



Published in final edited form as:

J Public Health Dent. 2014 January ; 74(1): 80–87. doi:10.1111/j.1752-7325.2012.00375.x.

The impact of oral health literacy on periodontal health status

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Abstract

Objective—The objective of this study was to describe oral health literacy (OHL) among periodontal patients and to examine its association with periodontal health status.

Methods—This cross-sectional study included new and referred patients presenting to the University of North Carolina Graduate Periodontology Clinic. Sociodemographic and dental history information were collected. OHL was measured using a dental word recognition instrument, Rapid Estimate of Adult Literacy-30 (REALD-30). Clinical periodontal examinations were completed.

Results—One hundred and twenty-eight participants enrolled and 121 completed all study examinations and instruments. Despite a high level of education among participants in our study, low levels of OHL were found in one-third (33 percent) of the study population. Thirty-one percent had moderate OHL (score of 22–25), 37 percent had high OHL (score = 26). The mean REALD-30 score was 23. Fifty-three percent of participants had severe periodontitis, 29 percent had moderate periodontitis, and 18 percent had mild or no periodontitis. Bivariate analysis showed a significant association between OHL and periodontal status ($P < 0.05$). The effect of OHL on periodontal health status remained statistically significant ($P < 0.002$) even after controlling for smoking, race, and dental insurance.

Conclusion—Lower OHL was associated with more severe periodontal disease among new and referred patients presenting to the University of North Carolina Graduate Periodontology Clinics.

Keywords

oral health; literacy; health literacy; periodontitis; periodontal disease

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Introduction

Health literacy includes the ability to understand instructions on prescription drug bottles, appointment slips, medical education brochures, doctor's directions and consent forms, and the ability to negotiate complex health-care systems. The 2006 National Assessment of Adult Literacy survey indicated that 43 percent of the adult population have limited health literacy skills and have difficulty understanding basic health information (1). Research in medical settings demonstrates the importance of literacy for patient adherence to medical instructions and increased positive health outcomes. Low health literacy is associated with worse health and less understanding of prevention, maintenance, and self-care instruction and advice (2). These skills are particularly critical in the management of chronic diseases (3,4).

Until recently oral health literacy has been largely ignored, but it is a priority for future research (5,6). Oral health literacy is the degree to which individuals have the capacity to obtain, process, and understand basic oral health information and services needed to make appropriate health decisions (6). Limited literacy skills among adults are widespread and are hypothesized to have a large effect on oral health disparities, creating a barrier to achieving better oral health outcomes (6,7).

Oral health literacy levels among dental patient populations can be estimated with the previously validated Rapid Estimate of Adult Literacy in Dentistry (REALD-30) (8). In a study assessing oral health literacy among adult general dental patients, it was found that those with incorrect knowledge of dental questions and fair/poor oral health status had greater odds of having a low literacy level than those with correct knowledge (7).

Periodontal disease is a widespread chronic inflammatory dental disease with potential for systemic health implications. Patients may present with a reversible condition: gingivitis, or an irreversible condition: periodontitis. This study focuses on patients with periodontitis as defined by the Centers for Disease Control and Prevention (CDC) (9). The American Academy of Periodontology estimates that about 50 percent of adults age 55–64 have at least one tooth with moderate to severe periodontal disease (10). Research indicates that complex relationships exist between periodontal disease and cardiovascular disease, pulmonary disease, diabetes, stroke, and preterm low birth weight (11). Management of this disease requires detailed understanding of complex self-care regimens as well as strict adherence to recall intervals; aspects of care which are likely related to oral health literacy. Studies have established that periodontal disease can be effectively treated and stabilized over time with sustained patient compliance (12). In addition, it has been consistently illustrated that there is an association between the presence of periodontal disease and decreased oral health-related quality of life (13–16).

Designing a program to address the patient's oral health literacy (from both the provider's and the patient's perspectives) may be important, but to date has not been routinely incorporated in management of periodontal disease.

