Oral health-related quality of life and perceived dental needs in the United States

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Abstract

Objectives: The purpose of this study is to investigate the oral health-related quality of life (OHRQOL) in the US population by sociodemographic factors, perception of dental needs, reported dental visits, and saliva indicators.
Methods: Data from the National Health and Nutrition Examination Survey (NHANES) 2003-2004 were used. NHANES measured OHRQOL by a modified version of the Oral Health Impact Profile.
Results: The study had 6,183 subjects who averaged an OHRQOL score of 2.8 points. About 40% had painful aching in the mouth during the last year on at least one occasion. Perceived need to relieve dental pain was the strongest risk factor for poor OHRQOL (resulting in a higher score by 5.2 points), followed by perceived need for a denture or feeling of dry mouth (each resulting in a higher score by about 2 points).
Conclusions: OHRQOL is the poorest among those with perceived dental needs especially those with the perceived need to relieve dental pain.

Introduction

Oral health-related quality of life (OHRQOL) is significant to the clinical practice of dentistry, dental research, and dental education (1) for it brings to the forefront the realization that human beings with their own perceptions and oral health behaviors are being cared for rather than solely focusing on the repair needed to the teeth and gingiva (2). Oral diseases have often been measured through the assessment of the objective clinical end points without regard to the psychosocial, emotional, or functional impact of disease (3). In an effort to capture these disease impacts, OHRQOL self-reporting systems have been developed (4). These OHRQOL instruments have assisted investigators in determining the influences of subjective factors on oral health (3,5,6). OHRQOL instruments vary in length, domains assessed, and scoring strategies (5). They have been utilized in demonstrating cross-cultural consistency (7-9) and investigating unique populations (such as the elderly) (8,10-12) or those with specific oral conditions (such as orofacial pain) (13,14). Only recently, OHRQOL has been evaluated in the US general population (15).

The Oral Health Impact Profile (OHIP-49) was developed with the aim of providing a comprehensive measure of self-reported dysfunction, discomfort, and disability as a result of oral conditions. Therefore, OHIP complements traditional clinical indicators of oral diseases and provides information about the burden of these diseases and the role of health services in reducing this burden in different populations (6) OHIP-14 is a shorter version of OHIP-49 which has been validated (12). The National Health and Nutrition Examination Survey 2003-2004 (NHANES) implemented the first multi-item OHRQOL assessment in the US general population using a short instrument adapted from the OHIP-14 (15).

Although there have been studies which describe OHRQOL by sociodemographic characteristics, clinical indices, and perceived oral health needs (10,16,17), what is lacking is the development of multivariate explanatory models of OHRQOL in relation to sociodemographic factors and perceived dental needs. Sanders *et al*. have described the impact of dental conditions on quality of life in the US adult population (15). The purpose of this study is to report in more detail the OHRQOL of the US population by age, gender, and race, sociodemographic factors, and perceptions

of dental needs. These analyses will thus provide control data for the many studies that focus on measuring OHRQOL in special populations

Methods

NHANES program

The NHANES is designed to evaluate the health and nutrition status of adults and children in the United States. The survey combines interviews and physical examinations. NHANES interviews include demographic, socioeconomic, dietary, and health-related questions. The examinations consist of medical and dental exams, physiological measurements, and laboratory tests administered by trained medical personnel (18).

NHANES 2003-2004 interview methods

Local health officials in each selected location are notified of the upcoming survey and selected households receive a letter introducing the survey. After identifying homes and verifying that occupants are eligible to participate in the survey, the interviewer proceeds to recruit those individuals. The interviewer explains the questionnaires to all eligible participants (16+ years) and informs them of their rights and about steps taken to ensure the confidentiality of the data. Adult participants are asked to sign a consent form, and participants (16-17 years) need to assent and their parents/guardians need to give consents. Generally, the interviews take place in the participants' homes. The interviews are conducted by trained interviewers. To encourage participation, participants receive compensation (19).

