Racial and Socioeconomic Disparities in Health from Population-Based Research to Practice-Based Research: The Example of Oral Health


Abstract: Oral health serves as an excellent model for understanding social disparities in health. Associations among race, socioeconomic status, oral health, and dental care are strong. Multiple points along the dental care process allow investigation of disparities and mechanisms; and there are multiple types of treatment services (ranging from those that all patients and clinicians would likely agree on, to multiple treatment options, to discretionary treatments). Florida Dental Care Study (FDCS) data are used to provide examples of these concepts. Without regard to whether the dental care system was ultimately entered, the FDCS found substantive social differences in 1) incidence of need; 2) responsiveness to this need; and 3) propensity to seek preventive services. Once the dental care system had been accessed, substantive social differences were still evident with regard to 1) clinical condition; 2) awareness of treatment options; and 3) treatment discussions and recommendations. Once differences in clinical condition were taken into account, and once analysis was limited to persons who had entered the dental care system, social differences in receipt of care were still evident. Findings suggested that although dental care was effective at treating and preventing certain oral conditions, social differences in treatment effectiveness were evident.

The growing literature on racial, ethnic, and socioeconomic status (SES) disparities in health and health care has documented significantly poorer health among low-SES and non-Hispanic African Americans (AAs) when compared to high-SES persons and non-Hispanic whites (NHWs).1 Disparities in oral health are also now widely recognized.2 In attempting to understand the reasons for these disparities, it is clear that social differences in health and health care should be distinguished from social disparities. A recent review1 by the Institute of Medicine concluded that social differences can be due to 1) clinical appropriateness, need, and patient preferences; 2) the operation of the health care system and the legal and regulatory climate; and 3) biases, stereotyping, and uncertainty. Differences due to items #2 and #3 constitute disparities as well as differences. The Institute of Medicine committee defined “disparities” in health care as racial or ethnic differences in the quality of health care that are not due to access-related factors or clinical needs, preferences that are based on a full and accurate understanding of treatment options, or appropriateness of intervention.1

Oral Health as a Model for Investigating Social Disparities in Health

Oral health serves as an excellent model for understanding social disparities in health and health care use and delineating mechanisms. This is because the associations among race, SES, and oral health and dental care are strong and because there are multiple points along the health care process from which to identify possible disparities and mechanisms—from disease incidence in the population at large (i.e., without regard to whether someone chooses to enter the dental care system), to the possible entry into the health care system, to treatment receipt, to treatment outcome. The study of dental care in social disparities research also offers key ad-
A Model of Oral Health

Understanding how oral health may influence dental care utilization first requires an understanding of the multiple dimensions of oral health. Included among the objectives of the FDCS was the development and testing of a multidimensional model of oral health, which by linking it to incident dental care utilization, would presumably improve our understanding of both oral health and dental care use. Analyses from the FDCS have demonstrated the construct validity and predictive validity of this model, as well as its utility in understanding incident dental care use. For the sake of brevity, we simply describe the model as comprising five dimensions of oral health and oral health-related quality of life (OHRQOL), as seen in Figure 1. These dimensions are the following: oral disease and tissue damage; oral pain and discomfort; oral functional limitation; oral disadvantage; and self-rated oral health. Table 1 shows how each of these dimensions were measured in the FDCS.

The emerging field of OHRQOL has produced oral health indices, profiles, and batteries. Some investigators have proposed oral health indices and profiles, which combine scores across dimensions of oral health to form a single score. However, if group differences in this score are observed, we still want to know if these differences exist across all dimensions, or if one dimension has such a large difference that the index overall exhibits group differences. And, if no group differences are observed, we still have the same question. Consequently, the FDCS approach focused on disaggregated results, rather than summary scores or indices, which may actually obscure change. For illustrative purposes, consider the person who goes to a dental office because of toothache pain (an example of oral pain and discomfort) due to severe dental caries (an example of oral disease and tissue damage). With extraction of the tooth, the person no longer has a decrement in oral health due to toothache pain (an example of oral pain and discomfort) due to severe dental caries (an example of oral disease and tissue damage). Without regard to whether the dental care system is ultimately entered, there may be substantive social differences in:

- recognition of symptoms;
- prevalence and incidence of oral symptoms and other aspects of need;
- responsiveness to this need, whether response means self-care or seeking formal dental care;
- propensity to seek preventive services.

