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Impact of oral disease on quality of life in the US and Australian populations

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Abstract

The US National Health and Nutrition Examination Survey (NHANES 2003–2004) evaluated oral health quality of life for the first time using a previously untested subset of seven Oral Health Impact Profile (OHIP) questions, i.e. the NHANES-OHIP.

Objectives—(i) To describe the impact of dental conditions on quality of life in the US adult population; (ii) to evaluate construct validity and adequacy of the NHANES-OHIP in NHANES 2003–2004 and a comparable Australian survey.

Methods—In the cross-sectional NHANES 2003–2004 survey of a nationally representative sample of US adults ($n = 4907$), prevalence was quantified as the proportion of adults who reported experiencing one or more impacts fairly often or very often within the past year. Construct validity was tested by comparing prevalence estimates across categories of sociodemographic, dental health and utilization characteristics known to vary in oral health. In 2002, Australian cross-sectional survey of a nationally representative sample of adults ($n = 2644$), adequacy of the NHANES-OHIP questions were tested with reference to a slightly modified version of the OHIP-14 questions.

Results—NHANES-OHIP prevalence estimates were markedly similar in the United States (15.3%) and Australia (15.7%). In the US construct, validity was evidenced by higher NHANES-OHIP scores among groups with greater levels of tooth loss, perceived treatment need and problem-oriented visiting and with lack of private dental insurance and low income. In Australia, prevalence for the NHANES-OHIP closely resembled prevalence estimates of the modified OHIP-14. Both varied to a similar degree across levels of tooth loss, perceived treatment need, problem-oriented visiting, and private dental insurance and income, demonstrating adequacy of the NHANES-OHIP as a brief independent instrument.

Conclusions—There was acceptable construct validity and adequacy of the NHANES-OHIP questionnaire. In the United States, the impact of oral disease disproportionately affected disadvantaged groups, a finding that supports application of the US Healthy People 2010 major goals of improved quality of life and reduced health disparities.

Keywords

adults; health policy; health surveys; NHANES; population groups

Health-related quality of life is well established in health services research, health economics and epidemiology. It serves variously as a marker of service need (1), a guide for priority setting (2), an indicator of intervention effectiveness (3), a utility index for economic evaluation (4), an outcome of clinical trials (5) and a health endpoint in its own right. By the year 2000, the scientific literature contained 3921 reports of the development and testing of health quality of life measures (6).

Somewhat at odds with this growth in quality of life research since 1990, the incorporation of quality of life objectives into health policy was tentative. While many countries set national health targets (7–11) and the World Health Organization (WHO) (12) set international ones, none specified quality of life targets. Hence it was a departure from tradition when *Healthy People 2010* aimed, as the first of its two major goals for the US population, ‘to help individuals of all ages increase life expectancy *and* improve their quality of life’ [emphasis in original] (13).

In 2000, the US Surgeon General’s Report on *Oral Health in America* (14) acknowledged the importance of oral health for quality of life in citing more than 170 documents on the subject. Despite the expansiveness of this review, no national survey had evaluated the impact of oral disease on quality of life in the US population. Self-rated assessment of teeth had been measured in the 1988–1994 National Health and Nutrition Examination Survey (NHANES III) with a single question that asked participants, ‘How would you describe the condition of your natural teeth: excellent, very good, good, fair or poor?’ (15) By contrast, national surveys in the United Kingdom (16), Australia (17, 18), Finland (19) and Germany (20) conducted during the last decade measured the adverse impact of oral conditions on well-being using the 14-item Oral Health Impact Profile (21).

The first multi-item assessment of oral health quality of life (OHQoL) in the US adult population was conducted in 2003 when seven questions drawn from the Oral Health Impact Profile (OHIP) (22) were added to the NHANES. The 49-item OHIP (22) and its 14-item short-form (OHIP-14) (21) are the most widely used instruments to evaluate the adverse impact of oral conditions on well-being. Questions ask about the adverse consequences of oral disease and dental conditions on aspects of well-being by measuring function, pain, social interaction and psychological well-being. OHIP questionnaires have been translated into more than 15 languages, including Spanish (23).

The theoretical basis of the OHIP was the 1980 WHO International Classification of Impairments, Disabilities and Handicaps (24) subsequently adapted for oral health (25). Since then, the term ‘quality of life’ has been applied to the OHIP, although there is debate in the literature about whether oral conditions actually affect oral health-related quality of life (26). Indeed, our preferred nomenclature is adverse impacts on well-being, but in this paper, we adopt the term OHQoL term for consistency with the NHANES 2003–2004 data documentation (27).