NHANES 2003-2004 sample and questionnaires

The NHANES sample is selected to represent the civilian, noninstitutionalized US population. The sample is a stratified multistage probability design and the stages of sample selection are: a) selection of primary sampling units (PSUs) which are counties or small groups of contiguous counties; b) segments within PSUs (a block or group of blocks containing a cluster of households); c) households within segments; and d) one or more participants within households (20). All subjects (16+ years) were eligible to complete two of the NHANES questionnaires concerning their demographics and oral health. It is the results from the public data set for these two questionnaires in NHANES 2003-2004 that were analyzed and reported in this paper. The OHRQOL instrument used in NHANES is the shortest version of the OHIP-49 Instrument which represents seven domains: functional limitation, physical pain, psychological discomfort, physical disability, psychological disability, social disability, and handicap (6). This short OHRQOL instrument used in NHANES is composed of seven questions: one question from each of the following domains: functional limitation, physical disability, social disability and handicap; two questions from the "physical pain" domain; and one question representing two domains: "psychological disability" and "psychological discomfort." Each question is answered on a 5-point Likert scale ranging from "never," "hardly ever," "occasionally," "fairly often" to "very often." Sanders *et al*. determined that this short instrument has acceptable construct validity by comparing prevalence and severity estimates across categories of sociodemographic, dental health, and utilization characteristics known to be associated with OHRQOL. Severity was defined as the sum of the scores (15). The data are posted on the NHANES Web site and are available to the public without prior permission.

Data management and statistical analysis

The dependent variable was the sum of the scores of the seven OHIP questions measured on a Likert scale from 0 to 4 where 0 indicates "never" and 4 indicates "very often." The sum of scores would range from 0 to 28 points. Optimum level of OHRQOL was defined when the subject answered "never" for all the seven OHRQOL questions resulting in an OHIP-7 score of 0. The independent variables were the sociodemographic factors (age, gender, race, income, education, country of birth, marital status, military service, and interview language), recent dental visit, perception of dental need, and saliva indicators. Mexican-Americans and other Hispanics were merged in one category. Minority subjects were defined as any non-Hispanic White subjects. The independent variables (sociodemographic and perceived oral health needs) were selected because these variables serve the purpose of the study and are available in the studied NHANES database.

SAS version 9.1 (SAS Institute Inc., Cary, NC, USA) was used to conduct all statistical analyses. The analysis considered the complex design of the NHANES sample using a Taylor series approach to calculate the standard errors and adjust for the sample weights to reflect the unequal probabilities of selection, nonresponse adjustments, and adjustments to independent population controls. Descriptive data were reported for those with optimum OHRQOL and those with less than optimum OHRQOL. Univariate and multivariate explanatory models of OHRQOL in the US population by the independent variables were developed. Generalized linear model statistical technique was used to generate the best explanatory model of the outcome by backward elimination with $P = 0.05$.

Results

The study had 6,183 subjects who averaged an OHIP-7 of 2.8 points which comprises 9.9% of the maximum possible score of 28 points (worst score). The results were consistent; however, there was a slight increase in the average OHIP-7 scores of subjects between 40 and 59 years. Male subjects scored a little lower than female subjects (2.6 versus 3.0 points) on the OHRQOL instrument and overall Hispanic and White subjects scored a little lower than Black subjects (2.4 and 2.8 versus 3.2 points, respectively). The trend was not different when the analyses were limited to subjects with less than the optimum level of OHRQOL who composed 53% of the sample (Table 1).

Table 2 details the seven OHRQOL questions asked in the NHANES03-04 questionnaire and describes the responses in percentage to the different questions for the entire sample. Most of the subjects (over 90%) reported "never" for having difficulty doing usual jobs/attending school or having their sense of taste affected because of oral health problems during the last year. The percentages of subjects reporting "never" dropped to 81% for questions related to living a less satisfying life or being self-conscious or embarrassed because of oral health during the last year. Also in the same period, about 10% of the sample reported occasional incidences where they had to avoid all or particular food because of oral health. Approximately 40% of the US population had at least one instance of painful aching in the mouth during the last year (Table 2).

Table 3 presents the results of univariate analyses of OHRQOL by sociodemographic factors, reported dental visit, perception of dental need, and saliva indicators. Income and education were related to the OHIP-7 scores; subjects with higher income and more education had lower scores compared to those with less income or education. Subjects who were interviewed in English or born in the United States scored on average about 1 point higher on the OHRQOL instrument compared to those interviewed in other languages or subjects who were born in other places. Pregnant women scored an average of 1.2 points lower than nonpregnant women. Of all demographic factors, being divorced was the strongest risk factor for poor OHRQOL.

Perceptions of dental needs were the strongest risk factors for poor OHRQOL; for example, self-perceived need to relieve pain was associated with a nearly 8 points higher OHIP-7 score followed by perceived need of extraction or denture or gum treatment or inaccessible dental care (each associated with scores of approximately 4 points). A feeling of mouth dryness while eating was also a strong risk factor associated with poor OHRQOL resulting in an increased score of nearly 3 points (Table 3).