Once the dental care system has been accessed, there may be substantive social differences in:

- clinical condition and disease severity;
- awareness of treatment options;
- treatment discussions and treatment recommendations;
- quality of care and treatment effectiveness.

Data from the Florida Dental Care Study (FDCS) are used in this article to provide examples of these concepts. One key objective of the FDCS was to investigate social differences in oral health and dental care. FDCS data provide examples of the concepts listed in bullets above, allowing for investigation of possible social disparities at each point along this health care process, from the population-based setting to the practice-based setting. The FDCS was a six-year observational prospective cohort study of diverse groups of dentate middle-aged and older adults. (A full list of publications from the study is located at the Internet site listed in the Acknowledgments.) The study used a “multidimensional model of oral health” as the conceptual basis for quantifying changes in oral health, for determining whether these changes are predictive of dental care use and dental self-care, and for quantifying the effectiveness of dental care. It also used a “behavioral model of health services utilization” as the conceptual basis for evaluating other predictors of dental care use (e.g., race and SES). We briefly discuss these two models in turn to provide background for our analyses.
tions were combined to form a single score. For this reason, ever since its baseline phase development in 1993, FDCS measurement entailed using an oral health/OHRQOL battery of questions, rather than using an index or profile approach.

A Model of Health Services Utilization

Several approaches have been proposed to better conceptualize the study of health services use, but the one that has received the broadest use—and the one used in the FDCS—has been a behavioral model proposed by Andersen and Newman. In this behavioral model, health care utilization is viewed as the result of characteristics of the population at risk and the health care delivery system. The relevant population characteristics can be summarized as predisposing, enabling, and need characteristics. Table 2 shows how the predisposing and enabling dimensions were measured in the FDCS (Table 1 lists the need characteristics). Predisposing characteristics are those that exist prior to disease and can be either mutable or immutable. Enabling characteristics are resources that affect one’s ability to access the health care system, such as household income or health insurance coverage. Need variables reflect illness that requires the use of services or a self-care response.

The model is depicted graphically in Figure 2 and was formally conceptualized in preparation for the FDCS. This model has two components: risk assessment of oral health (component #1) and risk assessment of utilization of dental care services (component #2). Because we relate risk assessment of oral health (1st component) to “risk assessment” of utilization of specific dental procedures (2nd component), the conceptual aspects of our model are explained best by describing separately components #1 and #2. The model has two outcomes of interest: 1) the use of dental care, and 2) oral health, which is affected by the first outcome. To communicate a correspondence between conceptual development (conveyed graphically in Figure 2) and the actual measurement of these concepts, we also make reference to items in Tables 1 and 2.

The basis for risk modeling of oral health is the notion that certain risk factors actually exist and

