Racial and Socioeconomic Disparities in Oral Disadvantage, a Measure of Oral Health-related Quality of Life: 24-month Incidence

L. Scott Chavers, MPH; Gregg H. Gilbert, DDS, MBA; Brent J. Shelton, PhD

Abstract

Objectives: *This paper estimates the incidence of oral disadvantage based on the subject's approach to dental care, sex, race, and financial status; identifies demographic and socioeconomic characteristics that were associated with oral disadvantage; and determines if these characteristics were differentially associated with the three domains of oral disadvantage.* ***Methods:*** *The Florida Dental Care Study was a longitudinal study of oral health in diverse groups of persons who at baseline had at least one tooth, were 45 years or older, and were either African American or non-Hispanic white. Incidence rates, odds ratios, and 95 percent confidence intervals were used to describe oral disadvantage and its relation to race, income, and other key sociodemographic characteristics.* ***Results:*** *The strongest independent predictors of oral disadvantage were approach to dental care (problem-oriented attenders or regular), and situation if faced with an unexpected $500 dental bill. Demographic and socioeconomic characteristics were differentially associated with each disadvantage domain.* ***Conclusions:*** *African Americans, females, rural residents, individuals who did not graduate from high school, individuals with limited financial resources, and problem-oriented dental attenders had significantly higher occurrences of oral disadvantage. Racial and sex disparities in oral disadvantage were largely explained by differences in approach to dental care and financial resources between these groups. [J Public Health Dent 2002;62(3):140-47].*

Key Words: quality of life, oral health-related quality of life, oral disadvantage, poverty, race, epidemiology.

For a wide array of health markers, financially challenged persons and racial and ethnic minorities are well known to have poorer health than their financially advantaged and majority counterparts. Similar findings have been observed when oral health has been the key outcome of interest (1,2). In our work to date from the Florida Dental Care Study (FDCS), we have been especially interested in the role that race and socioeconomic status play in a broad range of oral health-related quality-of-life outcomes, as well as their role in dental care use (3-6).

The assessment of an individual's general quality of life (QOL) and health-related QOL (HRQOL) has taken on greater prominence in recent decades. This is due to the recognition of the need to move beyond simply conceptualizing and measuring health as the lack of disease, to include measures of how health affects QOL. An individual's QOL can now be conceptualized as multidimensional and dependent on: (1) factors external to the individual (e.g., social, cultural, economic, and political); (2) health status and HRQOL (e.g., symptoms, functional status, and health perception components); and (3) factors internal to the individual (e.g., biology, lifestyle, health behavior, personality, and values components) (7).

Oral health can be conceptualized as a condition-specific component of health status and HRQOL. Oral health-related quality of life (OHRQOL) focuses on the aspects of human life that are generally affected by oral health or dental care. Oral health is an important component of health in its own right because it can have a substantial impact on the QOL of an individual (1,8,9), and because dental care constitutes a significant portion of the health care sector (10). Oral disadvantage is one component of OHRQOL (3,5), and connotes a psychosocial state in which persons affected by oral disease, tissue damage, or functional limitation do not perform normal social activities, such as interpersonal contacts or employment, because of their mouth.

Three objectives of the FDCS specific to the current report were to: (1) estimate the incidence of oral disadvantage based on the subject's approach to dental care, sex, race, and financial status; (2) identify demographic and socioeconomic characteristics that were associated with oral disadvantage; and (3) determine if these characteristics were differentially associated with the three domains of oral disadvantage.

Methods

Subject recruitment, informed consent, analysis, and report of these data were reviewed and approved by the Institutional Review Boards of the University of Florida and the University of Alabama at Birmingham.