The psychometric properties of the OHIP-14 are established (21) but the adequacy of the subset used in NHANES, hereafter referred to as the NHANES-OHIP, remains untested. Hence a preliminary aim of this study was to investigate the adequacy of the NHANES-OHIP as an independent subset of the OHIP questionnaire and investigate its construct validity through known group validity among population-groups both in the United States and Australia. The principal aim was to describe the impact of dental conditions on quality

of life in the US adult population as a basis for monitoring progress toward Healthy People 2010 major goals of improvements in quality of life and reducing disparities in health status.

Methods

This study is a secondary analysis of cross-sectional survey data obtained from representative non-institutionalized civilian samples of adults in the United States and Australia.

Sampling and data collection

The US data are from the 2003–2004 cycle of the continuous NHANES (28) that used a multistage clustered stratified probability design to sample 12 761 individuals. Of these individuals, 10 122 (79.3%) aged 2 months or older participated in a household interview conducted face-to-face with a trained interviewer in either English or Spanish. The NHANES-OHIP questions (Table 1) were asked in this interview. Subsequently, 9643 individuals aged 2 years and older (75.6%) attended a mobile examination centre (MEC) for a dental screening and other examinations.

Australian data are from the 2002 National Dental Telephone Interview Survey (NDTIS) (18) that used a stratified random sampling design to select individuals aged 5 years and older. Households were sampled from national telephone listings. Landline numbers are automatically listed on public directories unless householders pay a fee to opt-out. To capture these unlisted numbers, a random integer was substituted to all sampled numbers. One randomly sampled household occupant was interviewed. The participation rate was 64.8% ($n = 7312$). A self-administered questionnaire was subsequently mailed to a sample of adults 18 years of age or older that had completed the telephone interview in person ($n = 4782$). Of these 3131 responded yielding a response rate of 65.5% for the Australian dataset. The questionnaire included the NHANES-OHIP items presented using the same sequence and wording as the NHANES. Those seven questions were supplemented in Australia by the remaining seven items that comprise the OHIP-14. Both national surveys recorded the number of remaining teeth, and information about the use of dental services, perceived need for dental treatment, private dental insurance status and sociodemographic characteristics.

Items and scoring

Only minor wording differences distinguished the seven NHANES-OHIP questions from OHIP-14 questions (Table 1). Responses to questions about the perceived impact of problems with teeth, mouth or dentures over the preceding year were made on a five point ordinal scale coded 0 = never, 1 = hardly ever, 2 = occasionally, 3 = fairly often, 4 = very often. Each theoretical dimension of the OHIP was represented by an NHANES-OHIP question (Table 1). Consistent with previous national surveys using the OHIP-14 (29) we computed two established summary scores for which higher values denote poorer OHQoL.

- *Severity* is the sum of all ordinal response codes. Severity scores have a potential range of 0–28 across the seven item subset and of 0–56 across 14 items.
- *Prevalence* is the percentage of people responding with ‘fairly often’ or ‘very often’ to one or more questions.

While the ‘prevalence’ score evaluates only frequently occurring impacts, the ‘severity’ score, by using all response categories, overcomes limitations inherent in restricting summary scores to an arbitrary threshold.

Inclusion criteria and missing items

Inclusion for analysis was limited to dentate adults aged 18+ years who completed both stages of data collection. In the United States, this resulted in omission of 4502 people aged <18 years, 494 edentulous adults and 84 adults for whom a proxy interview was conducted. An additional omission was of people not classified into one, the four NHANES 2003–2004 major racial/ethnic groups composed of non-Hispanic White, non-Hispanic Black, Mexican American or Other Hispanic ($n = 135$). Thus, the sample size in the United States was 4907. We omitted 424 edentulous adults and a further 63 adults who were missing OHIP data, leaving a sample in Australia of 2644.

For the 0.03% of NHANES-OHIP items with missing values in the United States, the mean sample value for that item was substituted. We did likewise in Australia except where a respondent missed more than one item for the NHANESOHIP (2.0%) or more than two items for the OHIP-14 (1.8%). These individuals were omitted from analysis. These methods are consistent with those used in previous national surveys using the OHIP (29, 30).