### Table 1. Oral health and OHRQOL measures used in the FDCS

<table>
<thead>
<tr>
<th>Oral disease &amp; tissue damage</th>
<th>Oral pain &amp; discomfort</th>
<th>Oral functional limitation</th>
<th>Oral disadvantage</th>
<th>Self-rated oral health</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Measured by clinical examination</strong></td>
<td>Toothache pain</td>
<td>Difficulty speaking or pronouncing because of mouth</td>
<td>...due to disease and tissue damage</td>
<td>Self-rated overall oral health</td>
</tr>
<tr>
<td>Presence, location of teeth</td>
<td>Dental sensitivity</td>
<td>Current chewing difficulty</td>
<td>Avoided laughing or smiling because of mouth</td>
<td>dental health</td>
</tr>
<tr>
<td>Crown decay and fillings</td>
<td>Denture soreness</td>
<td></td>
<td>Avoided talking because of mouth</td>
<td>periodontal health</td>
</tr>
<tr>
<td>Root decay and fillings</td>
<td></td>
<td></td>
<td>Been embarrassed by appearance of mouth</td>
<td>Satisfaction with...</td>
</tr>
<tr>
<td>Bulk fractures of fillings</td>
<td></td>
<td></td>
<td></td>
<td>oral health</td>
</tr>
<tr>
<td>Cusp/incisal edge fractures</td>
<td></td>
<td></td>
<td></td>
<td>chewing ability</td>
</tr>
<tr>
<td>Root fragments</td>
<td></td>
<td></td>
<td></td>
<td>dental appearance</td>
</tr>
<tr>
<td>Severe root surface defects</td>
<td></td>
<td></td>
<td>Perceived need for dental care</td>
<td></td>
</tr>
<tr>
<td>Severe tooth mobility</td>
<td></td>
<td></td>
<td></td>
<td>...-yes, for a routine check-up</td>
</tr>
<tr>
<td>Periodontal attachment loss</td>
<td></td>
<td></td>
<td></td>
<td>...-yes, due to specific problem</td>
</tr>
<tr>
<td><strong>Self-reported measures</strong></td>
<td></td>
<td></td>
<td></td>
<td>...-no, in good shape now</td>
</tr>
<tr>
<td>Broken filling</td>
<td></td>
<td></td>
<td></td>
<td>...-no, have problem, but can wait</td>
</tr>
<tr>
<td>Broken tooth or cap</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cavities</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abscessed tooth</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Infected or sore gums</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Bleeding gums</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Loose tooth</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Loose cap or bridge</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Teeth stained or look bad</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bad breath</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Trouble with food catching</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Broken denture</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Has and wears...</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>maxillary full denture</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>maxillary partial denture</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mandibular partial denture</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dry mouth</td>
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</tbody>
</table>
are significant in understanding the variation in disease and other aspects of oral health. That is, oral disease is not distributed randomly in the population; rather, its distribution is affected by the presence of certain risk factors (past dental care use, race, SES, oral hygiene, etc.). From a modeling perspective, path A in Figure 2 is hypothesized to be statistically significant and substantively important. A more complex graphic would show paths leading from each of the hypothesized risk factors to the box containing oral health. Consequently, the effects of individual risk factors can be tested separately, for each aspect of oral health (oral disease, pain, functional limitation, etc.). In a longitudinal study, risk factors are measured at Time 1 and correlated with changes in oral health observed at Time 2 (labeled as “oral health (need factors) at Time 2” in Figure 2). The variables that are grouped as “Oral health at Time 1 and between Times 1 and 2” are the same ones that are measured at Time 2. All that has occurred is the passage of time. The two constructs will of course be correlated.

If the measures of oral health are quantified over time and an intervening dental treatment causes a change in these measures, then the change is an outcome of treatment. These outcomes could also be the result of a change in some other intervening factor, such as a change in oral hygiene behavior or, more indirectly, a change in attitude toward dental health. Consequently, what was called oral health (or “need factors”) at Time 1 can be conceptualized at Time 2 as oral health outcomes of treatment. The total effect of the predisposing and enabling characteristics on oral health outcomes can be quantified by adding the products of paths C and D, paths A, B, and D, paths A and E, and path F. An important feature of this model is that dental care is viewed as a modifier of the relationship between disease and health outcomes, not its sole determinant.

In Figure 2, the Andersen model is depicted by the “predisposing and enabling factors” and “need factors” boxes, each of which influences “dental care use.” Path C implies that the predisposing and enabling characteristics directly affect dental care use. In the context of their direct effect on dental care use (that is, for risk assessment of dental care utilization, or “component 2”), the variables in the first box are “predisposing and enabling factors”; in the context of their direct effect on oral health (“component 1” of Figure 1), these same variables can be theorized as “risk factors.” Also in the context of the Andersen model, oral health decrements act as need characteristics and directly affect dental care use. That is, path B is hypothesized to be substantively important and statistically significant. The effects of individual types of oral health decrements can also