Table 4 presents a multivariate model of the OHRQOL by sociodemographic factors, as well as reported dental visit, perception of dental need, and saliva indicators. Perceived need to relieve dental pain remained the strongest risk factor for poor OHRQOL (resulting in a higher OHIP-7 score by 5.2 points), followed by perceived need for a denture (resulting in a higher score by 2 points). Feeling of a dry mouth during

Table 1 The Mean OHIP-7 Scores by Age, Gender, Race (n = 6,183)

	Mean oral health-related quality of life score (n = 6,183)			Mean oral health-related quality of life score (for those with less than optimum level of quality of life (score >0 point, n = 3,255)				
Characteristics	Mean	SE	% Out of the max possible	Mean	SE	% Out of the max possible	Min	Max
Age								
15-19	2.20	0.17	7.87	4.06	0.21	14.51	1	24
20-29	2.63	0.19	9.38	4.45	0.26	15.91	1	28
30-39	2.74	0.12	9.79	5.36	0.24	19.13	1	25
40-49	3.41	0.25	12.18	5.83	0.32	20.82	1	28
50-59	3.22	0.19	11.48	5.78	0.30	20.66	1	28
60-69	2.32	0.15	8.27	5.00	0.32	17.84	1	27
70-79	2.10	0.17	7.49	4.54	0.29	16.23	1	28
80+	2.29	0.19	8.19	5.29	0.27	18.89	1	28
Gender								
Female	2.98	0.11	10.65	5.49	0.17	19.62	1	28
Male	2.57	0.14	9.17	4.83	0.17	17.24	1	28
Race								
Black	3.17	0.22	9.94	5.79	0.27	20.67	1	28
Hispanic	2.35	0.14	91.61	4.79	0.29	17.12	1	28
Other	3.09	0.32	88.95	5.67	0.52	20.23	1	28
White	2.77	0.14	90.11	5.10	0.17	18.20	1	28
Total	2.78	0.11	9.94	5.18	0.15	18.49	1	28

Table 2 The US Population Responses from NHANES 2003-2004 Data (as Percentage of Subjects) to Each OHIP-7 Question (n = 6,183)

	Possible answers									
	Very often		Fairly often		Occasionally		Hardly ever		Never	
Questions (Dimension)	%	SE	%	SE	%	SE	%	SE	%	SE
• How often during last year have you had painful aching anywhere in your mouth? (Physical Pain)	2.88	0.27	3.83	0.26	12.21	0.59	21.42	1.05	59.66	1.19
• How often during last year have you felt life in general was less satisfying because of problems with your teeth, mouth, or dentures? (Handicap)	2.01	0.23	2.57	0.28	5.48	0.38	8.58	0.44	81.36	0.83
• How often during last year have you had difficulty doing your usual jobs or attending school because of problems with your teeth, mouth, or dentures? (Social Disability)	0.59	0.14	0.83	0.12	2.06	0.21	4.67	0.28	91.85	0.53
• How often during last year has your sense of taste been affected by problems with your teeth, mouth, or dentures? (Functional Limitation)	0.94	0.22	0.90	0.16	2.52	0.24	3.99	0.33	91.64	0.51
• How often during last year have you avoided particular food because of problems with your teeth, mouth, or dentures? (Physical Disability)	3.11	0.30	3.19	0.33	10.00	0.62	8.60	0.58	75.09	0.84
• How often during the last year have you found it uncomfortable to eat any food because of problems with your teeth, mouth, or dentures? (Physical Pain)	2.54	0.20	3.13	0.36	11.48	0.52	10.68	0.66	72.17	0.94
• How often during last year have you been self-conscious or embarrassed because of your teeth, mouth, or dentures? (Psychological Disability, Psychological Discomfort)	4.16	0.36	2.11	0.23	6.35	0.49	6.81	0.26	80.57	0.71

eating also resulted in a 2-point higher OHIP-7 score. Being US born, poor, or divorced were all contributing factors to poorer OHIP-7 scores. It seems that there is an interaction between race and place of birth where place of birth played the most important role. For example, Black subjects born outside the United States had better OHIP-7 scores than Black subjects born in the United States (2.2 versus 3.3 points; $P = 0.0451$) and also (although not statistically significant) better OHIP-7 scores than White subjects born in the United States who averaged 2.8 points compared to their 2.2. However, only 7.6% of Black subjects in the sample were born outside the United States compared to 47.2% of Hispanics (data not shown).

Using the multivariate logistic regression model of the OHRQOL and the three most significant and important explanatory variables (based on beta coefficients) found in the previous linear multivariate analyses, the highest odds ratio of having less than optimum OHRQOL was 10.5 times (95% CI of 7.6-14.7) among those with perceived need to relieve pain compared to those without, followed by perceived needs for denture with OR of 2.6 (95% CI of 2.1-3.2) and feeling of dry mouth with OR of 2.2 (95% CI of 1.5-3.4) (all with $P < 0.001$ and R^2 of 61%).