To our knowledge, this is the first study to evaluate oral health literacy levels and the prevalence and severity of periodontal disease.

Methods

Sample and data collection

A convenience sample of participants was recruited from patients presenting for an initial consultation appointment to the University of North Carolina Graduate Periodontology

Clinic. Written informed consent and Health Insurance Portability and Accountability Act (HIPAA) consent forms were obtained for study participation. The study was approved by the Biomedical Institutional Review Board at the University of North Carolina. All subjects met the following inclusion criteria: a) 18 years of age or older; b) English speaking (REALD-30 has been validated in adult English-speaking populations only); and c) new or referred patients to the clinic (in an effort to reduce any potential confounding effects of repeated interactions in a periodontal clinic setting).

Oral health literacy assessment

Oral health literacy was measured using the REALD-30 (8). This previously validated (Cronbach's $\alpha = 0.87$) instrument includes 30 dental-related words arranged in order of increasing difficulty. Words were read aloud by the subject to the interviewer. Because REALD-30 is a word recognition test, participants were asked not to try to phonetically deduce the words, but rather to skip a word if they did not know it. One point is given to each word pronounced correctly and an overall score between 0 (lowest literacy) to 30 (highest literacy) is generated. The REALD-30 score was categorized as low (< 21), moderate (22 to 25), or high (≥ 26).

Two interviewers were trained and calibrated in the interview and survey methods. To promote consistent and correct interview techniques, interviewers were also provided with an instructional manual (containing the data collection protocol, consent and HIPAA forms, and survey questions). If the subject experienced difficulty reading the consent or HIPAA waiver forms, the interviewer read them aloud.

In addition to the REALD-30, each patient completed questionnaires regarding oral health knowledge and oral health behavior. Five true/false response questions were asked to assess dental knowledge and the respondents were given one point for each correct response to create a knowledge score: a) "It is normal to have bleeding of the gums while brushing or flossing your teeth"; b) "Plaque causes gum disease if not cleaned from the teeth and gums"; c) "Having persistent bad breath is a symptom of gum disease"; d) "Pus between the gum and a tooth is common in healthy gums"; and e) "Teeth can become loose and move if you have gum disease." The oral health behavior component consisted of six categorical questions on oral hygiene and dental habits including: smoking habits, brushing frequency, flossing frequency, rinse frequency, and toothpaste use. Additionally, sociodemographic questions were examined as exploratory covariates. Sociodemographic data collected included race, ethnicity, gender, marital status, education, age, annual family income, home ownership, amount of previous dental exposure, dental insurance status, and smoking status.

Clinical assessment

Following the interview, a periodontal examination was completed by one of five trained and calibrated examiners who were blinded to the results of the oral health literacy evaluation.

Clinical periodontal parameters were measured using a manual UNC-15 periodontal probe (Hu-Friedy Manufacturing, Chicago, IL, USA) at six sites per tooth (i.e., mesiobuccal, buccal, distobuccal, mesiolingual, lingual, and distolingual). The clinical parameters recorded included the following: probing depth (PD): distance from the gingival margin to base of the sulcus or pocket; clinical attachment loss (CAL): distance from the cemento-enamel junction to the base of the sulcus or pocket.

Periodontal health status was determined based on extent and severity of periodontal disease using the CDC case definition of periodontal disease (9) that defines disease as following: Severe Periodontitis: ≥ 2 interproximal sites with CAL ≥ 6 mm (on more than one tooth) and

1 interproximal site with PD \geq 5 mm; Moderate Periodontitis: 2 interproximal sites with CAL \geq 4 mm (on more than one tooth) or 2 interproximal sites with PD \geq 5 mm (on more than one tooth); Health or Mild Periodontitis: neither “moderate” nor “severe” periodontitis (9).

Prior to the conduct of this study, a training exercise with a gold standard examiner was conducted to standardize measurement techniques and quantitate variability within and between examiners. Percent agreement with the gold standard was >90 percent for PD and CAL measurements, and Kappa scores were >0.90 .