Table 2. Predisposing and enabling variables measured in the FDCS

<table>
<thead>
<tr>
<th>Predisposing variables</th>
<th>Enabling variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approach to dental care</td>
<td>Ability to pay an unexpected $500 dental bill</td>
</tr>
<tr>
<td>Age</td>
<td>Present financial situation (degree to which income meets expenses)</td>
</tr>
<tr>
<td>Race</td>
<td>Household income</td>
</tr>
<tr>
<td>Rural/urban area of residence</td>
<td>Poverty status relative to 100 percent and 150 percent thresholds</td>
</tr>
<tr>
<td>Level of formal education</td>
<td>Dental insurance coverage</td>
</tr>
<tr>
<td>Tooth brushing frequency</td>
<td>Time to the nearest dentist</td>
</tr>
<tr>
<td>Flossing frequency</td>
<td>Other dental self-care behaviors</td>
</tr>
<tr>
<td>Frequency of using toothpicks to clean teeth</td>
<td>Propensity to use homemade remedy</td>
</tr>
<tr>
<td>Propensity to select dental extraction over root canal</td>
<td>Propensity to select dental extraction over root canal</td>
</tr>
<tr>
<td>Self-rated general health</td>
<td>Smoking history and smokeless tobacco usage</td>
</tr>
<tr>
<td>Smoking history and smokeless tobacco usage</td>
<td>Diabetes diagnosis</td>
</tr>
<tr>
<td>Diabetes diagnosis</td>
<td>Dental attitudes and knowledge</td>
</tr>
<tr>
<td>Frustration with past dental care</td>
<td>Oral health decrements act as need characteristics and directly affect dental care use.</td>
</tr>
<tr>
<td>Quality of recent dental care</td>
<td>Self-rated general health</td>
</tr>
<tr>
<td>Importance of dental visits to prevent dental problems</td>
<td>Smoking history and smokeless tobacco usage</td>
</tr>
<tr>
<td>Eventuality of dental decline</td>
<td>Diabetes diagnosis</td>
</tr>
<tr>
<td>Influence of dental care costs on past treatment</td>
<td>Dental attitudes and knowledge</td>
</tr>
<tr>
<td>Cynicism toward dentists and dental care</td>
<td>Dental attitudes and knowledge</td>
</tr>
<tr>
<td>Effectiveness of dental care</td>
<td>Dental attitudes and knowledge</td>
</tr>
<tr>
<td>Know what a root canal procedure is</td>
<td>Dental attitudes and knowledge</td>
</tr>
</tbody>
</table>
be assessed quantitatively by comparing the magnitude of the paths going from each of the oral health measures (caries, functional deficits, etc.) to dental care use. Path E implies that oral health measures can themselves change, without the intervening influence of dental care use. Path D implies that dental care use can directly affect oral health. Note that the predisposing and enabling factors have a direct effect on dental care use through path C and an indirect effect on dental care use as quantified by the products of paths A and B. Path F implies that change in oral health itself can itself be influenced by predisposing and enabling factors.

Methods

FDCS sampling methodology details are provided elsewhere. The issue of bias due to attrition has also been addressed in detail earlier. Briefly, the 873 baseline subjects comprised a representative sample, defined as persons forty-five years old or older, who had a telephone, did not reside in an institutional setting, resided in one of four counties in north Florida, could engage in a coherent telephone conversation, and had at least one tooth (one objective was to investigate tooth loss). Race and ethnicity were queried separately; only AAs and NHWs were included because, in the four Florida counties selected, these two groups comprised more than 97 percent of the population. At baseline, this sample had an “interval since last dental visit” that was very similar to National Health Interview Survey (NHIS) data, and conclusions regarding determinants of dental care recency were the same. Additionally, the percentage that had at least one dental visit in the first two years of the FDCS (77 percent) was very similar to the figure (75 percent) among the comparable group of NHIS respondents.

An in-person interview and clinical dental examination were conducted at baseline. This was followed by telephone interviews at six, twelve, eighteen, thirty, thirty-six, forty-two, fifty-four, sixty, and sixty-six months. At twenty-four, forty-eight, and seventy-two months, the interview was done in person, and was followed immediately by the clinical examination. Examination diagnostic criteria and examiner reliability have been detailed previously.

These four dimensions comprise OHRQOL and are self-reported.

