dissatisfied	30 (7. 9)	3 (7. 1 4)	1 (9. 5 9)	1 (8. 3 2)	1 (9. 1 7)	1 (8. 1 1)	3 (3. 5)	5 (4. 9)	1 (3. 6)	2 (8. 3)

^aMissing data for 326 (34.5%); ^bmissing data for 8 (0.8%); ^cmissing data for 377 (39.9%); ^dmissing data for 174 (18.4%); ^emissing data for 117 (12.4%); ^fmissing data for 129 (13.7%); ^gmissing data for 213 (22.5%); ^hmissing data for 148 (15.7%).

Table 4. Odds ratios (ORs) and adjusted odds ratios (aORs), together with associated 95% confidence intervals (95% CIs) from bivariable and multivariable ordinal logistic regression models, respectively, of satisfaction with appearance of teeth, mouth or dentures for those with complete Aboriginal COE participant data for all investigated variables (n=451).

	Bivariable OR (95% CI)	Multivariable aOR (95% CI)
<i>Sex</i>		
Female	1 (reference)	1 (reference)
Male	0.6 (0.4, 0.9)	0.8 (0.5, 1.1)
<i>Age (years)</i>		
20-34	1 (reference)	1 (reference)
35-49	1.2 (0.8, 1.7)	1.8 (1.2, 2.9)
50-64	1.3 (0.8, 2.0)	1.1 (0.6, 1.9)
≥65	1.6 (0.6, 4.4)	0.9 (0.3, 2.8)
<i>Education completed</i>		
Year 11 or more	1 (reference)	1 (reference)
Year 10 or less	1.6 (1.1, 2.2)	1.5 (1.0, 2.3)
<i>Employment</i>		
Full-time employed	1 (reference)	1 (reference)
Part-time employed	1.5 (0.7, 3.2)	1.1 (0.5, 2.5)
Unemployed	1.8 (1.1, 2.8)	1.1 (0.7, 1.8)
Other	1.6 (1.0, 2.6)	0.9 (0.5, 1.6)
<i>Last visited dental professional</i>		
<12 mth ago	1 (reference)	1 (reference)
≥12 mth ago	0.8 (0.6, 1.2)	0.9 (0.6, 1.3)
Never	0.3 (0.1, 1.1)	0.7 (0.2, 2.7)
<i>Usual teeth brushing frequency</i>		
>1 per day	1 (reference)	1 (reference)
1 per day	1.6 (1.1, 2.3)	1.4 (0.9, 2.1)
<1 per day	2.2 (1.3, 3.7)	1.6 (0.9, 2.8)
<i>Do you have any dental caries?</i>		
No	1 (reference)	1 (reference)
Yes	4.5 (3.1, 6.6)	2.1 (1.4, 3.2)
<i>Do you have any dental problems?</i>		
No	1 (reference)	1 (reference)
Yes	12.0 (7.3, 19.9)	7.4 (4.1, 13.3)
<i>Do you have any dentures?</i>		
No	1 (reference)	1 (reference)
Yes	1.5 (0.9, 2.5)	1.3 (0.8, 2.4)
<i>Pain or discomfort in teeth/mouth in last 6 months</i>		
No	1 (reference)	1 (reference)
Yes	2.4 (1.7, 3.5)	1.5 (1.0, 2.2)