Sample Development. Data were derived from the FDCS, which was a prospective longitudinal study of oral health and dental care. The goal of the sampling design was to ensure that a large number of persons at a hypothesized increased risk for oral health dec-

Send correspondence to Mr. Chavers, Department of Diagnostic Sciences, University of Alabama at Birmingham, School of Dentistry, SDB Room 115, 1530 3rd Avenue South, Birmingham, AL 35294-0007. E-mail: chavers@uab.edu. Reprints will not be available. Dr. Gilbert is with the Department of Diagnostic Sciences, School of Dentistry, and Dr. Shelton is with the Department of Biostatistics, School of Public Health, both at the University of Alabama at Birmingham. Sources of support: DE12457, DE11020, DE14164. Manuscript received: 8/27/01; returned to authors for revision: 10/12/01; final version accepted for publication: 11/17/02.

rements would be included (namely, African Americans, rural residents, persons who were 45 years old or older, and the poor). The sample was limited to persons who had at least one tooth at baseline. Briefly, subjects were from four counties in north Florida: three nonmetropolitan counties and one metropolitan county. Telephone screening using Donnelley listings and random digit dialing (RDD) identified 5,254 persons meeting age and residence eligibility. Persons who were aged 45 years or older and lived in target areas were screened for dentate status, race, and poverty status, resulting in 3,998 eligible respondents. A random sample of dentate respondents stratified by nonmetropolitan and metropolitan counties identified 873 individuals who ultimately agreed to participate in the study. Baseline data were collected on the 873 participants from August 1993 to April 1994, and resulted in a sample of only minimal bias with respect to the population of interest (11). Other details of sampling methodology and selection are provided in an earlier publication (11).

By the 24-month interview, 764 persons (unweighted *n*) remained in the study, of whom 723 (unweighted *n*; weighted *n*=739) participated in a clinical examination. Of the 109 subjects who did not participate in the 24-month interview, 35 refused to participate, 29 were deceased, 10 were medically unable to participate, and 35 could not be located. Persons who participated through the 24-month interview were more likely to have been well educated, regular dental care attenders, above the 100 percent poverty threshold, in better self-rated general health, non-Hispanic white, and less likely to report disadvantage. The issue of bias in the sample due to attrition has been addressed in detail earlier (6). As an example of the typical magnitude of the bias, 28 percent of the 873 baseline participants reported having experienced oral disadvantage due to functional limitation in the six months before the baseline interview. Had the sample been limited at baseline to those who ultimately participated at 24 months, the figure would have been 24 percent. Consequently, the estimate of disadvantage incidence in this report is likely an underestimate of the true incidence of disadvantage. The magnitude of the bias was less for the other measures of oral disadvantage. No differences in participation were observed with respect to age group, sex, area of residence, "ability to pay an unexpected $500 dental bill," or "present financial situation."

Data-gathering Stages. Subjects participated for a baseline in-person interview, which typically lasted 30 minutes, immediately followed by a clinical dental examination. The baseline interview queried 92 items concerning past dental care utilization, attitudes toward dentists and dental care, numerous self-reported dental signs and symptoms, certain health-related habits, and financial and demographic circumstance. Self-reported items were elicited by asking a series of closed-ended questions that queried each item separately; that is, symptom checklists were not used.

The baseline interview and clinical examination were followed by a telephone interview at 6 months, 12 months, and 18 months. Another in-person interview and clinical examination were conducted at 24 months. These interviews queried dental care utilization and numerous self-reported dental signs and symptoms, including oral disadvantage.

Description of Variables. We hypothesized that approach to dental care, demographic factors, and socioeconomic factors would be predictors of oral disadvantage. Therefore, we queried specific items shown in Table 1. The questionnaire and test-retest re-

TABLE 1
Approach to Dental Care, Demographic, Socioeconomic, and Oral Disadvantage Variables Used in Analyses

Approach and Demographic Variables	Socioeconomic Variables	Oral Disadvantage
Approach to dental care	Level of formal education	*due to disease/tissue damage ...*
Age group	Dental insurance coverage	—Avoided laughing or smiling because of mouth
Race	Ability to pay an unexpected $500 dental bill	—Avoided talking because of mouth
Sex	Present financial situation	
Rural/urban area of residence	Household income	*due to pain ...*
	Poverty status relative to 100% threshold*	—Trouble sleeping because of mouth pain
		—Mouth pain/discomfort kept from doing normal daily activities
		due to function ...
		—Avoided chewing hard things because of mouth
		—Been prevented from eating foods because of mouth
		—Avoided eating with others because of chewing problems

*Measured during the telephone screening survey.