Disease and tissue damage measured by clinical exam and self-report

Figure 1. Conceptual framework of the multidimensionality of oral health and OHRQOL
Participants were asked for permission to review their dental records. Of the 297 dentists in 286 practices named by subjects through forty-eight months, all but ten practices participated. Methodologic details about this phase of data collection have been published previously.45

Participants were asked about dental care utilization, oral symptoms and related behaviors, dental attitudes, oral hygiene habits, history of or current presence of various dental diseases and conditions, and sociodemographic circumstance. Questionnaire content and test-retest reliability of questions have been described previously.9,27,30 Additionally, dentists who coincidentally served one or more FDCS participants were asked to complete an eleven-page questionnaire about themselves and the characteristics of their practices. A total of 204 of the 286 dental practices returned a practice characteristics questionnaire. (Complete wording of all FDCS questionnaire items can be viewed at the Internet site listed in the Acknowledgments.)

The ultimate goal of this line of research is to understand disease and its impact. Therefore, comparing the rates of diseases, conditions, and decrements in OHRQOL between social groups was of prime interest. As findings from the FDCS emerged, it became clear that a participant’s “approach to dental care” was a salient factor in understanding oral health and dental care use, as well as a strongly predictive factor that crossed race and SES lines. Consequently, we concluded that approach to care was also an important variable for social disparities research. Approach to care was self-reported as a distinguishing characteristic during the baseline interview. Participants were asked to describe their approach to 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.” Persons who responded #1 or #2 were classified as “problem-oriented attenders”; those who responded #3 or #4 were classified as “regular attenders.”

**Results**

**Social Differences in Prevalence of Disease and Its Impact**

When compared to their NHW, higher SES, and regular attender counterparts, AAs, lower SES persons, and problem-oriented attenders had a higher prevalence of coronal caries, root fragments, cusp/incisal edge fractures, root caries, severely mobile teeth, and severe periodontal attachment loss, even though they had a higher prevalence of missing teeth.5,6,8,12 Problem-oriented attenders had a higher prevalence of fractured fillings, but AAs and lower SES persons did not.5 NHWs, higher SES persons,
and regular attenders had a higher prevalence of filled coronal surfaces.5

The prevalence of OHRQOL decrements was also higher among AAs, lower SES persons, and problem-oriented attenders, as measured by dental pain, chewing difficulty, oral disadvantage, self-rated oral health, dissatisfaction with chewing ability, and perceived need for dental care.4,7,9-12,33

Social Differences in Incidence of Disease During Follow-Up

The prevalence of diseases and conditions at baseline is not only relevant for its own sake when attempting to understand social disparities in health, but it is also necessary to understand social differences in the incidence of new diseases and conditions after baseline and during the FDCS follow-up period. The typical measure of this new disease is incidence, defined as new disease observed during follow-up. However, in high-risk populations with substantial disease at baseline, relying on this measure alone can miss substantial change. For that reason, the FDCS disaggregated post-baseline change into “onset,” “recovery,” and “chronicity.”14,36 “Onset” only occurs when new disease is evident among persons, mouths, or teeth (depending on the unit of analysis) that did not have the disease at baseline. Therefore, only units that did not have the disease at baseline are “eligible” to experience onset. Units that did have disease at baseline can still change—as a result of no longer having the disease at follow-up, also known as experiencing “recovery.” Conversely, units that did have disease at the beginning of the observation interval but which did not recover can now be said to have “chronic” disease, which in the FDCS was defined as having the disease for two consecutive observation intervals (six months for self-reported information, and twenty-four months for clinical examination data). The conceptions of onset, recovery, and chronicity are especially relevant for high-risk populations, whose incidence rate for new disease could be low only because so many units had disease at the beginning of the observation interval.

Despite having a higher prevalence at baseline, AAs, lower SES persons, and problem-oriented attenders still had a higher incidence of periodontal attachment loss, tooth loss, coronal caries, root caries, and a phenomenon that to our knowledge was first reported in the FDCS: tooth loss occurring outside of a health care facility.13,16,17,25,37,46 When compared to their NHW, higher SES, and regular attender counterparts, AAs, lower SES persons, and problem-oriented attenders also had a higher incidence of onset of new OHRQOL decrements—namely, dental pain, chewing difficulty, and oral disadvantage.19,21,32 AAs, lower SES persons, and problem-oriented attenders were also more likely to have experienced chronic decrements in OHRQOL during follow-up, including a small percentage of the sample that reported these decrements at baseline and every six-month interval during the first twenty-four months of the study.19,32,36