Data analysis

The purpose of this study was to address the relationship between oral health literacy and periodontal health status in a convenience sample of patients presenting to the University of North Carolina Graduate Periodontology Clinics. The outcome variable was periodontal health status, as defined by the CDC (9) and coded as Severe Periodontitis = 1; Moderate Periodontitis = 2; Health or Mild Periodontitis = 3.

The primary explanatory variable was the REALD-30. Additional variables considered as covariates included race (Caucasian/non-Caucasian); education (high school/college); dental insurance (yes/no); smoking (current or former smoker/never smoked); family history of periodontal diseases (yes/no); age; and sum of oral health knowledge questionnaire items.

Statistical analysis was performed using SAS 9.2 (SAS Institute, Inc., Cary, NC, USA). Exploratory univariate analyses were performed to examine distributions of data and to inspect for outliers or missing data. Bivariate analysis was then performed to investigate associations between patient characteristics and periodontal health status using Mantel-Haenszel analysis.

A proportional odds model using forward selection was generated for periodontal disease status. REALD-30 score, age in years, and patient characteristics were included in the model as possible explanatory variables. For the noncontinuous variables, the reference groups defined in the model were Caucasian, 4-year college degree or more, no dental insurance, never smoked, low dental knowledge, and a positive family history of periodontal disease. Level of significance was set at 0.05.

Results

One hundred and twenty-one subjects were included in this cross-sectional study. Previous studies using the REALD-30 established the minimum sample size of 102 to detect enough power at $\alpha = 0.05$ (7,17).

Among the 121 subjects recruited for the study (Table 1), slightly more than half of the participants were female (51 percent) and the majority were Caucasian (74 percent). The average age of participants was 54 years [standard deviation (SD) 13.6]. Less than half (44 percent) of subjects had dental insurance. The majority of those with insurance were covered by private insurance (81 percent). A large portion of subjects (45 percent) had at least a 4-year college degree.

Most subjects presented to the University of North Carolina Graduate Periodontology Clinic for comprehensive periodontal treatment (73 percent), with the remainder referred for prescription procedures (i.e., clinical crown lengthening, dental implant placement, gingival grafting) (Table 2). Only 13 percent of subjects reported being current smokers, but a large

portion reported being former smokers (45 percent). Less than half of subjects (42 percent) reported having never smoked. Very few patients reported having diabetes (5 percent).

Results from the behavior survey showed, as expected for a predominantly referral based specialty, that the majority of subjects had recently been to the dentist (85 percent). Subjects reported a variety of dental behaviors and frequencies of visits (Table 2).

Results from the REALD-30 were relatively evenly distributed among the three categories, with 33 percent scoring 21 or less (low oral health literacy), 31 percent scoring 22–25 (moderate oral health literacy), and 37 percent scoring 26 or greater (high oral health literacy). The mean score was 23 (SD 4.31).

Of the participants, more than half of the subjects had severe periodontal disease (53 percent) with 29 percent having moderate periodontitis and 18 percent having mild or no periodontal disease. Bivariate comparisons (Table 3) suggest that race, smoking, and categorized REALD-30 were all significantly associated ($P < 0.05$) with periodontal health status (health/mild, moderate, severe), while education, family history, and insurance status were not. Age was examined in our bivariate analysis but not included in Table 3 as it was linear and not a categorical variable as were the other measures presented. We used a Cochran–Mantel–Haenszel statistical test to examine age and found no significant association with periodontal disease.

Figure 1 shows the relationship between oral health literacy and periodontal health status. Among subjects with low oral health literacy, 75 percent ($n = 30$) had severe disease, while among subjects with high oral health literacy, only 39 percent ($n = 17$) had severe disease. Conversely, among subjects with low oral health literacy, only 8 percent ($n = 3$) demonstrated health/mild disease, while among subjects with high oral health literacy, 27 percent ($n = 12$) demonstrated health/mild disease.