Construct validity and adequacy

Since psychometric properties of the OHIP-14 are well established, concerns about validity are limited to construct validity and adequacy. Our approach in evaluating construct validity was based on comparison of mean scores and prevalence estimates across categories of sociodemographic, dental health and utilization characteristics known to be associated with OHQoL. Known group validity assesses ‘the measure’s ability to distinguish reliably between groups of people who should score high on the trait and low on the trait’. (p.14) (31). Our rationale was that variables known to be associated with OHQoL would be significantly related with NHANES-OHIP questions in both populations. Selected population subgroups were classified by: sex (male, female); age group (18–29, 30–49, 50–69, 70+ years); race/ethnicity (non-Hispanic White; non-Hispanic Black; Hispanic, US-born; Hispanic, foreign-born) or country of birth (Australia, Other); household income (tertiles of poverty income ratio in the US dollars and pretax household income categories in Australian dollars: [$<\$30\,000$, $\$30\,000$ to $<\$60\,000$, $\$60\,000$ +]); number of remaining teeth (<20, 20–24, 25–27, 28+), perceived need for a dental filling or extraction (yes/no); private dental insurance cover (yes/no); time since last dental visit (<12 months, 1–5 years, >5 years and never); and main reason for last visit (check-up, exam or clean; problem; other [United States only]). A racial comparison was not possible between nations since indigenous Australians, who comprise <3% of the population, have no meaningful representation in the United States. Instead, for descriptive purposes, we compared Australian-born adults with those born elsewhere as an indicator of ethnic and cultural variation. However, we did not draw inferences about known group validity from these comparisons.

Adequacy of the NHANES-OHIP to represent the OHIP-14 was assessed by comparing scores for the two scales in the Australian survey. Adequacy was confirmed if the direction and magnitude of responses obtained by this subset replicated those obtained by the longer OHIP-14 questionnaire used in Australia.

Statistical considerations

We substituted the Wald test for ANOVA to derive P -values for differences between means since the latter cannot be used for complex survey data. In addition, we quantified the relative effect size between the reference category value and comparison category values as the ratio of net difference between comparisons groups divided by the reference category value.

NHANES data were weighted using the 2-year MEC examination sample weight to account for differential probabilities of selection with estimates adjusted for noncoverage and nonresponse. Australian data were weighted to account for sampling probabilities and age and sex characteristics for each of the 13 sampling strata. Data were analysed in STATA 10 (32) using the survey estimation commands to adjust for the complex survey designs.

Results

Comparison of national samples

Samples were representative of their respective populations for demographic characteristics. The mean age of the US sample was 43 years and of the Australian was 44 years. The racial/ethnicity mix in the United States was dominated by non-Hispanic Whites (71.2%) and in Australia by Australian-born people (78.3%). The populations were alike in levels of tooth retention. Perceived need for a dental filling or tooth extraction was higher in the United States (39.1%) than in Australia (30.3%). Approximately, half the population in both countries held private dental health insurance. The samples were also similar with respect to dental attendance: about 60% had last visited a dentist within 12 months and about 57% last visited for a checkup or clean (Results not tabulated).

Two items ranked among the top three in both nations (Table 2): 'Avoided particular foods' (6.1% in the United States, 8.1% in Australia); and being 'Self-conscious or embarrassed' (6.4% in the United States, 6.6% in Australia). Different items were first-ranked but both dealt with pain or discomfort. The US population was approximately half as likely as the Australian to report each item 'occasionally' (Table 2), and were more inclined to report impacts affecting them 'hardly ever' or 'never'. One consequence of the greater tendency to report items 'hardly ever' or 'never' in the United States, is that mean NHANES-OHIP severity scores were lower among Americans (2.81) than Australians (4.90) (Table 3). In turn, the NHANES-OHIP mean severity score (4.9) was lower than the OHIP-14 mean severity score (7.2), a difference that occurs by necessity since the former was based on the sum of seven items and the latter on the sum of 14 items. Yet, prevalence in the United States (15.3%) corresponded closely with that in Australia, regardless of whether the Australian estimate was based on the seven NHANES-OHIP items (15.3%) or all 14 OHIP items (15.7%). That the point prevalence estimate determined by the NHANES-OHIP and OHIP-14 in Australia differed by less than one percentage point, supported the congruency of the subset for assessing prevalence.