Higher Prevalence and Incidence Do Not Translate into Higher Dental Care Utilization

Having established that AAs, lower SES persons, and problem-oriented attenders had both a higher prevalence and incidence, we next determined whether having more disease and disease impact translated into higher dental care utilization rates during follow-up or became manifest by other responses, such as dental self-care. This investigation ultimately led to our description of a phenomenon that we have come to refer to as the “paradox of dental need.”30,34 Without even focusing on the social disparities issue directly, we can conclude that a substantial number of dental problems remained or developed among the population that did not enter the dental care system. This paradox of dental need has three components: 1) need predicts dental care use but is dependent upon which measure of need is used; 2) however, persons with a higher probability of new dental problems are actually less likely to seek dental care; and 3) self-reported disease and oral pain are associated with a higher likelihood of seeking care, whereas clinically determined need, chewing difficulty, lower self-rating, and satisfaction with oral health are actually associated with a lower likelihood, the former direction being the predominant and expected direction. Taken as a whole, analyses regarding the paradox of dental need34 suggested that 1) persons who enter the dental care system are actually in better dental health than those who do not; 2) need factors predict dental care use, but this conclusion is dependent upon which measure of need and which dental care outcome measure is used; 3) self-reported disease and oral pain are associated with a higher likelihood of seeking care, whereas clinically determined need, chewing difficulty, lower self-rating, and satisfaction with oral health are actually associated with a lower likelihood, the former direction being the predominant and expected direction. Taken as a whole, analyses regarding the paradox of dental need suggested that 1) persons who enter the dental care system are actually in better dental health than those who do not; 2) need factors predict dental care use, but this conclusion is dependent upon which measure of need and which dental care outcome measure is used; 3) self-reported disease and oral pain are associated with a higher likelihood of seeking care, whereas clinically determined need, chewing difficulty, lower self-rating, and satisfaction with oral health are actually associated with a lower likelihood, the former direction being the predominant and expected direction. Taken as a whole, analyses regarding the paradox of dental need suggested that 1) persons who enter the dental care system are actually in better dental health than those who do not; 2) need factors predict dental care use, but this conclusion is dependent upon which measure of need and which dental care outcome measure is used; 3) self-reported disease and oral pain are associated with a higher likelihood of seeking care, whereas clinically determined need, chewing difficulty, lower self-rating, and satisfaction with oral health are actually associated with a lower likelihood, the former direction being the predominant and expected direction.
though oral disease and tissue damage determined by clinical examination predict dental care use, they actually predict in a negative direction; 5) even though need strongly predicts use, predisposing and enabling characteristics are also strongly predictive (even with need factors taken into account), and their effects are especially strong when care is sought for more “discretionary” reasons, such as for a dental cleaning or a dental check-up; and 6) the conclusions one makes about the role of need characteristics in dental care utilization depend upon how one defines need and how one defines the utilization outcome.

In FDCS analyses that focused on racial differences in dental care utilization, we chose to stratify analyses by race instead of simply using race as a predictor variable. This latter strategy was indeed more elucidative, because stratified analyses led to a better understanding of the predictors of dental utilization, as well as to a better understanding of the distinction between prevalence of a factor and the race-specific magnitude of its effect on dental care use and of racial differences in the statistical significance and effect magnitude of predictors. Racial differences in approach to dental care were especially revealing. A total of 61 percent of AAs classified themselves at baseline as consistent problem-oriented attenders, compared to only 25 percent of NHWs. What has consistently emerged from FDCS findings to date has been the value of understanding participants’ typical approach to dental care, which not only predicts subsequent dental utilization, but also is associated with dental disease, self-reported oral health problems, dental attitudes, dental self-care, dental self-extractions, and use of tobacco products. Racial differences in ability to pay an unexpected dental bill were also revealing. More than half of NHWs stated that they would be able to pay comfortably, compared to less than one-fourth of AAs. Income has consistently been identified as a predictor of dental utilization. Our race-specific analyses highlight the racial differences in this key predictor.