TABLE 2
Factor Loadings of Oral Disadvantage Using Oblique Promax Rotation

Question	Factor 1	Factor 2	Factor 3
Avoided laughing or smiling because of unattractive teeth or gums	**0.9366**	–0.0379	–0.0786
Avoided talking to someone because of unattractive teeth or gums or bad breath	**0.6921**	–0.0003	0.0338
Avoided chewing hard things because of teeth or dentures	0.0433	**0.6821**	–0.0066
Prevented from eating foods because of teeth or dentures	–0.0232	**0.9626**	–0.0137
Avoided eating with others because of a problem with chewing	0.0145	**0.4041**	0.0978
Embarrassed by the appearance or bad health of teeth or gums	**0.6546**	0.1361	0.0866
Pain or discomfort from teeth or dentures prevented normal daily activities	–0.0308	–0.0494	**0.9821**
Trouble sleeping because of pain or discomfort from teeth or dentures	0.0328	0.0487	**0.6480**
Eigenvalues	6.24	1.52	1.12
Variance explained, %	10.14	13.05	13.33

Factor 1 indicates oral disadvantage due to disease/tissue damage.
Factor 2 indicates oral disadvantage due to functional limitation.
Factor 3 indicates oral disadvantage due to pain.
Boldface indicates questions loading on each factor.

liability of questions have been described previously (3-5,12). The actual wording of these items is available at the web site listed in the *Acknowledgments* section at the end of this paper.

For approach to dental care, our expectation was that typical dental care utilization behavior would be a strong predictor of oral disadvantage. At baseline, participants were asked to describe their "approach" to dental care as: (1) "I never go to a dentist"; (2) "I go to a dentist when I have a problem or when I know that I need to get something fixed"; (3) "I go to a dentist occasionally, whether or not I have a problem"; or (4) "I go to a dentist regularly." For the purpose of this report, persons who responded #1 or #2 were classified as "problem-oriented attenders," and those who responded #3 or #4 were classified as "regular attenders." Other demographic characteristics queried were: age group (45–64 years old, or ≥65 years old), sex, race, and area of residence (rural or urban). Race and ethnicity were queried separately, and the study was limited to African Americans and non-Hispanic whites.

Six socioeconomic variables were queried. Ability to pay an unexpected $500 dental bill was measured by three categories ("able to pay comfortably," "able to pay, but with difficulty," or "not able to pay the bill"). Present financial situation was measured by four categories ("I really can't make ends meet," "I manage to get by," "I have enough to manage, plus some extra," or "Money is not much of a problem; I can buy about whatever I want"). Poverty status relative to the 100 percent threshold as defined by the 1990 US Census was estimated during the telephone screening survey. Participants were also asked to report their total household income (above or below a $20,000 threshold), level of formal education, and whether they had any dental insurance coverage. For the sake of brevity, discussion of financial status is limited to ability to pay an unexpected $500 dental bill. This is because results and conclusions using any of the measures were substantially redundant.

We have previously described the factor analysis of the eight measures of oral disadvantage shown in Table 1 (5). Briefly, the factor analyses suggested oral disadvantage should be analyzed as three different but related "domains": oral disadvantage due to disease/tissue damage, oral disadvantage due to pain, and oral disadvantage due to function. Table 2 shows the eigenvalues, percentage of variance explained by each of the three factors, along with the rotated promax factor loadings of the eight questions used to measure oral disadvantage. The questionnaire was not originally designed for subjecting the measures of oral disadvantage to factor analysis, wherein more questions would be used for the measurement of the factors (13). As a result, factor 3 contained only two items. We maintained oral disadvantage due to pain as a separate domain based on differential predictors of each at baseline (5), and potential differences in intervention options for the three disadvantage domains. Oral disadvantage was measured by asking subjects to report whether mouth problems caused them to avoid certain activities at the time of the interview or within the last six months. Most of these items were adapted with minor revision from the work of Cushing, Sheiham, and Maizels (14). Table 3 lists the frequency of responses to the eight measures of oral disadvantage. Also listed in Table 3 is the dichotomization of the four categorical responses for the three oral disadvantage domains used in the analyses. The decision to dichotomize the four categorical responses was based on the relatively small cell sizes in the "sometimes," "fairly often," and "very often" categories.