Construct validity and adequacy

Testing for known group validity using mean severity scores revealed expected associations that generally were of a similar magnitude between countries, as assessed using the relative effect (Table 4). On average, mean severity scores were significantly higher in both populations among adults with low household income, fewer retained teeth, perceived need for treatment, among adults without private dental insurance and those seeking dental care for a problem rather than attending for a check-up.

Prevalence estimates were markedly similar in both nations using the subset and the full OHIP-14 (Table 5). NHANES-OHIP prevalence estimates differed by 0.4 of a percentage point between the US (15.3%) and Australian (15.7%) populations. In addition, estimates for this subset closely approximated prevalence estimates of the OHIP-14 (16.5%) supporting the adequacy of subset to evaluate that evaluated by the slightly modified OHIP-14. Prevalence did not differ on the basis of age in either population. Compared with prevalence among non-Hispanic Whites (15.1%), prevalence among foreign-born Hispanics was substantially lower (8.6%) representing an effect size of 44%.

The magnitude of the relative effect of income was also remarkably similar using the three scales: prevalence was elevated among the lowest income – relative to the highest income tertile by 114%, 112% and 116% for the US and Australia NHANES-OHIP and the OHIP-14 respectively. As expected, prevalence was greater in both populations among those adults who perceived a need for dental treatments than adults with no perceived need.

Discussion

This study makes two important contributions. As the first analysis of OHQoL in the general US adult population, it joins a small but growing number of countries are capable of reporting OHQoL at the population level. Other countries with equivalent national data are the United Kingdom (16), Australia (17, 18), Finland (19) and Germany (20). Malaysia (33) holds preliminary data for the adult population. The second contribution is confirmation of the adequacy of NHANES-OHIP, as a brief independent scale suitable for use in cross-national comparisons of OHQoL with other surveys using the standard set of OHIP-14 questions.

The strongest evidence for known-group validity was observed using prevalence, a measure that is most likely to be reported in national surveys that often prefer to report percentages because they are widely understood. Although severity scores in the United States were lower than that in Australia, it was notable that most of the known-group comparisons yielded similar relative differences using those severity scores. Lower severity scores in the United States were attributed to a greater tendency of Americans to report impacts ‘hardly ever’ or ‘never’ compared with Australians who showed a greater tendency to report impacts ‘occasionally’. A similar phenomenon was noted in a comparison of OHIP responses in the UK and Australian national surveys, where Australians were more likely to report impacts ‘occasionally’ than were adults in the United Kingdom (29). One possible explanation for this variation is that the different modes of administration of the OHIP questionnaire elicit different responses. In Australia, the questionnaire was self-administered in a pen and paper questionnaire while in the United States and the United Kingdom, the OHIP questions were asked in a face-to-face interview.

This national survey offers insights into population outcomes that may not be apparent in patient samples. For example, an unexpected finding in the United States was the substantial advantage of foreign-born people of Hispanic origin over the majority group – the non-Hispanic White population. This previously recognized relationship (34–36) is counter-intuitive since Latinos have higher rates of poverty, lower levels of educational attainment, greater representation in unskilled occupations and less health insurance coverage, all of which are independent risk markers for poorer health. The finding is not explained by the younger age profile of Hispanics since age was not associated with OHQoL. A second element to this paradox is that the health advantage for foreign-born Hispanic is in sharp contrast to health outcomes for non-Hispanic Blacks. These groups share a similarly poor socioeconomic profile and face similar access barriers to healthcare, yet, non-Hispanic Black has the worst health status of all racial/ethnic groups in the United States. Further research is required to investigate whether the advantage holds for all Latino groups and to establish an explanation for this apparent protective effect, before we can comment on its policy implications for this rapidly growing segment of the population.

Two limitations of this study are the cross-sectional study design and the descriptive nature of the analyses. These constraints mean that caution is required in interpretation. Nevertheless, as the purpose of cross-sectional surveys is to provide prevalence estimates for the study population and to enable the generation of new hypotheses, the design and analyses are entirely appropriate in this first national survey of the impact of oral conditions

on quality of life in the United States. Possibly of greater concern is that two different modes of administration to evaluate OHIP as discussed above. Recent inquiry into the effect of administration mode showed, that at least among older participants, telephone administration yielded more positive health QoL estimates than self-administered questionnaires (37). However, administration mode does not detract from the quality of the NHANES-OHIP as a scale, and does not affect estimates obtained for either country – only their comparisons with each other.

