Influence of Cigarette Smoking on the Overall Perception of Dental Health Among Adults Aged 20–79 Years, United States, 1988–1994

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SYNOPSIS

Objective. Investigation into the relationship between lifestyle factors (particularly cigarette smoking) and perceived oral health has been limited. Data from the third National Health and Nutrition Examination Survey (NHANES III), 1988–1994, were used to explore this relationship in a large sample of U.S. adults.

Methods. This study used data on 13,357 dentate participants in NHANES III aged 20–79 years. In NHANES III, information on perceived dental health, sociodemographic attributes, smoking status, frequency of dental visits, dental insurance, and general health perception were collected during a home interview, and oral health status was assessed at a mobile examination center.

Results. Overall, 34.4% of individuals in the study sample reported having an unfavorable perception of their dental health by qualifying it as "fair" or "poor." Furthermore, 46.6% of smokers had an unfavorable dental health perception, compared to 28.3% of non-smokers. An interaction between smoking and race/ethnicity was found in logistic regression modeling. Stratified results show that cigarette smoking was not a significant predictor for an unfavorable dental health perception among individuals who self-identified as Mexican American, but smoking was a significant predictor for an unfavorable dental health perception among those who identified as non-Hispanic black or non-Hispanic white.

Conclusions. This is the first study to describe the effects of smoking on dental health perception while controlling for examined oral health status. Because perceived dental health is a potential indicator for dental care utilization, a better knowledge of the factors that influence dental health perception is not only important for dental services planning, but also for understanding oral health–related quality of life issues. Additionally, given that smoking may negatively affect dental health perception, these findings have potential implications for smoking cessation activities conducted by dental care providers.

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Oral health is recognized today as an integral determinant of overall health and social well-being. To be able to speak, eat, and socialize are fundamental to success and happiness in life.[1] Even among older, medically compromised adults, poor oral health has a significant effect on overall well-being and health perception.[2] Although dental care utilization patterns and dental examination findings are important measures for ascertaining oral health status and overall quality of life, there are many motivating factors that promote dental care utilization that require evaluation as well. Among the factors that affect dental care–seeking behavior, perceived dental health has been determined to be an important predictor.[3,4]

A potentially important predictor of perceived dental health that has been largely overlooked in past studies is cigarette smoking. Either smoking was not included as an independent factor for analysis, or inferences regarding the influence of cigarette smoking were based on specific minority ethnic communities that may not have been representative of the wider population.[5,6] Gilbert et al. have reported that problem-oriented dental care users were more likely than routine dental care users to use tobacco and more likely to self-rate at a lower dental health status.[7] Although a relationship between cigarette smoking and self-reported oral hygiene habits has been reported in conjunction with some oral health problems including bleeding or receding gums, staining, mouth sores, and bad breath,[8] little has been reported on the influence of smoking on the perception of dental health.

Understanding the factors influencing an individual's dental health perception is important for evaluating the effectiveness of the delivery of dental services as well as the effectiveness of disease prevention activities at the community level. The relationship between seeking and receiving dental care and perceived dental health has been evaluated longitudinally. Gilbert et al. reported that individuals with low self-rated dental health were less likely to seek dental care of any type compared to individuals who self-reported disease or oral pain.[9] Furthermore, people who report improvement in their dental health over time use significantly more dental visits and dental services compared with individuals whose dental health perception deteriorates or remains unchanged over time.[10]

Many independent factors have been considered as predictors of dental health perception.[11–13] These factors can be grouped into *sociodemographic variables* (e.g., age, gender, and race/ethnicity), *clinical oral health variables* (e.g., oral diseases and conditions), *behavioral variables* (e.g., diet and hygiene), and finally the *enabling variables* (e.g., insurance status and access to care). Some of these variables have not only been used to evaluate the possible relationship with dental health perception, but also to evaluate the relationship with perceived dental treatment needs.[14] It is important to note that perceived dental health and perceived dental treatment needs may have different implications for future dental health care utilization patterns[15,16] and discrepancies are generally common between dentists' and patients' dental health ratings.[13,17]