Statistical Methods. Results were weighted using the sampling proportions to reflect the population in the counties studied, using a method that minimized the variance inflation resulting from sample design effects (11). Data management and analyses were conducted using SAS Systems for Windows®, version 8.0 (SAS Institute, Inc., 1999).

Participants were at risk of oral disadvantage onset at the end of each six-month interval on the condition that no disadvantage was reported during the preceding six-month interval. Intervals at risk were calculated for each participant beginning with the six-month interview, if there was no report of disadvantage at baseline, and ended with the 24-month interview. If a subject did not participate in

TABLE 3
Frequency of Responses to Eight Measures of Oral Disadvantage, and Dichotomization of Three Oral Disadvantage Domains

	Frequency of Responses to 8 Measures of Oral Disadvantage					Dichotomization of 8 Measures of Oral Disadvantage		Dichotomization of 3 Measures of Oral Disadvantage	
Measures of oral disadvantage	Missing *n* (%)	No *n* (%)	Sometimes *n* (%)	Fairly Often *n* (%)	Very Often *n* (%)	No *n* (%)	Yes† *n* (%)	No‡ *n* (%)	Yes‡ *n* (%)
Due to disease/tissue damage								9,140 (92.8)	708 (7.2)
Avoided laughing/smiling	209 (6)	3,003 (86)	169 (4.8)	37 (1.1)	74 (2.1)	3,003 (91.5)	280 (8.5)		
Avoided talking	211 (6)	3,129 (89.6)	86 (2.5)	20 (0.6)	46 (1.3)	3,129 (95.4)	152 (4.6)		
Been embarrassed	208 (6)	3,008 (86.1)	150 (4.3)	46 (1.3)	80 (2.3)	3,008 (91.6)	276 (8.4)		
Due to pain								6,347 (96.8)	210 (3.2)
Trouble sleeping	213 (6.1)	3,172 (90.8)	80 (2.3)	12 (0.3)	15 (0.4)	3,172 (96.7)	107 (3.3)		
Kept from doing normal activites	214 (6.1)	3,175 (90.9)	62 (1.8)	21 (06.)	20 (0.6)	3,175 (96.9)	103 (3.1)		
Due to function								8,683 (88.3)	1,145 (11.7)
Avoided chewing hard things	224 (6.4)	2,566 (73.5)	338 (9.7)	132 (3.8)	232 (6.6)	2,566 (78.5)	702 (21.5)		
Prevented from eating foods	215 (6.2)	2,926 (83.8)	157 (4.5)	81 (2.3)	113 (3.2)	2,926 (89.3)	351 (10.7)		
Avoided eating with others	209 (6.0)	3,191 (91.4)	38 (1.1)	13 (0.4)	41 (1.2)	3,008 (91.6)	276 (8.4)		

*Percentages exclude missing values.
†Includes responses: sometimes, fairly often, and very often.
‡Sum of oral disadvantage dichotomized measures within each of the three oral disadvantage domains.

an interview, the interval was omitted from the calculation of time at risk. At baseline, 329 individuals reported oral disadvantage due to one of the three disadvantage domains within the last six months prior to the interview, and were not eligible for disadvantage onset at the six-month interval. However, participants were allowed to reenter the risk pool if they reported a recovery from disadvantage. The percentage of individuals reporting oral disadvantage at baseline and each interval were described previously (15).