We compared the NHANES-OHIP items in the United States with an identical set of questions *plus* the remaining seven OHIP-14 items in Australia. One caveat to our findings is that this assembled collection of 14 items closely resembled, but was not identical to, the psychometrically tested and validated OHIP-14. While use of these 14 items is defensible in this analysis, we recommend the use of standard OHIP-14 (21) when questionnaires of this length are indicated. When a shorter questionnaire is indicated because of budgetary constraints or respondent burden, the seven NHANES-OHIP items serve adequately as a measure of the adverse impact of oral conditions on well-being. Generally, the benefit arising from a reduction in the number of questionnaire items imposes a cost of reduced validity, but in the case of the NHANES-OHIP items, no loss of validity was evident.

The NHANES-OHIP questions were pilot tested by the National Center for Health Statistics prior to inclusion. It may be unfortunate that OHIP-14 questions #5 and #10 measuring self-consciousness and embarrassment respectively were combined in NHANES-OHIP question QHQ.680 – especially as these represent two separate theoretical OHIP dimensions (psychological discomfort and psychological disability). Nevertheless, expert opinion (38) and empirical evidence (39) now suggest the existence of a more parsimonious set of OHIP dimensions comprising psychosocial impact, orofacial pain, oral functions and social impact. This would counter any concerns about theoretical ambiguity in question QHQ.680.

At first appearance, it might be surprising that while age was a nonsignificant factor, younger age groups reported more frequent impacts of oral health on quality of life. Yet, a similar finding has been reported in other national surveys (30) where it was proposed that historical experiences of birth cohorts altered expectations about oral health, thereby accounting for the observed age-group differences. While that conclusion remains speculative, it highlights the well-known limitation that any single cross-sectional study cannot distinguish between cohort and ageing effects. Hence the current findings should not be interpreted as an indication that ageing somehow attenuates adverse impacts of oral health on quality of life.

This study has implications for the public health and for future studies of OHQoL. Methodologically, the consistency of findings using the OHIP, particularly when quantified as prevalence, provides confidence that OHQoL can be compared between and within populations. The substantive finding that approximately 15% of adults have adverse impacts of oral health on quality of life supports the US Surgeon General's report (14) that drew attention to the importance of oral health for overall health and well-being. Population-groups that are socioeconomically disadvantaged, and that have limited access to dental care, are the same groups found here to have poorer OHQoL. Consistently, those same groups are found to have more severe dental disease when they are examined in national surveys. The value of these findings is in illustrating that oral disease produces substantial suffering and ill-health, particularly for disadvantaged people, in two economically developed nations.

From a policy perspective in the United States, as we look to evaluating progress towards *Healthy People 2010* objectives in improving the quality of life for all Americans (13), it is

critically important that OHQoL be included in national surveys of the nation's health, such as NHANES. This study provides evidence that the NHANES-OHIP is a valid and reliable measure of OHQoL in large population surveys and should continue to be assessed in future surveys to monitor the broad objectives of Healthy People 2010. That the greatest impacts are felt by those of low socioeconomic status and those who cannot access the dental care delivery system reinforces the urgency of addressing these health disparities.

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Table 1

Seven OHQoL items used in the US (2003–2004 NHANES) and Australian survey (2002 NDTIS), and remaining seven OHIP-14 items used in the Australian survey

NHANES item no	Item wording How often during the last year ...	Survey	Corresponding OHIP item no	Theoretical dimension
OHQ.620	...have you had painful aching anywhere in your mouth?	NHANES, NDTIS	No. 3 in OHIP-14 ^a	Physical pain
OHQ.630	...have you felt that life in general was less satisfying because of problems with your teeth, mouth or dentures?	NHANES, NDTIS	No. 13 in OHIP-14	Handicap
OHQ.640	...have you had difficulty doing your usual jobs (or attending school) ^b because of problems with your teeth, mouth or dentures?	NHANES, NDTIS	No. 12 in OHIP-14 ^c	Social disability
OHQ.650	...has your sense of taste been affected by problems with your teeth, mouth or dentures?	NHANES, NDTIS	No. 2 in OHIP-14	Functional limitation
OHQ.660	...have you avoided particular foods because of problems with you teeth, mouth or dentures?	NHANES, NDTIS	No. 28 OHIP-49	Physical disability
OHQ.670	...have you found it uncomfortable to eat any foods because of problems with your teeth, mouth or dentures?	NHANES, NDTIS	No. 4 in OHIP-14	Physical pain
OHQ.680	...have you been self-conscious or embarrassed because of your teeth, mouth or dentures?	NHANES, NDTIS	No. 5 + 10 in OHIP-14 ^d	Psychological discomfort; Psychological disability
	...have you had trouble pronouncing any words because of problems with your teeth, mouth or dentures?	NDTIS	OHIP-14 No. Q1	Functional limitation
	...have you felt tense because of problems with your teeth, mouth or dentures?	NDTIS	OHIP-14 No. Q6	Psychological discomfort
	...has your diet been unsatisfactory because of problems with your teeth, mouth or dentures?	NDTIS	OHIP-14 No. Q7	Physical disability
	...have you had to interrupt meals because of problems with your teeth, mouth or dentures?	NDTIS	OHIP-14 No. Q8	Physical disability
	...have you found it difficult to relax because of problems with your teeth, mouth or dentures?	NDTIS	OHIP-14 No. Q9	Psychological disability
	...have you been a bit irritable with other people because of problems with your teeth, mouth or dentures?	NDTIS	OHIP-14 No. Q11	Social disability
	...have you been totally unable to function because of problems with your teeth, mouth or dentures?	NDTIS	OHIP-14 No. Q14	Handicap