Perceived dental health also has a significant predictive effect on overall health perception and life satisfaction.[18] Numerous instruments have been developed to assess dental health perception and its relationship to quality of life issues. These include the Subjective Oral Health Status Indicators (SOHSI), the Oral Health Impact Profile (OHIP), and the Geriatric Oral Health Assessment Index (GOHAI).[19–22]

Smoking is a known risk factor for oral disease, such as periodontal disease and oral cancer.[23–28] An association has recently been reported between passive smoking and pediatric dental caries as well.[29] Given the significant relationship between cigarette smoking and oral health, the purpose of this study was to examine the relationship between cigarette smoking and overall perception of dental health among a nationally representative sample of U.S. adults.

METHODS

Study population

Data from 13,357 adults who participated in the third National Health and Nutrition Examination Survey (NHANES III) from 1988 to 1994 were used. Conducted by the National Center for Health Statistics of the Centers for Disease Control and Prevention, NHANES III utilized a complex, stratified, multistage probability design capable of producing a nationally representative sample of the non-institutionalized civilian population of the United States. NHANES III oversampled individuals who were younger than 6 years of age, older than 60 years of age, and non-Hispanic black or Mexican American. The sample design and informed consent methods have been described in detail elsewhere.[30]

For the present study, data were obtained from the household interview questionnaire and a standardized oral health exam. Trained dentists conducted the dental examinations at mobile examination centers (MECs). Detailed descriptions of the NAHNES III oral health component protocol, quality control processes, and measurement issues have been published elsewhere.[30–32] Among the 20,050 adults completing a home interview, we excluded 3,057 individuals who were younger than 20 or older than 79 years of age from the present study. We also excluded 3,636 individuals who did not complete a dental exam or who were identified as edentulous during the MEC visit. This yielded an analytical sample of 13,357 dentate adults aged 20–79 years.

Outcome variable

The primary outcome variable was based on responses to the question, "How would you describe the condition of your natural teeth: excellent, very good, good, fair, or poor?" (NHANES III question HAQ1). Individuals who responded either "poor" or "fair" were classified for the present study as having an unfavorable perception of their dental health. Those who responded "excellent," "very good," or "good" were classified as having a favorable perception of their dental health. The conceptualization of dental health used for this analysis incorporates perceptions of both natural teeth and the surrounding periodontium. The rationale for this approach is further explained in the Discussion section.

Covariate selection

We included demographic indicators that have been reported to be associated with oral health. Age was grouped into six 10-year intervals for the purpose of calculating prevalence estimates. For most of the analyses, age was dichotomized as

either 20–49 years or 50–79 years. In NHANES III, respondents were asked to report their "race" and "ethnicity." For the present study, self-reported race/ethnicity was categorized as non-Hispanic black, non-Hispanic white, Mexican American, and other. Individuals who were identified as "other" were included only in the total population estimates. Educational attainment was categorized as not having completed high school, having completed high school, or having at least some college experience. Poverty status was dichotomized as ≤100% of the federal poverty level or >100% of the federal poverty level. Poverty status was calculated by dividing self-reported annual family income by the adjusted federal poverty income threshold for the given family size. Gender was also included in the analyses.

Cigarette smoking status was categorized as current smoker, former smoker, or never smoked. Individuals who reported that they had smoked at least 100 cigarettes (approximately five packs) in their lifetime but no longer smoked were classified as former smokers. The perception of general health was based on a five-point scale (NHANES III question HAB1). We described individuals as having an unfavorable perception of their overall health by grouping "poor" and "fair" responses from the perceived general health question. Individuals who responded "excellent," "very good," or "good" were considered to have a favorable perception of their overall health.