Table 4 reports the odds ratio (OR), confidence intervals, and P -values for the proportional odds model for periodontal disease severity. REALD-30 score (continuous), race, dental insurance, and smoking were included in the final model for periodontal health status using forward variable selection. The adjusted OR for REALD-30 score was 0.84 ($P = 0.002$); meaning that higher literacy scores were “protective.” For consistency in interpretation, we calculated the inverse ($1/0.84$) to get an OR > 1 . In other words, if health literacy score decreases one unit (decrease in oral health literacy level), then the likelihood of having worse periodontal disease is 1.19 times more likely when adjusted for race, dental insurance, and smoking status ($P = 0.002$). Compared with Caucasians, non-Caucasians were 5.00 times more likely to have worse periodontal disease status adjusting for other variables ($P = 0.006$) and compared with people who have dental insurance, people without dental insurance were 2.32 times more likely to have worse periodontal disease status adjusting for other variables ($P = 0.043$). Smokers were 3.86 times more likely to have worse periodontal disease status adjusting for other variables ($P = 0.001$) when compared with nonsmokers.

Discussion

To our knowledge this was the first study to examine the association between oral health literacy and periodontal health status. Although recent studies have highlighted the importance of oral health literacy as it relates to a patient’s oral health, they have not focused specifically on periodontal health status. It has been demonstrated that there is an association between health literacy and chronic disease control. For example, diabetic patients with inadequate health literacy are 2.03 times more likely to have poor glycemic control (HbA1c > 9.5) and 2.33 times as likely to have retinopathy (3). In another study, 92

percent of patients with an adequate level of health literacy knew that a blood pressure of 160/ 100 mmHg is high, but only 55 percent of patients with an inadequate level of health literacy knew this (18). Periodontal disease is similarly chronic in nature; patient understanding and compliance are essential for successful long-term maintenance and periodontal stability (19,20). The results of this study indicated that race, smoking, and oral health literacy were significantly associated ($P < 0.05$) with periodontal health status (health/mild, moderate, severe). A surprising finding from our study was that education, family history, and insurance status were not found to be associated with periodontal health status despite the fact that these factors have been cited as predictors of periodontal disease in other populations (21–23). In our sample, over 80 percent had more than a college education, had no family history of periodontal disease and had private insurance. Our relatively small sample size may have resulted in this limited variation in this study.

This study did not find an association between knowledge and having periodontal disease. Several reasons may explain this discrepancy. First, there is not currently a validated measure for periodontal knowledge applicable to this study. Thus, the knowledge questions likely did not capture all important items needed to completely measure knowledge. Second, a few literacy conceptual models consider knowledge to be part of literacy; others think of it as a separate part of an individual's capacity to understand and use health information. Knowledge about disease often does not translate into the practice of the behaviors that are needed to manage the disease. Literacy encompasses a set of skills that includes accessing, processing, and acting on information to manage health.

These findings must take into consideration the limitations of the study. This study was cross-sectional and therefore does not lead to casual inferences. Eighty-five percent of the subjects reported being seen by a dentist within the last year. A high percentage of participants reported brushing, flossing, and rinsing, which suggests previous education regarding plaque control. This may have led to increased oral health literacy among the study population. The population sample in the present study was a convenience sample and may not be representative of the general population, or of those attending a general dentist's practice. Due to the sample size, we were unable to examine the existence of effect modification. This should be considered in future studies. It is also important to understand the limitations of the REALD-30. It is a word recognition test and does not measure reading comprehension. Therefore it is not a comprehensive dental health literacy instrument, although it does show a strong association with reading comprehension (8). Finally, while examiners in this study were calibrated, variations in examination technique could have occurred among the multiple examiners in the study.