Incidence rates were derived by calculating the number of onsets per person-intervals at risk. Logistic regression analysis was performed to estimate odds ratios (OR), which were then used to quantify the magnitude of effect for the demographic and socioeconomic variables with the occurrence of oral disadvantage within each interval, for each of the three disadvantage domains. Because a person could report more than one oral disadvantage domain at each interview, SAS macro coding was used to correlate the error terms across the three disadvantage domains, which is necessary to avoid invalid estimation of the parameter estimates and their standard deviations. Correlating the error terms across the three disadvantage domains also allowed direct comparison of the magnitude of the associations between the demographic and socioeconomic variables and the three disadvantage domains. This was done for both the multivariate-univariable (three outcomes—one predictor variable) and multivariate-multivariable (three outcomes—multiple predictor variables) analyses. This is in contrast to doing three separate univariate-multivariable logistic regressions for each of the three disadvantage domains, the error terms of which would not be correlated across equations, and which would preclude direct comparison of the magnitude of their parameter estimates. A generalized estimating equation (GEE) was used to estimate standard errors of the odds ratios using an unstructured correlation matrix structure for the data.

Results

Oral Disadvantage Incidence. Oral disadvantage due to disease/tissue damage, due to pain, and due to function were reported at least once in 264, 157, and 408 study participants, respectively. Table 4 shows the incidence of oral disadvantage by domain for all subjects, and by their approach

TABLE 4
24-month Incidence* of Oral Disadvantage for Sample Overall, and by Approach to Dental Care and Race/Ability to Pay Unexpected $500 Dental Bill

Measure of Oral Disadvantage (Person Intervals)	All Subjects	Dental Attenders' Approach to Dental Care		Race and Ability to Pay Unexpected $500 Dental Bill			
				Not Able to Pay or Able to Pay with Difficulty		Able to Pay Comfortably	
		Regular	Problem-oriented	African Americans	Non-Hispanic Whites	African Americans	Non-Hispanic Whites
Due to disease/tissue damage (3,066)	50.9	25.2	88.0†	107.6	72.0†	35.0	16.5
Due to pain (3,300)	27.6	17.2	41.1†	57.2	33.5†	10.3	10.9
Due to function (2,686)	101.3	71.5	146.7†	200.4	88.2†	52.4	79.5

*Rate/1,000 person-intervals.
†$P<.05$ for differences between strata.

TABLE 5
24-month Incidence* of Oral Disadvantage by Sex and Age Group

Measure of Oral Disadvantage	Sex		Age Group	
	Males	Females	45–64 Years	65+ Years
Due to disease/tissue damage	36.1†	63.6†	53.1	48.3
Due to pain	24.6	29.9	29.3	25.5
Due to function	84.4†	116.2†	93.7	112.4

*Rate/1,000 person-intervals.
†$P<.05$ for differences between strata.

to dental care and race-financial status. For the overall sample, oral disadvantage incidence was highest for oral disadvantage due to function, followed by disadvantage due to disease, and then disadvantage due to pain. Problem-oriented dental attenders had significantly higher incidences for each oral disadvantage domain than did regular dental attenders. Individuals who were not able to pay an unexpected dental bill, or were able to pay with difficulty, had significantly higher incidences for each oral disadvantage domain than did individuals who were able to pay comfortably. African Americans who were not able to pay an unexpected $500 dental bill or who were able to pay, but with difficulty had significantly higher incidences of oral disadvantage for each domain when compared to non-Hispanic whites. There was no significant difference in the incidence of oral disadvantage between African Americans and non-Hispanic whites who were able to pay an unexpected $500 dental bill comfortably in any of the three domains. The transitional patterns of oral disadvantage by domain at the subject level are provided through the Web site listed in the *Acknowledgments* section.

Table 5 shows the incidence of oral disadvantage by sex and age group. Females had a significantly higher incidence of oral disadvantage due to disease/tissue damage and due to function compared to males. No significant difference in oral disadvantage incidence was observed in the two age groups for the three disadvantage domains.

Demographic and Socioeconomic Variables. Table 6 gives the odds ratios (OR) and corresponding 95 percent confidence interval (95% CI) for each demographic and socioeconomic variable. This is done for each oral disadvantage domain using two columns. In the first column, we show a univariable analysis (a cross-tabulation of the demographic and socioeconomic variables with the onset of oral disadvantage). In the second column, we show the OR and 95 percent CI after adjustment for all other variables in the table simultaneously using a single trivariate multivariable regression analysis.