Past dental history was categorized as no dental visit in the past 12 months or one or more dental visits in the past 12 months. Another potential predictor of dental health care utilization, dental insurance, was categorized as having insurance that provided some dental benefits or having no dental insurance. Poor oral health status, determined by dental examination, was defined by either the presence of periodontal disease or at least two surfaces of untreated decay. Untreated dental decay was categorized into three groups: three or more dental surfaces with caries, one to two surfaces affected by caries, or caries-free. Using previously reported criteria, we defined the presence of periodontal disease as having any periodontal site with 3 mm or more of attachment loss and 4 mm or more of pocket depth.[33]

Data analysis

All statistical analyses were performed with SUDAAN software, Version 7.5.[34] Sample weights were used in calculating prevalence estimates and related standard errors and in calculating odds ratios (ORs) and 95% confidence intervals (CIs) to account for the unequal probability of selection and non-response. We assessed potential differences among individuals for the outcome variable within the sociodemographic, smoking status, and dental-related categories by using paired *t*-tests. Statistical significance was set at $p<0.05$.

Logistic regression models were used to calculate simple and adjusted ORs with 95% CIs. The dependent variable was an unfavorable perception of dental health. All independent variables were modeled as categorical variables, as described above. Multivariate non-automated stepwise regression modeling was used to assess relationships between the covariates. The standard for retaining variables to produce the most parsimonious model was set *a priori* using a Satterthwaite adjusted *F*-statistic of $p\leq0.05$. Potential interactions were assessed throughout the modeling process by independently incorporating relevant product-terms of the retained significant variables. Satterthwaite *F*-statistic *p*-values were used to evaluate significance of interaction terms at $p\leq0.05$.

RESULTS

The prevalence of perceived condition of natural dentition by selected characteristics is presented in Table 1. More than half of the adults in the sample reported the condition of their natural teeth to be good (36.0%), very good (18.2%), or excellent (11.5%). There was a noticeable increase in the percentage of adults responding "poor" from the younger to the older age groups (range: 9.1% for the 20–29 year group to 19.1% for the 70–79 year group). Among individuals with an unfavorable perception of their overall health, higher percentages perceived the condition of their natural teeth to be poor, fair, or good as opposed to very good or excellent.

Overall, 34.4% of respondents reported an unfavorable perception of their dental health (Table 2). Individuals who self-identified as Mexican American, those who self-identified as non-Hispanic black, those with lower educational attainment, those living in poverty, and those with an unfavorable perception of their overall health were more likely to have an unfavorable perception of their dental health than individuals in the corresponding reference categories. Both cigarette smokers and former smokers were more likely to have an unfavorable perception of their dental health than non-smokers (46.6% of cigarette smokers and 31.8% of former smokers vs. 28.3% of non-smokers). Individuals who reported not having had a dental visit in the past 12 months were more likely to have an unfavorable perception of their dental health than those who reported having had at least one dental visit. Those without dental insurance were more likely to have an unfavorable perception of their dental health than those with dental insurance and those with poor clinical oral health status were more likely to have unfavorable dental health than those without poor oral health. No significant difference was observed between men and women in the likelihood of reporting unfavorable dental health.

Results of the logistic regression modeling are shown in Table 3. Current cigarette smoking, older age, lower educational attainment, self-identifying as non-Hispanic black or Mexican American, an unfavorable perception of overall health, not having had a dental visit in the past 12 months, and poor clinical oral health status were independently associated ($p<0.05$) with having an unfavorable dental health perception in a multivariate logistic regression model that incorporated the most influential covariates (Model 1). Additional modeling (Model 2) showed a significant interaction between race/ethnicity and cigarette smoking status (Satterthwaite adjusted *F*-statistic $p=0.007$). No other interactions were found.