Oral health literacy has been examined among various populations. Similar to our results, Jones *et al.* (7) found about one-third of the subjects fell into the low literacy category (REALD-30 score <22). In an indigenous Australian population it was found that lower oral health literacy was significantly associated with decreased dental knowledge and more harmful oral-health-related behavior (24).

Results from the current study demonstrate that as oral health literacy scores (sum of REALD-30) decreased by one unit, the likelihood of having worse periodontal disease was 1.19 times ($P = 0.002$). Thus, if the REALD-30 score decreased by two points the patient was approximately 2.5 times more likely to have worse periodontal disease. Interestingly, level of education was not significantly associated with periodontal health status ($P = 0.39$) in the multivariate model although it was in the bivariate analysis. Other studies have found an association between periodontal health status and education (25). Using National Health and Nutrition Examination Survey (NHANES) III data, Borrell *et al.* (25) found that compared with those with more than a high school education, those with less than a high

school education were twice (1.48 to 2.89) as likely to have periodontitis. The discrepancy of the Borrell study versus ours may be due to the very high level of education present among our subjects. Eighty-two percent of the sample reported having completed some college or higher, while only 44 percent of the NHANES III population had this level of education. Interestingly, despite the high level of education among participants in our study, low levels of oral health literacy were found in one-third (33 percent) of the study population. Similar to the NHANES III study and many other epidemio-logic reports, our study also found that race was significantly associated with periodontal health (25,26).

The findings of the present study reinforce the need for effective communication between dental health-care providers and patients regarding their periodontal disease condition. A 2005 report on the role of literacy in oral health notes that many health practitioners are not adequately prepared to address literacy needs of their patients (5). Furthermore, they point out that patients may not be aware of their own low literacy. Education level may not necessarily be related to oral health literacy level. Among adults who score in the lowest literacy category, 71 percent describe themselves as having no difficulty with reading or writing (27). Due to the chronic nature of periodontal diseases and the importance of an effective maintenance program, it is imperative that the patient has an understanding of the risk factors and etiologic factors related to periodontal disease. The patient must be equipped to adequately control the modifiable factors to reach and maintain a level of periodontal stability and health. Recommendations for overcoming low literacy barriers in nursing and medicine include assessing readability of informed consent, patient education, and other documents, including literacy issues in patient documentation, creating simple graphic descriptions of information, and using instruments or methods to identify patients with low literacy (28). Further studies are needed to assess effective methods to improve provider communication and patient understanding in the oral health care setting.

Many opportunities exist for further research examining the relationship between oral health literacy and periodontal disease status. Our study population was limited to patients seeking treatment at the University of North Carolina Graduate Periodontology Clinic. It would be beneficial to extend the study population to include patients in various clinical settings including community health centers and private dental practices. This would not only increase the sample size but also allow for greater potential variation (i.e., socioeconomic status, education level, periodontal disease status) among subjects and less bias toward having periodontal disease. A recent national survey of dentists' communication styles found that most dentists do not routinely utilize communication techniques thought to be most effective with patients with low literacy skills (29). It would be valuable to perform a prospective study evaluating oral health and the effectiveness of various communication and education methods aimed at increasing a subject's oral health literacy.

In conclusion, this study demonstrated a significant association between oral health literacy and periodontal health status among patients presenting to the University of North Carolina Graduate Periodontology Clinic. Dental providers should identify patients who are having difficulty using periodontal health information and assist them in better acting on the information by using effective patient communication techniques and reinforcing positive oral health behaviors. Research is needed to establish a causal relationship between oral health literacy and periodontal health status and to identify mechanisms so that inventions can be developed.

Acknowledgments

This study was supported by Award Number UL1RR025747 from the National Center for Research Resources and by Grant # RO1DE018045 from the National Institute of Dental and Craniofacial Research.