Univariable Analyses. Approach to dental care, race, educational level, and situation if faced with an unexpected $500 dental bill were associated with each of the three disadvantage domains. Sex and dental insurance were associated with both the disease/tissue damage and functional limitation disadvantage domains. No difference was seen in the two age groups for the three disadvantage domains.

Multivariable Analyses. Multivariable analyses were conducted to determine the association between each demographic or socioeconomic variable and oral disadvantage, after adjusting for the influence of the other variables. Approach to dental care was associated with both the disease/tissue damage domain and the functional disadvantage domain. However, problem-oriented attenders were more likely to experience disadvantage due to disease/tissue damage (OR=2.0) than disadvantage due to functional limitation (OR=1.5). African Americans had an adjusted disadvantage occurrence due to functional limitation 1.3 times higher than non-Hispanic whites. Disadvantage due to disease/tissue damage occurred 1.6 times as often in females than males. Rural residents reported significantly higher occurrence of disadvantage due to pain (OR=1.8) when compared to urban residents. Individuals who

TABLE 6
Demographic and Socioeconomic Predictors of Oral Disadvantage

	Disadvantage Due to					
	Disease/Tissue Damage		Pain		Function	
Demographic Variables (Weighted Person-intervals)	Unadjusted OR (95% CI)	Adjusted* OR (95% CI)	Unadjusted OR (95% CI)	Adjusted* OR (95% CI)	Unadjusted OR (95% CI)	Adjusted* OR (95% CI)
Approach to dental care						
Problem-oriented attenders (1,598)	3.3 (2.2, 4.8)†	2.0 (1.3, 3.1)†	2.4 (1.5, 3.9)†	1.3 (0.8, 2.1)	1.8 (1.4, 2.4)†	1.5 (1.1, 2.1)†
Regular attenders (1,894)	1.0	1.0	1.0	1.0	1.0	1.0
Missing (0)						
Age group						
65+ years (1,444)	0.9 (0.6, 1.2)	0.8 (0.6, 1.2)	0.8 (0.6, 1.3)	0.8 (0.6, 1.3)	1.2 (0.9, 1.6)	1.1 (0.8, 1.4)
45–64 years (2,050)	1.0	1.0	1.0	1.0	1.0	1.0
Missing (0)						
Race						
African Americans (971)	2.1 (1.5, 3.0)†	1.2 (0.8, 1.8)	2.3 (1.5, 3.4)†	1.4 (0.9, 2.1)	1.7 (1.3, 2.3)†	1.3 (1.1, 1.7)†
Non-Hispanic whites (2,510)	1.0	1.0	1.0	1.0	1.0	1.0
Missing (11)						
Sex						
Female (1,963)	1.8 (1.2, 2.7)†	1.6 (1.1, 2.4)†	1.2 (0.8, 1.9)	1.0 (0.6, 1.5)	1.3 (1.1, 1.7)†	1.3 (1.0, 1.7)
Male (1,530)	1.0	1.0	1.0	1.0	1.0	1.0
Missing (0)						
Area of residence						
Rural (1,745)	0.8 (0.6, 1.2)	1.1 (0.8, 1.6)	1.3 (0.8, 1.9)	1.8 (1.2, 2.9)†	0.9 (0.7, 1.2)	1.1 (0.8, 1.4)
Urban (1,747)	1.0	1.0	1.0	1.0	1.0	1.0
Missing (0)						
Socioeconomic Variables (Weighted Person-intervals)						
Level of formal education						
Did not graduate high school (735)	2.2 (1.6, 3.1)†	1.3 (0.9, 1.8)	2.7 (1.8, 4.0)†	1.8 (1.1, 3.0)†	1.8 (1.4, 2.3)†	1.3 (1.0, 1.7)
Graduated high school (2,754)	1.0	1.0	1.0	1.0	1.0	1.0
Missing (4)						
Dental insurance						
No (2,315)	2.2 (1.4, 2.3)†	1.5 (1.0, 2.4)	1.4 (0.9, 2.3)	1.1 (0.7, 1.7)	1.4 (1.0, 1.9)†	1.3 (0.9, 1.7)
Yes (1,174)	1.0	1.0	1.0	1.0	1.0	1.0
Missing (4)						
Situation if faced with unexpected $500 dental bill						
Unable to pay (489)	2.5 (1.8, 3.5)†	2.5 (1.4, 4.5)†	2.3 (1.5, 3.5)†	3.0 (1.5, 6.3)†	1.5 (1.1, 1.9)†	0.9 (0.6, 1.4)
Able to pay, with difficulty (1,369)	2.0 (1.4, 2.8)†	2.3 (1.4, 3.9)†	1.9 (1.3, 3.0)†	2.9 (1.5, 5.4)	1.3 (1.0, 2.7)	1.1 (0.8, 1.5)
Able to pay comfortably (1,625)	1.0	1.0	1.0	1.0	1.0	1.0
Missing (10)						