As a result of the race/ethnicity and smoking interaction, we performed a stratified analysis. Table 4 displays the logistic regression results for predictors of an unfavorable dental health perception stratified by race/ethnicity in an analysis that controlled for all other independent covariates. Parsimonious regression modeling revealed that current cigarette smoking was a significant indicator for unfavorable dental health perception only among non-Hispanic black (OR=1.49; 95% CI 1.24, 1.80) and non-Hispanic white adults

Table 1. Perceived condition of natural dentition among dentate adults aged 20–79 years, by selected characteristics, United States, 1988–1994: weighted percents and standard errors (*N*=13,357)

Characteristic	*Excellent* *Percent (SE)*	*Very good* *Percent (SE)*	*Good* *Percent (SE)*	*Fair* *Percent (SE)*	*Poor* *Percent (SE)*
Total	11.5 (0.6)	18.2 (0.5)	36.0 (0.7)	22.5 (0.7)	11.9 (0.5)
Age					
20–29 years	13.1 (1.0)	20.7 (1.0)	34.3 (1.2)	22.5 (1.1)	9.1 (0.7)
30–39 years	12.8 (1.3)	19.7 (1.2)	36.0 (1.5)	22.3 (1.4)	9.2 (0.9)
40–49 years	11.5 (1.3)	19.2 (1.6)	37.1 (1.3)	20.4 (1.3)	11.7 (1.1)
50–59 years	8.8 (1.2)	13.9 (1.2)	38.9 (2.2)	22.3 (1.6)	16.1 (1.3)
60–69 years	9.1 (1.0)	13.3 (1.0)	35.0 (1.8)	25.0 (1.6)	17.5 (1.3)
70–79 years	7.9 (1.1)	13.4 (1.6)	33.8 (2.0)	25.8 (1.3)	19.1 (1.6)
Race/ethnicity					
Mexican American	6.2 (0.4)	9.4 (0.7)	29.7 (1.1)	37.0 (1.2)	17.8 (0.6)
Non-Hispanic black	7.5 (0.5)	12.9 (0.6)	32.9 (0.9)	30.5 (1.0)	16.3 (0.7)
Non-Hispanic white	12.9 (0.7)	20.3 (0.7)	36.4 (1.0)	19.6 (0.8)	10.7 (0.6)
Gender					
Male	11.6 (0.8)	18.0 (0.8)	35.7 (1.1)	23.3 (0.9)	11.5 (0.7)
Female	11.5 (0.7)	18.4 (0.8)	36.2 (0.9)	21.7 (0.9)	12.3 (0.9)
Educational attainment					
Did not complete high school	4.7 (0.6)	8.5 (0.9)	32.0 (1.2)	31.0 (1.1)	23.8 (1.1)
Completed high school	9.8 (0.8)	15.3 (1.0)	37.2 (1.2)	24.8 (1.2)	12.9 (0.8)
Some college	16.0 (0.9)	24.9 (0.9)	36.8 (1.2)	16.7 (0.8)	5.6 (0.5)
Poverty status					
≤100% of federal poverty level	7.2 (1.3)	10.4 (1.1)	30.0 (1.4)	30.8 (1.6)	11.9 (0.6)
>100% of federal poverty level	12.4 (0.7)	19.6 (0.6)	36.6 (0.8)	20.9 (0.7)	10.5 (0.6)
Overall health perception					
Unfavorable	4.5 (0.8)	7.0 (0.8)	24.0 (1.6)	36.3 (1.5)	28.3 (1.5)
Favorable	12.6 (0.7)	19.9 (0.6)	37.8 (0.9)	20.3 (0.7)	9.4 (0.6)
Cigarette smoking					
Current smoker	8.0 (0.8)	12.5 (0.8)	32.9 (1.4)	26.9 (1.3)	19.7 (1.2)
Former smoker	10.9 (0.9)	20.0 (1.2)	37.3 (1.6)	21.1 (1.0)	10.7 (0.7)
Never smoked	13.9 (0.9)	20.7 (0.8)	37.1 (0.9)	20.5 (0.8)	7.9 (0.5)
Dental visit past 12 months					
Yes	13.5 (0.7)	20.6 (0.7)	37.4 (0.9)	19.5 (0.8)	9.0 (0.6)
Dental insurance					
Yes	13.8 (0.9)	21.4 (1.0)	36.8 (1.0)	19.5 (0.9)	8.6 (0.5)
Untreated dental decay					
≥3 surfaces	2.3 (0.5)	4.2 (0.5)	25.6 (1.5)	34.1 (1.3)	33.9 (1.5)
1–2 surfaces	5.4 (0.8)	10.7 (1.2)	37.4 (1.5)	31.3 (1.7)	15.2 (1.4)
None	14.6 (0.7)	22.6 (0.7)	38.1 (1.0)	18.4 (0.8)	6.4 (0.4)
Periodontal disease					
Yes	4.3 (0.6)	10.0 (1.0)	32.4 (1.5)	30.1 (1.4)	23.3 (1.6)
No	12.8 (0.7)	19.9 (0.6)	36.7 (0.8)	21.1 (0.7)	9.5 (0.5)