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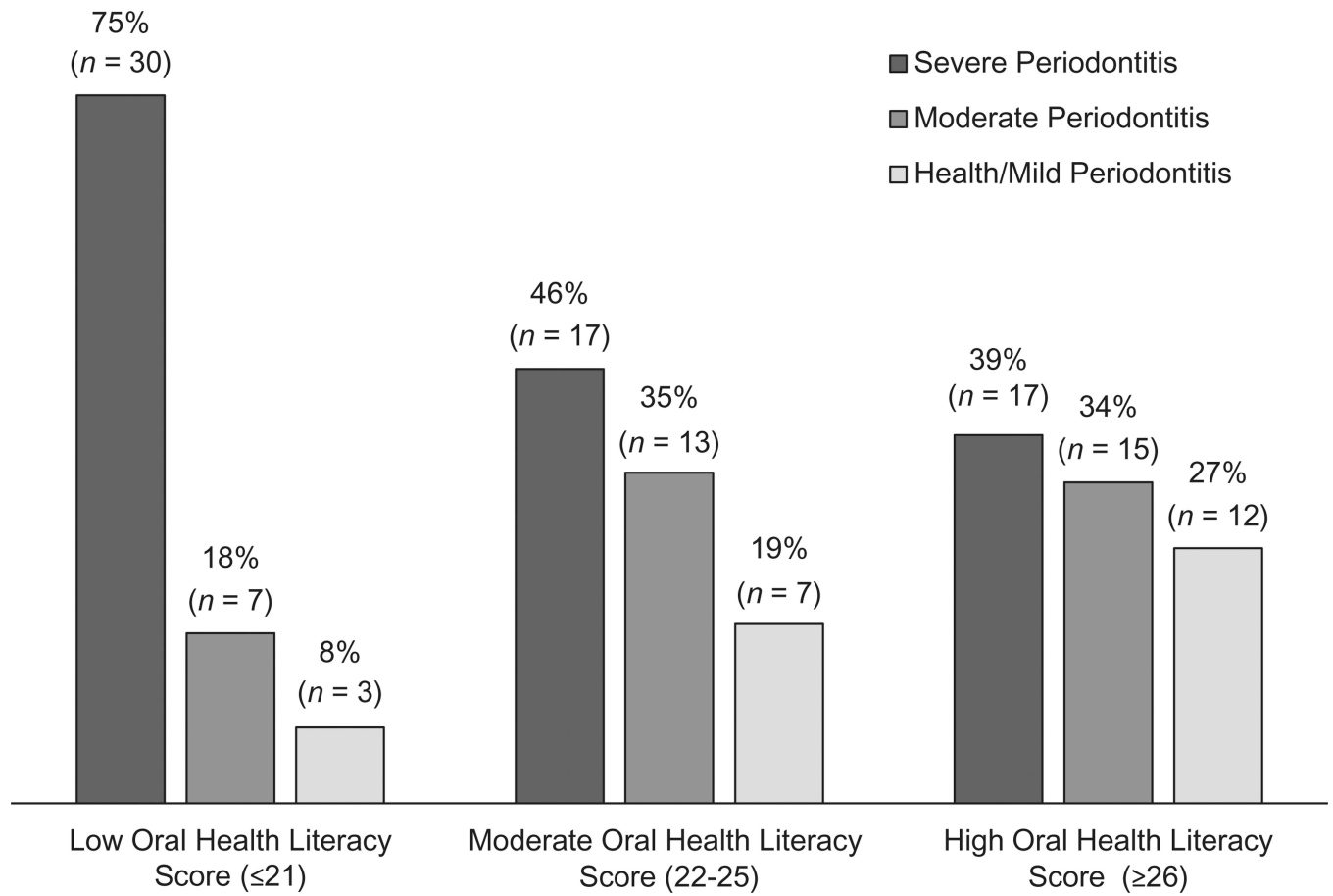


Figure 1.
Periodontal health status by oral health literacy category.