Discussion

This study investigates the OHRQOL in relation to perceived oral health needs using sociodemographic factors, perception of dental needs, reported dental visits, and saliva indicators as variables. It has the same limitations of the NHANES 03-04 study design by sampling only a civilian, noninstitutionalized US population. In spite of these limitations, still, the NHANES is one of the most representative and largest public health datasets of the US population.

Our findings indicate an association between OHRQOL and perceived dental needs, in particular, the perceived need to relieve dental pain. In our study, 40% of the sample reported dental pain at least once during the last year. This is consistent with a British study reviewing the literature of dental pain that estimated the prevalence of dental pain defined as pain or discomfort in the mouth, teeth, or gums to range between 19 and 66% (21). Among studies with a time frame of 12 months and among mid-aged adults, the prevalence ranged between 41 and 66%. However, the study clearly found that epidemiological data on dental pain are of poor quality and there is a need for well-designed studies using random samples and standardized measurements (21).

An additional study among adults in the UK that found the prevalence of dental pain to be 28% also determined a gender difference with the prevalence being higher among females. This same study found the lowest pain reported in the age group 65+ and highest in the age group 16-44 years. We found OHRQOL to be slightly lower among middle-aged adults compared to younger and older subjects and among females compared to males; however, both factors were not part of the final model associating OHRQOL with perceived needs. The study also found that non-utilization of dental services increased the likelihood of dental pain, as did perceived treatment need (22). Utilization of dental services in our study led to better OHRQOL in univariate analysis but changed

Table 3 Univariate Analysis of the OHIP-7 Scores by Sociodemographic Characteristics, Recent Dental Visit, Perception of Dental Need, and Saliva Indicators

Factors	Parameter estimate	Standard error	*P* value
Demographic characteristics			
Age			
Years	0.00	0.00	0.5606
Gender			
Female	0.41	0.12	0.0029
Pregnancy			
Yes	–1.22	0.29	0.0008
Race			
Hispanic	–0.49	0.21	0.0348
Non-Hispanic Black	0.43	0.24	0.0914
Non-Hispanic White	–0.05	0.18	0.7883
Other	0.33	0.29	0.2795
Country of birth			
United States	0.81	0.16	0.0002
Household family income			
11 categories from $0 to $75,000 +	–0.22	0.03	<0.0001
Level of education			
1 = less than HS, 2 = HS diploma, 3 = higher	–0.39	0.09	0.0005
Interview language			
English	0.91	0.22	0.0011
Marital status			
Married	–0.63	0.12	<0.0001
Never married	–0.27	0.12	0.0406
Widowed	0.05	0.19	0.7769
Live with a partner	0.72	0.33	0.0448
Separated	1.03	0.36	0.0125
Divorced	1.75	0.25	<0.0001
Military service			
Served in the military (Yes)	–0.20	0.25	0.4455
Reported dental visit			
In the last 3 years			
Yes	–0.48	0.16	0.0103
Perception of dental need			
Need for a tooth to be filled or replaced	2.87	0.16	<0.0001
Need for a tooth to be extracted	4.02	0.20	<0.0001
Need denture	3.93	0.30	<0.0001
Need gum treatment	3.91	0.27	<0.0001
Need to relieve pain	7.86	0.44	<0.0001
Need dental cleaning	1.06	0.15	<0.0001
Need but could not get care	4.05	0.27	<0.0001
Saliva indicators			
Level of saliva			
1 = too little, 2 = did not notice, 3 = too much	–0.27	0.40	0.5082
Feel dry mouth when eating			
Yes	2.95	0.42	<0.0001

direction in multivariate analyses. The Normative Aging Study suggested that while OHRQOL was related negatively to utilization, measures of dental pain and oral discomfort were related positively. The study suggested that because better levels of OHRQOL are probably associated with better perceived oral health, the finding that better OHRQOL were negatively associated with utilization further validates it as a measure of perceived need (23).