SE = standard error

(OR=1.88; 95% CI 1.51, 2.34). Among Mexican Americans, only lower educational attainment, having an unfavorable perception of overall health, and having poor clinical oral health status were significantly associated with having an unfavorable perception of dental health. Age, smoking status, and dental visits for Mexican Americans were not included in this final model, but they were tested for and found to be nonsignificant indicators for unfavorable dental health perception during the modeling process. Being 50 years of age and older and not having had a dental visit in the past 12 months were associated with having an unfavorable perception of dental health among non-Hispanic black and non-Hispanic white respondents.

Table 2. Number and percent of dentate adults aged 20–79 with unfavorable dental health self-perception, by selected characteristics, United States, 1988–1994 (*N*=13,357)

Characteristic	*Number*	*Percent (SE)*
Total	13,357	34.4 (1.0)
Age		
50–79 years	4,344	41.2 (1.1)[a]
20–49 years[b]	9,013	31.8 (1.1)
Race/ethnicity		
Mexican American	4,055	54.8 (1.2)[a]
Non-Hispanic black	3,923	46.8 (1.1)[a]
Non-Hispanic white[b]	4,813	30.4 (1.2)
Sex		
Male	6,254	34.8 (1.1)
Female[b]	7,103	34.0 (1.1)
Educational attainment		
Did not complete high school	4,822	54.8 (1.0)[a]
Completed high school	4,287	37.7 (1.5)[a]
Some college[b]	4,165	22.4 (0.9)
Poverty status		
≤100% of federal poverty level	2,855	52.4 (1.9)[a]
>100% of federal poverty level[b]	9,348	31.5 (1.0)
Overall health perception		
Unfavorable	2,981	64.6 (1.5)[a]
Favorable[b]	10,375	29.7 (1.0)
Cigarette smoking		
Current smoker	3,608	46.6 (1.7)[a]
Former smoker	3,021	31.8 (1.3)[a]
Never smoked[b]	6,727	28.3 (1.1)
Dental visit past 12 months		
No	5,246	47.2 (1.3)[a]
Yes[b]	8,045	28.5 (1.1)
Dental insurance		
No	5,551	37.2 (1.2)[a]
Yes[b]	5,196	28.0 (1.1)
Oral health status		
Poor	5,079	57.4 (1.4)[a]
Not poor[b]	7,299	23.6 (0.9)

[a]$p<0.05$ for comparison with reference category.