*Adjusted for all other variables in the table.
†$P<.05$.

did not graduate from high school were 1.8 times as likely to report disadvantage due to pain than individuals who graduated. Situation if faced with an unexpected $500 dental bill was associated with disadvantage due to disease/tissue damage and due to pain.

Discussion

Our analyses support four conclusions: (1) there are significant differences in oral disadvantage incidence based on approach to dental care, race, sex, area of residence, level of formal education, and financial circumstance; (2) after adjusting for the effects of other variables, approach to dental care and situation if faced with an unexpected $500 dental bill were the most strongly associated with disadvantage occurrence; (3) racial and sex disparities in oral disadvantage were largely explained by differences in approach to dental care and financial resources between these groups; (4) different demographic and socioeco-

nomic characteristics were differentially associated with each disadvantage domain. We will now discuss each of these conclusions in turn.

Incidence of Oral Disadvantage. Overall, there were 101 occurrences of oral disadvantage due to function per 1,000 individuals, 51 occurrences of oral disadvantage due to disease per 1,000 individuals, and 27 occurrences of oral disadvantage due to pain per 1,000 individuals in the 24 months of follow-up. This indicates that oral disadvantage is a common occurrence in the general population, with the majority of disadvantage attributed to functional decrements.

The estimates of oral disadvantage incidence are conservative, due to the conservative method of defining an occurrence. The reports of oral disadvantage were transitory, making it difficult to determine if a report of oral disadvantage was a new occurrence or a previous occurrence of more than six-months' duration. Therefore, we decided to define an occurrence conditional on the absence of disadvantage at the beginning of the interval. By this definition, an individual reporting disadvantage at the end of two consecutive intervals contributed only one occurrence. Our conditional onset criterion also serves to exclude the most severely affected individuals who had a primary occurrence of disadvantage at each of the four intervals.

Independent Predictors of Oral Disadvantage. Multivariable analysis indicated that the strongest independent predictors of disadvantage were approach to dental care and situation if faced with an unexpected $500 dental bill. Each had an OR of two or more for at least one domain, after adjustment for other demographic and socioeconomic variables. Regular dental attenders reported significantly lower rates of oral disadvantage compared with problem-oriented attenders. One study (16) suggested that regular dental attenders place a greater emphasis on preventive as well as corrective interventions than do problem-oriented attenders. Regular attenders were also more likely to recognize the prophylactic benefits of careful oral hygiene, demonstrated a more sophisticated understanding of dental health, and were less likely to report tobacco use than problem-oriented attenders. Prior research has also demonstrated that regular dental attenders report a lower incidence of tooth loss (17), and were more likely to use incident dental services (6), both of which are hypothesized to be related to oral disadvantage.

Race was a weak predictor of oral disadvantage due to function (OR=1.3). The multivariable analysis demonstrated a reduction in the effect of race and sex on disadvantage occurrence, but an increase in the effect of the participant's ability to pay an unexpected $500 dental bill. This indicates that the differences in oral disadvantage attributed to race and sex may be due to differences in financial circumstance. Other significant differences observed between race and sex groups on disadvantage may be due to differences between groups in their tendency to report any symptoms, unobserved differences in oral health, or differences in importance placed on oral health.