There were no statistically significant racial differences in prevalence of frustration with past dental care, propensity to use a homemade remedy, or presence of dental insurance. However, these similar prevalences between races contrast with the substantively different effects on dental utilization that were evident between AAs and NHWs. These race-stratified analyses of care suggested that 1) AAs are more likely to be problem-oriented attenders, to be unable to pay an unexpected $500 dental bill, and to have dental problems; 2) although AAs reported higher levels of need for dental care, they were nonetheless less likely to have sought dental care; 3) NHWs were much more likely to have sought care for preventive reasons; 4) frustration with past dental care, propensity to use a homemade remedy, and dental insurance were salient predictors of use among AAs, but not among NHWs, with other covariates taken into account; 5) although NHWs reported a greater ability to pay for dental care, ability to pay actually had a stronger effect on dental utilization among NHWs than it did among AAs; 6) NHWs were more responsive to a broken tooth and satisfaction with dental appearance than AAs, and broken fillings and oral disadvantage were salient predictors among NHWs, but not among AAs; and 7) although fewer predictors were statistically significant in the AA model, ability to explain utilization was better for AAs, judging from a better regression model fit.

At baseline, AAs, lower SES persons, and problem-oriented attenders had more negative attitudes toward dental care and dental health and were less knowledgeable of dental services. Dental attitudes at baseline were significantly associated with approach to dental care, but race and SES contributed independently to dental care even with dental attitudes taken into account. These results foreshadowed the longitudinal findings in which baseline approach to dental care very strongly predicted dental care utilization during follow-up, but race and SES also predicted utilization independent of and in addition to approach to care.

Response to dental conditions is not limited to seeking formal care; it can also entail dental self-care, including dental self-extraction. Although problem-oriented attenders used less dental care, they did not compensate by employing more “conventional” dental self-care behaviors, but reported being more likely to employ “unconventional” behaviors. They were more likely to believe that nothing can be done to prevent dental problems.

**Social Differences in Receiving Specific Dental Services**

Having established that AAs, lower SES persons, and problem-oriented attenders were less likely to enter the dental care system for any reason even though they had higher levels of need, we next determined whether—once analysis had been limited to persons who had entered the dental care system—social differences were still evident. Because per-
sons could, and in many instances did, receive services of more than one type, a methodologic issue arose when wanting to quantify effects across services, by race, SES, and approach to care. Adjusting for the correlation that may exist across receipt of multiple service outcomes required development of statistical programming to address this issue in the FDCS.47

Analyses revealed that even with other predisposing, enabling, and need characteristics taken into account, AAs were much less likely to receive dental cleanings, restorative dentistry, and fixed prosthodontic services and were much more likely to have a tooth extracted. SES was predictive of receipt of fixed prosthodontic services, but not other service categories. Problem-oriented attenders were much less likely to receive a dental cleaning, but approach to care was not associated with receipt of other services.

Tooth Loss as an Example of Social Disparities in Health Care Use

To our knowledge, the FDCS was the first longitudinal study focused on social disparities in tooth loss that had detailed, tooth-specific information on clinical status, a level of detail necessary for comprehensive case-mix adjustment. This proved elucidative, because social differences in dental clinical status, along with information on post-baseline dental symptoms, did indeed account for a major portion of social disparities in tooth loss. However, had we not been persistent about understanding the mechanism, we would not have concluded that there even was a disparity in tooth loss incidence. This is because without disaggregating the tooth loss process into two steps, we would not have observed any social differences. Before entering the dental care system, race and SES make a difference due to social differences in disease levels and new dental symptoms and due to social differences in propensity to seek dental care. After entering the dental care system, race and SES make a difference due to social differences regarding which treatment is ultimately received. The larger contribution of the FDCS analyses of social disparities in tooth loss lies in its demonstration that we cannot understand health disparities without understanding disparities in health care use and treatment receipt. Our example underscores the importance of disaggregating health care use (e.g., dental care use) from health outcome (e.g., tooth loss). Because social disparities in health care use and health outcome can operate in opposite directions, disaggregation allows us to observe a substantial disparity. If disaggregation is not done, then no disparity is apparent. This disaggregation not only identifies a disparity; it helps us to understand its mechanism. Taken as a whole, the tooth loss analyses suggested that 1) race and SES are strong determinants of tooth loss incidence; 2) a detailed accounting of racial and SES differences in dental disease extent and severity and new dental symptoms explains a major portion of social disparities in tooth loss, a leading measure of a population’s oral health; 3) AAs and lower-SES persons are less likely to enter the dental care system, but are at increased risk for tooth loss once they do; and 4) accounting for disparities in dental care use plays a major role in understanding race and SES effects on tooth loss; absent such understanding, the total effects of race and SES on health can be underestimated.