[b]Reference category

SE = standard error

DISCUSSION

The aim of this study was to improve understanding of the relationship between smoking status and self-perceived dental health using data on a sample of adults who were representative of the U.S. population aged 20–79 years. The data suggest that among the selected demographic, enabling, behavioral, and clinical characteristics examined, cigarette smoking is an important indicator for having an unfavorable dental health perception. Since the Surgeon General's seminal publication on smoking and health in 1964[35] and continuing with the recent Surgeon General's report on *The Health Consequences of Smoking*,[36] a plethora of additional information has emerged demonstrating a relationship between smoking and poor oral health status. However, reported information quantifying the effects of smoking on dental health perception has been limited. Although Atchison and Gift have reported that non-smoking behavior was indicative of a more positive dental health perception among a diverse group of adults using U.S. data from the International Collaborative Study II (ICS II), they did not describe how differing levels of smoking status may affect dental health perception.[6]

Perceived dental health data reported from the ICS II participatory sites in the U.S. (based on a six-point scale, from 1=excellent to 6=poor) have indicated that significant differences between race/ethnic groups in self-perceived dental health exist at the extremes of the scale.[37] Other research has indicated that general health perception, dental visits, and economic status are associated with perceived dental health.[6] Using a rating system similar to that used in NHANES III to assess perceived health status, a Los Angeles study of Medicare recipients found that other factors associated with differences in dental health perception include a concern with appearance of teeth, race, education, and mental health problems.[38] Although our results support previous findings indicating that the major correlates to self-rated dental health include education, dental visits, and overall health perception, these findings also suggest that the influence of race/ethnicity on dental health perception is more complex than has been previously reported.

The interaction between smoking and race/ethnicity in the regression models describing unfavorable perception of dental health is a significant finding. These data suggest that smoking is not only a factor of interest, but is also an effect modifier for the association between race/ethnicity and perceived dental health. The influence of smoking on unfavorable dental health perception varied across racial/ethnic groups and was found only among current cigarette smokers. This suggests that cultural influences may mitigate smoking effects on unfavorable dental health perception. These findings support earlier conclusions by Atchison and Gift, who suggested that cultural values may play a mixed role in perception of dental health for various ethnic groups.[6] Cigarette smoking has been found to vary between and within racial/ethnic populations, often related to lifestyle differences or strong parental and community disapproval.[39] Our findings may reflect complex interactions involving multiple factors such as individuals' susceptibility to advertising, affordability of cigarettes, lifestyle preferences, and community values.

The U.S. Surgeon General has reported that lifestyle behaviors such as tobacco use profoundly affect oral health.[40] Given that Tomar and Asma have reported that more than half of periodontal disease cases in the U.S. can be attributed to smoking,[28] reducing tobacco use will not only reduce the burden of poor oral health, but it may improve dental health perception. This cluster of effects may influence overall health and health-related quality of life.

It has been reported that a relationship exists between dental health behaviors and general health behaviors[41] and

Table 3. Results of simple and multivariate logistic regression analyses to assess predictors of unfavorable dental health perception among U.S. adults aged 20–79 years (*N*=13,357)

Characteristic	*Unadjusted OR (CI)*	*Model 1 OR (CI)*	*Model 2 OR (CI)*
Age			
50–79 years	1.51 (1.36, 1.67)	1.43 (1.23, 1.67)	1.44 (1.23, 1.69)
20–49 years	1.00	1.00	1.00
Sex			
Male	1.04 (0.94, 1.14)		
Female	1.00		
Race/ethnicity			
Mexican American	2.78 (2.40, 3.22)	1.84 (1.58, 2.14)	
Non-Hispanic black	2.02 (1.78, 2.28)	1.31 (1.14, 1.52)	NR
Non-Hispanic white	1.00	1.00	
Cigarette smoking status			
Current smoker	2.21 (1.94, 2.51)	1.73 (1.44, 2.08)	
Former smoker	1.18 (1.01, 1.38)	1.10 (0.94, 1.28)	NR
Never smoked	1.00	1.00	
Educational attainment			
Did not complete high school	4.21 (3.71, 4.78)	1.79 (1.52, 2.12)	1.78 (1.51, 2.11)
Completed high school	2.10 (1.83, 2.41)	1.50 (1.31, 1.72)	1.49 (1.30, 1.71)
Some college	1.00	1.00	1.00
Poverty status			
≤100% of federal poverty level	2.40 (2.02, 2.84)		
>100% of federal poverty level	1.00		
Overall health perception			
Unfavorable	2.37 (1.64, 3.42)	2.74 (2.27, 3.31)	2.73 (2.26, 3.30)
Favorable	1.00	1.00	1.00
Dental visit past 12 months			
No	2.00 (1.64, 2.44)	1.51 (1.31, 1.74)	1.51 (1.31, 1.74)
Yes	1.00	1.00	1.00
Dental insurance			
No	1.52 (1.37, 1.68)		
Yes	1.00		
Oral heath status			
Poor	4.37 (3.82, 5.00)	3.14 (2.70, 3.65)	2.73 (2.26, 3.30)
Not poor	1.00	1.00	1.00
Interaction between smoking and race/ethnicity	—	—	p=0.007[a]