Reporting a rural residence and not graduating from high school were each independent predictors of disadvantage due to pain. After adjusting for the effect of other variables, the magnitude of the association observed in area of residence increased. The observed difference between rural and urban residence may be due to differences in access to routine dental care. Urban residents may be accessing the dental care system before antecedent conditions progress to pain. Not graduating high school may also indicate an access to care issue not captured in the other demographic and socioeconomic variables

Differential Association with Disadvantage Domains. In the multivariable analyses, problem-oriented attenders were more likely to experience disadvantage due to disease and disadvantage due to function. African Americans were more likely to report disadvantage due to function. Rural residents were more likely to report disadvantage due to pain. Individuals who were not able to pay an unexpected $500 dental bill were more likely to experience disadvantage due to pain. In light of these differential associations with the three disadvantage domains, we suggest that future studies continue to disaggregate oral disadvantage into specific domains. Health indices aggregate these categories, which may tend to obscure the associations detected in our analysis.

Study Strengths and Limitations. The findings should be interpreted in light of the strengths and limitations of the study. To our knowledge, this is the first longitudinal study of oral disadvantage. The results are generalizable to individuals with similar racial, socioeconomic, and demographic characteristics, and who have telephones. Further studies using an even broader range of racial an socioeconomic groups are warranted.

We evaluated oral disadvantage as three separate domains. This methodology allowed for differential quantification of the effects of specific characteristics on each of the three oral disadvantage domains. For example, in Table 6, we were able to distinguish significant differences between males and females across domains that would be obscured if the domains were aggregated.

Although the study used short intervals between the administrations of questionnaires, i.e. six months, some oral disadvantage conditions may have had shorter periods of duration, and may not have been recalled by the study participants. Furthermore, chronic cases of oral disadvantage lasting longer than six months were difficult to differentiate from primary disadvantage events occurring in two adjacent intervals. Both of these situations would underestimate oral disadvantage. We also should note that our measures of oral health used extent and duration, not severity. Thus, we further recommend further including gradations of severity, as well as ranking the importance of these OHRQOL events in relation to other domains that affect overall QOL.

We utilized person-intervals as the unit of analysis, not the individual. In doing so, we are not able to characterize individuals reporting various events within multiple disadvantage domains. The characterization of multiply disadvantaged individuals would be informative, and will be the focus of future research.

Finally, the measures of area of residence, insurance status, and ability to pay an unexpected $500 dental bill are likely to vary across time. Because these variables were measured at baseline only, we were not able to evaluate their change longitudinally. However, we do not expect that there would be a large amount of variation in these variables over the short duration of follow-up.

All measurements used in the analyses were self-reported and did not rely on clinical data. Self-assessments of oral health have become a useful tool in dental research. Cross-sectional self-assessments have demonstrated that oral health has a substantial impact on adults' daily activities and QOL (3,5,8,9,18-21). However, the use of clinical data does not address how or to what extent oral diseases and disorders affect functioning and psychosocial well-being. The use of self-reported measures allows for a better measurement of the multidimensional aspects of OHRQOL, wherein the dimensions do not exist independently, but exist in the context of other QOL dimensions (22).

Implications for Public Health Policy. We judge that our findings are salient to public health policy due to the identification of the substantial incidence of oral disadvantage within our population. The identification of racial and socioeconomic disparities and the importance of approach to dental care underscore the need for public health intervention. The interruption of events leading to oral disadvantage within these groups, through educational interventions at the patient and community level, may significantly improve OHRQOL, QOL, and reduce the proportion of health care resources now allocated to treating these detriments.

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The informed consent of all who participated in this investigation was obtained after the nature of the procedures had been explained fully. An Internet home page devoted to details about the FDCS can be found at http://nersp.nerdc.ufl.edu/~gilbert/ (formerly at http://www.nerdc.ufl.edu/~gilbert/).

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