Dental practice characteristics, as well as social differences in the degree to which treatment alternatives are discussed with patients, may also play a role in social disparities in tooth loss, and this line of research may prove fruitful. AAs reported a lower likelihood that a dentist had discussed alternatives to dental extraction. During the forty-eight-month follow-up period, the same phenomenon was observed: AAs who lost at least one tooth were much less likely to have reported that the dentist had discussed other treatment alternatives.37

Social Differences in Treatment Preference

One reason that we observe social differences in receipt of treatment services could also be due to social differences in treatment preference. Although the measurement of dental attitudes does shed some light on treatment preferences,27 the only FDCS item that specifically queried treatment preference had to do with a scenario asked at baseline regarding preference for a dental extraction or root canal treatment. Ultimately, this baseline response was very strongly predictive of whether FDCS participants received an extraction or root canal treatment during follow-up, demonstrating the high predictive validity of the question. The hypothetical scenario required choosing either to 1) extract the tooth before even knowing the cost of treatments; 2) extract, but after knowing the cost of all treatments; or 3) have root canal treatment despite knowing costs. The key advantage of a hypothetical scenario is that it allows racial com-
comparisons that are not confounded by racial differences in patient-provider interactions or clinical circumstance at the time of treatment. AAs were significantly less likely to choose root canal treatment, with SES taken into account. Results from the multivariable regression suggested that the race effect could be explained by combined racial differences in patient preference, treatment acceptability, and ability to afford treatment.

### Social Differences in Treatment Effectiveness

An additional step in the health care process from which social differences might be manifest has to do with possible differences in treatment effectiveness. That is, given that social groups have received the same treatment and given that we have accounted for any social differences in clinical circumstance, are differences in treatment effectiveness still evident? Analyses from the FDCS regarding social differences in treatment effectiveness are ongoing. However, recent analyses using certain OHRQOL outcomes suggest that AAs experience greater treatment effectiveness than NHWs when receiving a dental extraction, although conclusions do vary depending upon presenting symptoms.

Observational studies of treatment effectiveness are recognized as alternatives to randomized clinical trials when randomization into treatment groups is unethical or not practical. However, because persons in observational studies naturally self-select into whether they receive treatment, results from these observational studies (such as the FDCS) can be biased if characteristics associated with treatment group assignment (or whether or not someone received any treatment) are also associated with treatment outcome. That is, persons who receive treatment could have improved anyway, even if they had not received treatment, leading to an incorrect conclusion about the effectiveness of treatment. To account for this possible “selection bias,” the FDCS was the first study to apply sample selection models to a longitudinal study and to binary (yes/no; e.g., onset or not) outcomes. Adjustment for selection bias can make a substantial difference in conclusions made about treatment effectiveness. This is due in part to an adverse selection phenomenon in which those most in need of treatment (and consequently who may be most likely to benefit from it) are actually the ones least likely to seek treatment, a phenomenon that we have come to refer to as the “paradox of dental need.”

### Discussion

A potentially important limitation of the FDCS sample is that it was derived from four counties in one state. Although we have demonstrated that the FDCS sample had much in common with what would have been derived from a comparable national sample, we remind the reader that generalization is with regard to the defined population of interest, and studies from other populations—especially other racial and ethnic minority groups and other age group cohorts—are advisable.

This study provides evidence that oral health can serve as a model for understanding social disparities in health. Social differences and disparities in oral health and dental care are evident at multiple points along the continuum—from health differences and disparities that remain out in the population at large, to those that are still evident at entry into the dental care system, to those evident as a result of treatment receipt, to those that are evident based on treatment outcome. These findings can serve as background for research specifically designed to delineate further mechanisms in social disparities and for developing policy initiatives to ameliorate these disparities.

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REFERENCES