Few studies specifically directly relate the OHRQOL to other measurements of self-reported dental pain. A study in Boston among healthy community-dwelling older males found that men with better OHRQOL scores reported less

Table 4 Multivariate Analysis of the OHIP-7 Scores by Sociodemographic Characteristics, Recent Dental Visit, Perception of Dental Need, and Saliva Indicators*

Factors	Parameter estimate	Standard error	*P* value
Intercept	0.80	0.29	0.0151
Demographic characteristics			
Age			
1 for 40-59 , 0 otherwise	0.43	0.17	0.0211
HH family income			
11 categories from $0 to $75,000+	–0.07	0.03	0.0319
Race			
Minority	–1.01	0.24	0.0007
Country of birth			
United States	0.39	0.26	0.1518
Marital status			
Divorced	0.72	0.23	0.0079
Reported dental visit			
In the last 3 years			
Yes	0.67	0.13	0.0001
Perception of dental need			
Need for a tooth to be filled or replaced	0.61	0.15	0.0008
Need for a tooth to be extracted	0.93	0.23	0.001
Need denture	2.06	0.25	<0.0001
Need gum treatment	1.29	0.18	<0.0001
Need to relieve pain	5.23	0.49	<0.0001
Need but could not get care	1.70	0.30	<0.0001
Saliva indicators			
Feel dry mouth when eating			
Yes	2.02	0.30	<0.0001
Interaction (minority * US born)	0.89	0.28	0.0064

* R^2 is 33%.

dental pain or discomfort (23). Similarly, a British study found the proportion of patients with dental pain who reported some impact on quality of life ranging from 56% for feeling like isolating oneself from other people to 78% for feeling irritable or miserable (24).

In our study, perceived need for a denture was also significantly associated with a lower OHRQOL. This is consistent with a study of Japanese subjects recruited from an academic prosthodontic clinic that showed improved OHRQOL with increasing quality of removable partial denture independent of the effects of age, gender, or number of missing teeth (25). Lahti *et al*. agreed with this hypothesis after studying a Finnish population, concluding that impaired subjective oral health in relation to number of missing teeth might be improved by wearing removable dentures (26). Walter *et al*. found that subjects with missing anterior teeth have an approximately 21-fold greater risk of impaired OHRQOL relative to those who retained all of their anterior teeth (27). John *et al*. concluded that wearing removable dentures was a stronger predictor of impaired OHRQOL than demographic variables, where age and education had almost negligible effects (16). Our study found that about 20% of Americans were at some point in the last year self-conscious or embarrassed by their teeth, dentures, or mouth.

Several studies have shown that increasing age is associated with an improvement of OHRQOL (28,29). In contrast, OHRQOL in our study was the lowest in the middle age group (45 to 59 years). In Australia, those aged 30-49 years and, in the UK, those under 30 years old showed the worst scores. In both countries, adults aged 70+ showed much better scores than the rest (29). This is similar to our study where the 70- to 79-year-old group posted the lowest score of all age groups. Also non-US born subjects in our sample enjoyed a better OHRQOL compared to US-born subjects. Interestingly, US-born Hispanics enjoyed almost the same level of OHRQOL as US-born Black subjects, which was lower than the level of US-born White subjects. In smaller studies of Alabaman African-Americans and White subjects, African-Americans had poorer OHRQOL (30). Similarly, a North Carolina study found that low-income Hispanics with low education levels, no insurance, and limited English had an overwhelmingly perceived need for preventive dental prophylaxis, dental checkup, and dental filling (31). In our study, being US born or interviewed in English resulted in poorer OHRQOL. Since the majority of Hispanics in the NHANES 03-04 sample are non-US born (47%) compared to 4.8% of non-Hispanic white and 7.6% of Black subjects, it might be reasonable to think that NHANES-OHIP is not a validated

instrument to be used among the US Hispanic population or that US Hispanics have lower expectations of their OHRQOL. This remains to be proven. However, the Spanish version of OHIP was found to be valid in two studies in Spain and Chile (32,33) where the Hispanic population is more homogenous compared to the US population.

It is possible that gender could be related to OHRQOL. A national study in Germany found males to have poorer OHRQOL compared to females (16), whereas large studies in the UK and Australia found that females have a more impaired OHRQOL compared to males (26). This is consistent with our findings that women have a slightly poorer OHRQOL than men. Our study also confirms previous findings that a feeling of dry mouth results in poor OHRQOL (10,17,34). A Chinese study among hospitalized geriatric patients suggested that reducing oral dryness for geriatric patients might be an important treatment to optimize OHRQOL in this population (35).

The purpose of this study was to provide more specific detail about the OHRQOL of a US sample population by studying the impact of age, gender, race, sociodemographic variables, and perceptions of dental needs on OHRQOL. These analyses could then be used as control data for the many studies investigating OHRQOL in unique populations as well as allow comparisons with populations from other countries. Our study concluded that OHRQOL is the poorest among those with perceived dental needs especially those with the perceived need to relieve dental pain.

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