^aThe NHANES OHIP subset uses wording shown in table, whereas the OHIP-14 asks '...have you had painful aching in your mouth'.

^bWords in parentheses used in NHANES only.

^cNHANES-OHIP uses wording shown in table, whereas the OHIP-14 asks '...have you had difficulty doing your usual jobs because of'.

^dNHANES-OHIP combines two items from the OHIP-14, one that asks about being self-conscious and one that asks about being embarrassed.

Table 2

Individual OHIP items reported at different frequency thresholds in the dentate US and Australian populations

Individual OHIP items	Never, hardly ever	Occasionally	Fairly often, very often ^a	
	% (SE)	% (SE)	% (SE)	Rank
USA				
1. Painful aching in mouth	80.4 (0.93)	12.7 (0.66)	6.8 (0.55)	1
2. Life less satisfying	89.7 (0.64)	5.7 (0.39)	4.6 (0.42)	5
3. Difficulty doing usual job	96.5 (0.39)	1.9 (0.24)	1.5 (0.24)	7
4. Taste affected	96.0 (0.41)	2.3 (0.25)	1.7 (0.31)	6
5. Avoided particular foods	84.1 (0.99)	9.8 (0.69)	6.1 (0.68)	3
6. Uncomfortable to eat	83.2 (0.80)	11.2 (0.52)	5.6 (0.52)	4
7. Self-conscious or embarrassed	87.1 (0.79)	6.5 (0.64)	6.4 (0.53)	2
Australia				
1. Painful aching in mouth	74.4 (1.35)	21.0 (1.25)	4.6 (0.70)	5
2. Life less satisfying	81.5 (1.21)	13.2 (1.07)	5.3 (0.67)	4
3. Difficulty doing usual job	94.4 (0.79)	4.7 (0.75)	1.0 (0.29)	7
4. Taste affected	91.2 (0.97)	6.6 (0.83)	2.2 (0.55)	6
5. Avoided particular foods	73.2 (1.37)	18.7 (1.19)	8.1 (0.88)	2
6. Uncomfortable to eat	68.7 (1.44)	23.0 (1.28)	8.3 (0.93)	1
7. Self-conscious or embarrassed	76.6 (1.29)	16.8 (1.17)	6.6 (0.67)	3

^aPresented in rank order of prevalence scores, i.e. percentage of adults reporting one or more items 'fairly often' or 'very often'.

Table 3

Comparison of summary scores in the United States and Australia

	Severity ^a	Prevalence ^b
	Mean (95% CI)	Proportion (95% CI)
US NHANES-OHIP (7 items)	2.81 (2.56, 3.07)	15.3% (13.4, 17.4)
Australia NHANES-OHIP (7 items)	4.90 (4.61, 5.19)	15.7% (13.6, 18.1)
Australia OHIP-14 (14 items)	7.19 (6.70, 7.68)	16.5% (14.4, 18.9)

^aSum of scored responses (potential range 0–28 for 7 items and for 0–56 for 14 items).

^bProportion of respondents reporting one or more items 'fairly often' or 'very often'.