Table 1

Sociodemographic Characteristics

	Total*	Frequency	Mean (SD) or percent (%)
Sex	118		
Male		58	49
Female		60	51
Age (years)	121		54 (13.6)
Race	120		
White		90	74
Black/African American		20	17
Hispanic/Latino		3	2
Native American		1	1
Asian		6	5
Dental insurance	119		
Yes		52	44
No		67	56
Type of dental insurance	43		
Medicaid		4	9
Private		35	81
Other		4	9
Education level	119		
Some high school or less		3	3
High school graduate or GED		19	16
Some college or technical degree		44	37
4-year college degree or more		53	45
Marital status	118		
Married		71	60
Separated/divorced		25	21
Never married or single		13	11
Other		9	8
Annual income	114		
Less than \$10,000		14	12
\$10,000 to \$29,999		30	26
\$30,000 to \$49,999		31	27
\$50,000 to \$69,999		14	12
\$70,000 to \$89,999		13	11
\$90,000 or more		12	11
Home ownership	109		
Yes		83	76
No		26	24

* Not all items were answered by every enrolled subject.

GED, general equivalency diploma; SD, standard deviation.

Table 2

Dental Characteristics

	Total*	Frequency	Percent (%)
Reason for clinic visit	117		
Comprehensive periodontal treatment		85	73
Prescription procedure		32	27
Previous dental care	110		
1–4 restorations/procedures		53	48
5 or more restorations/procedures		57	52
Time since last dental checkup/cleaning	120		
More than 2 years		10	8
1 to 2 years		8	7
Less than 1 year		102	85
Frequency of brushing teeth	121		
Once/twice a week		4	3
Once a day		26	21
More than once a day		91	75
Frequency of flossing teeth	121		
Never		1	1
Hardly ever		12	10
Once/twice a week		32	26
Once a day		52	43
More than once a day		24	20
Use mouth rinse	121		
Yes		91	75
No		28	23
Don't know		2	2
Family history of periodontal disease	118		
Yes		24	20
No		94	80
Cigarette smoking	121		
Current smoker		16	13
Former smoker		54	45
Never smoked		51	42
Diabetes	121		
Yes		6	5
No		115	95

* Not all items were answered by every enrolled subject.

Table 3

Percent Distribution and Periodontal Disease Severity by Predictor Variables

	Percent distribution				P-value*
	Overall (possible n = 121)	Healthy/mild (n = 22)	Moderate (n = 35)	Severe (n = 64)	
Race					
White/Caucasian	75	86	89	63	0.004
Non-White/minority	25	14	11	37	
Education					
High School or less	18	14	9	25	0.072
Some college or more	82	86	91	75	
Dental insurance					
No	56	50	53	60	0.340
Yes	44	50	47	40	
Smoking					
Never	42	59	57	28	0.001
Current or former	58	41	43	72	
Family history of periodontal disease					
No	80	77	86	77	0.652
Yes	20	23	14	23	
Dental knowledge					
Low (<50% correct)	14	5	14	17	0.715 [†]
Moderate (>50% correct)	26	32	29	22	
High (100% correct)	60	64	57	61	
Categorized REALD-30					
Low (<22)	33	14	20	47	<0.001 [†]
Moderate (22–25)	31	32	37	27	
High (26–30)	36	55	43	27	

* Based on Mantel-Haenszel Mean Score Statistics with standardized midrank scores, unless otherwise noted.

[†] Mantel-Haenszel Nonzero Correction Statistics with standardized midrank scores.

Table 4

Proportional Odds Model for Oral Health Literacy and Periodontal Disease Status *

	OR*	95% C.I.	P-value
REALD-30 score (0–30)	1.19	(1.06, 1.33)	0.002
Race (Non-Caucasian versus Caucasian)	5.00	(1.60, 15.61)	0.006
Dental insurance (No versus Yes)	2.32	(1.03, 5.22)	0.043
Smoking (Yes versus No)	3.86	(1.73, 8.61)	0.001

* Odds of worse periodontal disease status.

CI, confidence intervals; OR, odds ratio; REALD-30, Rapid Estimate of Adult Literacy-30.