[a]Satterthwaite adjusted *F*-statistic

OR = odds ratio

CI = confidence interval

NR = not reported

that these health behaviors are interrelated predisposing factors for oral and overall health.[42] For example, smoking is a common health behavior risk factor for both dental and cardiovascular disease. Individuals may also perceive dental health as having an impact on their overall quality of life.[43] Gift et al. have studied oral health and health-related quality of life within a multidimensional framework to describe the importance of examining oral health as an integral part of general health.[44] Our findings indicate that a lower self-rating of overall health is significantly associated with a lower self-rating of dental health.

It has been suggested that the relationship between clinical oral health status and perceived dental health is inconsistent.[40] Although Gooch et al. found that toothache and greater numbers of decayed teeth were strongly associated with a lower self-rating of dental health,[45] Rosenberg et al. reported that some clinical measures of caries history were not associated with perceived dental health.[46] However, data from our

Table 4. Results of multivariate logistic regression analysis, stratified by race/ethnicity and controlled for all other covariates, for adults aged 20–79 years with an unfavorable dental health perception (*N*=13,357)

Self-reported characteristic	*Mexican American OR (CI)*	*Non-Hispanic black OR (CI)*	*Non-Hispanic white OR (CI)*
Age			
50–79 years		1.35 (1.14, 1.60)	1.50 (1.26, 1.79)
20–49 years		1.00	1.00
Cigarette smoking status			
Current smoker		1.49 (1.24, 1.80)	1.88 (1.51, 2.34)
Former smoker		1.15 (0.91, 1.46)	1.14 (0.94, 1.38)
Never smoked		1.00	1.00
Educational attainment			
Did not complete high school	2.44 (1.90, 3.13)	1.68 (1.37, 2.05)	1.75 (1.39, 2.21)
Completed high school	1.75 (1.36, 2.26)	1.56 (1.28, 1.90)	1.47 (1.24, 1.73)
Some college	1.00	1.00	1.00
Overall health perception			
Unfavorable	2.93 (2.56, 3.36)	3.85 (3.09, 4.81)	2.43 (1.90, 3.11)
Favorable	1.00	1.00	1.00
Dental visit past 12 months			
No		1.30 (1.12, 1.52)	1.60 (1.33, 1.93)
Yes		1.00	1.00
Oral heath status			
Poor	3.02 (2.49, 3.66)	2.53 (2.11, 3.05)	2.43 (1.90, 3.11)
Not poor	1.00	1.00	1.00

OR = odds ratio

CI = confidence interval

study suggest that a significant relationship does exist between a lower self-rating of dental health and poor clinical oral health status. Because our preliminary findings suggested that indicators of periodontal disease and untreated dental caries were associated with dental health perception (Table 1), we aggregated tooth decay and periodontal disease into a single oral health status covariate. Parsimonious regression models further indicated that poor dental health status was one of the strongest indicators for a fair or poor perception of one's dental health.