Table 4Mean (SE) severity scores in the dentate US and Australian adult populations^a

	NHANES-OHIP in the United States			NHANES-OHIP in Australia			OHIP-14 in Australia		
	Mean (SE)	Effect	P-value	Mean (SE)	Effect	P-value	Mean (SE)	Effect	P-value
All	2.81 (0.12)			4.90 (0.15)			7.19 (0.25)		
Sex			0.033			0.244			0.503
Male	2.62 (0.17)	Ref		4.72 (0.21)	Ref		7.02 (0.36)	Ref	
Female	2.99 (0.12)	14%		5.07 (0.21)	7%		7.36 (0.34)	5%	
Age group			0.005			0.638			0.558
18–29 years	2.56 (0.15)	24%		5.19 (0.44)	16%		7.66 (0.74)	19%	
30–49 years	3.08 (0.17)	49%		4.88 (0.21)	9%		7.13 (0.35)	11%	
50–69 years	2.86 (0.15)	38%		4.80 (0.20)	7%		7.12 (0.34)	11%	
70+ years	2.07 (0.18)	Ref		4.49 (0.35)	Ref		6.43 (0.55)	Ref	
Race/ethnicity (United States only)			<0.001						
Non-Hispanic White	2.77 (0.15)	Ref		–	–		–	–	
Non-Hispanic Black	3.33 (0.24)	20%		–	–		–	–	
Hispanic, US-born	3.23 (0.23)	17%		–	–		–	–	
Hispanic, foreign-born	1.83 (0.14)	–34%		–	–		–	–	
Country of birth (AU only)									
Australia	–	–		4.72 (0.16)	Ref	0.043	6.93 (0.27)	Ref	0.064
Other	–	–		5.53 (0.37)	17%		8.12 (0.58)	17%	
Income			<0.001			<0.001			<0.001
Low	3.71 (0.23)	72%		6.13 (0.27)	56%		9.25 (0.45)	68%	
Moderate	2.67 (0.11)	24%		5.18 (0.30)	32%		7.77 (0.50)	41%	
High	2.15 (0.15)	Ref		3.93 (0.23)	Ref		5.50 (0.38)	Ref	
Number of remaining teeth			<0.001			<0.001			<0.001
<20 teeth	4.51 (0.27)	106%		7.08 (0.46)	61%		11.08 (0.76)	74%	
20–24	3.17 (0.23)	45%		5.23 (0.44)	19%		7.58 (0.69)	19%	
25–27	2.79 (0.20)	28%		5.61 (0.40)	27%		8.39 (0.68)	32%	
28+	2.19 (0.10)	Ref		4.41 (0.19)	Ref		6.36 (0.31)	Ref	
Perceived need for treatment			<0.001			<0.001			<0.001

	NHANES-OHIP in the United States				NHANES-OHIP in Australia				OHIP-14 in Australia			
	Mean (SE)	Effect	P-value		Mean (SE)	Effect	P-value		Mean (SE)	Effect	P-value	
Need filling or extraction	4.64 (0.20)	190%			6.92 (0.31)	74%			10.23 (0.51)	76%		
Don't need filling or extraction	1.60 (0.08)	Ref			3.98 (0.15)	Ref			5.82 (0.26)	Ref		
Dental insurance			0.002				<0.001				<0.001	
Has private dental insurance	2.44 (0.11)	Ref			4.33 (0.22)	Ref			6.21 (0.35)	Ref		
No private dental insurance	3.14 (0.18)	29%			5.51 (0.21)	27%			8.27 (0.36)	33%		
Time since last dental visit			0.001				0.498				0.511	
Less than 12 months	2.70 (0.14)	Ref			5.04 (0.21)	Ref			7.42 (0.35)	Ref		
One to five years	2.62 (0.15)	-3%			4.73 (0.22)	-6%			6.94 (0.37)	-6%		
More than 5 years, never	3.82 (0.23)	42%			4.55 (0.52)	-10%			6.58 (0.87)	-11%		
Reason for dental visit			<0.001				<0.001				<0.001	
Check-up, exam or clean	1.75 (0.10)	Ref			3.89 (0.17)	Ref			5.63 (0.29)	Ref		
Problem	4.41 (0.18)	152%			6.23 (0.25)	60%			9.26 (0.41)	64%		
Other (United States only)	3.98 (0.20)	128%			-	-			-	-		

^aSeverity is computed as the sum of all ordinal response codes. Severity scores have a potential range of 0–28 across the seven item subset and of 0–56 across the 14 OHIP-14 items.