Findings from the 1989 National Health Interview Survey indicate that people who rate their health as excellent or very good are more likely to have had a dental visit within the past year or to have private dental insurance coverage compared to those who rate their overall health as fair or poor.[47] Even though dental insurance was associated with favorable self-perceived dental health in our bivariate analysis (Table 2), dental insurance was not a significant independent cofactor in the regression analysis. These findings are similar to those reported by Gift et al. using similar data from Phase 1 of NHANES III, 1988–1991.[48]

A model highlighting a variety of factors that may influence perceived dental heath status has been presented by Gift et al.[48] As described by the authors, the model parallels work by Andersen[49] and considers population factors (demographic and cultural determinants) and enabling factors (access to care and ability to pay, orientation to care, health literacy) as multiple influences on the perception of oral health. Although the authors did not ascribe any specific health behavior as an enabling factor, they ascribed "predisposing/enabling" factors, such as education, ability to pay, general health perception, and dental utilization as points of influence along a continuum toward "overall perceived condition of natural dentition." The primary difference between their approach and ours was the inclusion of an unfavorable health behavior in our model, i.e., cigarette smoking. Among the intermediate (predisposing/enabling) factors described, education and overall health perception remained significant factors in the Gift et al. model following multivariate regression modeling, but the ability to pay covariates did not. Our modeling approach produced similar main effect findings. However, the primary difference was the discovery that smoking was a significant effect modifier in our regression models describing factors predicting perceived dental health.

Although the American Dental Association has promoted tobacco-use prevention activities in the dental office[50] and the Centers for Disease Control and Prevention have highlighted tobacco control activities as a critical element in the effort to reduce oral and pharyngeal cancers,[51] tobacco cessation intervention is not commonplace in dental practice, and intervention advice, when provided, is often cursory and spurious.[52,53] Because smoking may negatively affect dental health perception and individuals with an unfavorable perception of dental health are less likely to be regular users of dental services than those with a favorable self-perception, our findings have potential implications for tobacco cessation

activities conducted by dental providers. Although brief interventions from health care providers can lead to smoking cessation, more intense and more frequent tobacco-use prevention activities are more effective.[54] Effective dental practice–based tobacco-use prevention programs could achieve cessation rates in excess of 10% each year.[55]

This study focused on smoking status as an important indicator variable for unfavorable dental health perception. A limitation of this study is the inability to assess the direct impact of smoking cessation on perceived dental health status independent of other covariates examined, such as receipt of routine dental care. Additionally, this study used data derived from a question that specifically assessed the perceived condition of respondents' natural teeth. We used the terms "favorable" and "unfavorable" perception of dental health to describe concepts such as perceived oral health or perceived dental condition. This assumes a broader definition for the outcome variable by incorporating the perception of both natural teeth and the periodontium. This approach has been used by others[47] and is used in the current NHANES. In the 2003–2004 survey, following the question "How would you describe the condition of your teeth?" a follow-up open-ended question probing for specific problems "with teeth" is administered to participants who respond "good," "fair," or "poor." Periodontal or gum-related problems are valid responses to this follow-up inquiry.

This is the first study to report on the relationship between smoking and dental health perception in analyses controlling for oral health status. These findings are important for dental health professionals and public health policy makers. Individuals' perceived dental health is currently recognized as a good indicator of perceived dental treatment needs and future dental care utilization. Recognizing significant indicator variables likely to influence and result in dental health care–seeking behavior may aid in planning of community programs for dental services and the allocation of resources. Furthermore, understanding the factors that influence dental health perception is essential for expanding our knowledge of quality of life issues. Improvements in dental health perception may require a multidimensional approach that not only includes reducing the burden of dental disease but addresses cultural issues and lifestyle factors such as smoking. Further research is needed to evaluate the potential effectiveness of smoking cessation in improving dental health perception and oral health–related quality of life.

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