Table 5

Prevalence of oral health impacts on quality of life in the US and Australian populations^a

	NHANES-OHIP in the United States			NHANES-OHIP in Australia			OHIP-14 in Australia		
	Proportion (SE)	Effect	P-value	Proportion (SE)	Effect	P-value	Proportion (SE)	Effect	P-value
All	15.3 (0.94)			15.7 (1.14)			16.5 (1.16)		
Sex			0.012			0.071			0.101
Male	12.8 (1.42)	Ref		13.6 (1.62)	Ref		14.6 (1.67)	Ref	
Female	17.7 (0.95)	38%		17.8 (1.60)	31%		18.5 (1.61)	26%	
Age group			0.062			0.290			0.185
18–29 years	13.5 (1.47)	12%		18.8 (3.30)	3%		19.7 (3.37)	–4%	
30–49 years	16.9 (1.31)	40%		13.7 (1.61)	–25%		14.3 (1.63)	–31%	
50–69 years	15.5 (1.11)	28%		15.5 (1.55)	–15%		16.1 (1.56)	–22%	
70+ years	12.1 (1.74)	Ref		18.2 (3.20)	Ref		20.6 (3.32)	Ref	
Race/ethnicity (United States only)			<0.001						
Non-Hispanic White	15.1 (1.06)	Ref		–	–		–	–	
Non-Hispanic Black	19.5 (1.28)	29%		–	–		–	–	
Hispanic, US-born	16.5 (2.15)	9%		–	–		–	–	
Hispanic, foreign-born	8.6 (0.99)	–44%		–	–		–	–	
Country of birth (AU only)									
Australia	–	–		14.9 (1.24)	Ref	0.164	15.5 (1.25)	Ref	0.098
Other	–	–		18.8 (2.74)	27%		20.3 (2.84)	31%	
Income			<0.001			<0.001			<0.001
Low	21.0 (1.59)	114%		23.2 (2.05)	112%		24.3 (2.08)	116%	
Moderate	15.2 (0.99)	56%		15.6 (2.15)	43%		16.7 (2.22)	48%	
High	9.8 (1.46)	Ref		11.0 (1.92)	Ref		11.3 (1.93)	Ref	
Remaining teeth			<0.001			<0.001			<0.001
<20 remaining teeth	27.6 (2.46)	157%		33.8 (3.68)	173%		35.1 (3.68)	170%	
20–24 teeth	17.8 (2.00)	66%		16.7 (2.98)	35%		17.7 (3.04)	36%	
25–27 teeth	15.5 (2.09)	44%		18.9 (3.19)	53%		19.9 (3.22)	53%	
28+ teeth	10.8 (1.00)	Ref		12.4 (1.41)	Ref		13.0 (1.44)	Ref	
Perceived need for treatment			<0.001			<0.001			<0.001

	NHANES-OHIP in the United States			NHANES-OHIP in Australia			OHIP-14 in Australia		
	Proportion (SE)	Effect	P-value	Proportion (SE)	Effect	P-value	Proportion (SE)	Effect	P-value
Need filling or extraction	28.0 (1.49)	302%		25.7 (2.36)	132%		26.3 (2.37)	118%	
Do not need filling or extraction	7.0 (0.67)	Ref		11.1 (1.25)	Ref		12.0 (1.29)	Ref	
Dental insurance			0.006			0.010			0.005
Has private dental insurance	12.4 (1.32)	Ref		12.7 (1.68)	Ref		13.2 (1.68)	Ref	
No private dental insurance	17.8 (1.14)	44%		18.8 (1.56)	48%		20.0 (1.62)	52%	
Time since last dental visit			<0.001			0.623			0.953
Less than 12 months	14.0 (1.17)	Ref		16.5 (1.69)	Ref		16.8 (1.69)	Ref	
One to five years	14.8 (1.07)	6%		14.6 (1.54)	-12%		16.3 (1.67)	-3%	
More than 5 years, never	22.9 (1.91)	64%		14.7 (2.81)	-11%		16.0 (2.94)	-5%	
Reason for dental visit			<0.001			<0.001			<0.001
Check-up, exam or clean	8.4 (0.80)	Ref		11.1 (1.47)	Ref		11.7 (1.51)	-49%	
Problem	25.7 (1.87)	206%		21.8 (1.83)	97%		22.9 (1.85)	Ref	
Other (United States only)	22.6 (2.31)	169%		-	-		-	-	

^aPrevalence is measured as the percentage of people responding with 'fairly often' or 'very often' to one or more question.