Healthy Practices, Social Relationships and Dental Perceptions Among US Dentate Adults

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Abstract

Objective: *This study explored and described the effects of healthy practices and social relationships on dental perceptions among U.S. dentate adults.* ***Methods:*** *Guided by the Alameda County Study: Health and Ways of Living, weighted data from the Third National Health and Nutrition Examination Survey of 8,449 U.S. dentate adults aged 18-64 years were analyzed with SUDAAN 7.5.3.* ***Results:*** *Healthy practices and social relationships showed protective effects against unfavorable dental perceptions after controlling for socio-demographic characteristics, dental access, and related clinical dental status. Besides healthy practices and social relationships, education, family income, having dental visit in the past 12 months, having dental decay, having defective tooth condition, and number of natural teeth helped explain unfavorable dental perceptions in the adjusted model. Compared with persons who had high social relationships and high healthy practices, those who had low social relationships with very low, low and medium healthy practices were about five times (OR=5.07; 99% CI=3.24, 7.91), almost four times (OR=3.61; 99% CI=2.22, 5.87), and two times (OR=2.24; 99% CI=1.37, 3.67) more likely, respectively, to have unfavorable dental perceptions. In the adjusted model, these odds ratios decreased to three (OR=3.30; 99% CI=2.01, 5.41), two (OR=2.06; 99% CI=1.15, 3.69) and non-significant difference, consecutively.* ***Conclusions:*** *Influence of healthy practices and social relationships on dental health may encourage dental health professions to participate in general health behavior modifications and social actions to foster social relationships, in addition to preventive dental care.*

Key Words: social support, social networks, health behaviors, health surveys, dental health surveys, perceptions.

Introduction

Human social relationships have been shown to affect health and well being (1-4). The first wave of research after the influential work of social epidemiologists John Cassel (1976) and Sydney Cobb (1976) focused on the macro level of analysis between social relationships and various health outcomes, including longevity, physical, mental and social health at both individual and aggregated levels (5-7). After being criticized for unclear measurement and subjective interpretations, this approach to social relationships was modified and resulted in a new generation of network measures (2). This new approach operationalized social relationships as intimate, informal and formal. Examples of each level were being married, membership in voluntary associations, belonging to churches, contacts with friends and relatives (8-11). Gottlieb, among others, named this type of social relationship 'social integration' or 'social participation' because it is operationalized and measured in terms of people's involvement in social activities (5). Others referred to it as social connectedness, social ties, social embeddedness or social activity (2). Whatever this social relationships approach was named, studies often involved large samples with a longitudinal design and focused on macro level rather than on detailed assessments of the nature and quality of social relationships. The Alameda Study is considered a landmark study in this area (2, 3, 8, 9).

Ever since the Alameda County Study, *Health and Ways of Living*, suggested that number of healthy lifestyle practices and the extent of an individual's formal and informal social connectedness were important determinants of longevity, physical and social health status, (8, 9) questions have been raised about the generalizability of these findings to other populations and to other domains of health. Several studies have evaluated the applicability of the Alameda findings and generalizations to other geographic locations, such as Tecumseh in Michigan (12) and North Carolina (13). Since the late 1980s, studies of the effect of social relations on oral health have been accumulated but are likely limited to the elderly groups (14). Research has not yet been carried out to evaluate whether the generalizations from the Alameda Study extend to the oral health of the general population. The key foci of the Alameda Study—the number of healthy lifestyle practices and the extent of an individual's social relationships—have not yet been explored systematically in relation to the oral health domain.

This study explored whether the number of healthy practices and the extent of an individual's social relationships were related to the perceived dental status of the adult population using data from the Third National Health and Nutrition Exami-

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nation Survey (NHANES III). Also, the nature of such relationships was examined. Detail of NHANES III has been shown elsewhere (15, 16).

Methods

Sample. This study included 10,037 dentate adults 18-64 years of age who participated in NHANES III during 1988 though 1994. However, the actual number of observations used in each pairwise deletion analysis varied from 8,449 to 10,037 to avoid large missing cases due to a listwise procedure (17). Samples were those who (i) provided self-responses to the questions about healthy practices, social relationships, perceived general status, perceived dental status, and the interval since the last dental visit; (ii) were rated as reliable respondents by the NHANES III interviewers; and (iii) participated in the oral examination component of the NHANES III. Only dentate adults were included because a person without natural teeth was not asked about their perceived dental status. Because adults age 65 and over in NHANES III were more likely to be excluded from the oral examination due to medical exclusion criteria than those who were 64 years of age or under (18), they were excluded from this study.

Data Analysis. The analyses were performed with weighted data using SUDAAN software (Version 7.5.3) that can accommodate the NHANES III complex sampling design (19, 20). Logistic regression analyses were used with an alpha level 0.01 for all statistical evaluation of the results. Correlations between the studied variables were checked to avoid a multicollinearity problem in the analysis (21). To meet the NHANES III analytical guideline, collapsing of variable categories was done if a minimum unweighted cell size of 30 could not be obtained in any analysis (16).

The dependent variable of this study was having a fair or poor dental perception. This variable was generated from the Household Adult Questionnaire (HAQ) single question, "how would you describe the condition of your natural teeth: excellent, very good, good, fair or poor." Fair and poor dental perception categories were pooled for analytical purpose (16).

Two independent variables of this study were the number of healthy practices and the extent of social relationships. The number of healthy practices was generated from the Household Adult Questionnaire (HAQ), the Mobile Examination Center Adult Questionnaire (MEC) and the anthropometric examination. These five practices were (i) eating breakfast daily; (ii) being physically active; (iii) being a non-tobacco user; (iv) being a non-binge or non-heavy drinker of alcohol beverages; and (v) maintaining one's weight within desirable limits for one's age, sex, and height. Besides the variable 'Eating breakfast daily', definitions of the other four practices were based on those used in Healthy People 2010, e.g., 'Having a desirable body weight' was an adult 20 to 64 years of age who had Body Mass Index (BMI) between 18.5 and 25.0 kg/m^2 or an adolescent 18 to 19 years of age who had BMI between 95th percentile of those BMI values (22). Each healthy practice score was combined and categorized as very low (0-1 practices), low (2 practices), medium (3 practices), high (4-5 practices). The extent of social relationships, which was generated from the HAQ, was measured by a sum of five items including (i) the frequency with which an individual talks on the telephone with family, friends or neighbors; (ii) the frequency with which an individual gets together with friends or relatives; (iii) the frequency with which an individual visits neighbors in his or her own or others' homes; (iv) the frequency with which an individual attends church or religious services; and (v) the frequency with which an individual attends meetings of clubs or other voluntary organizations. Because of the highly skewed distribution of each item's responses, each item response was transformed into a standardized T score. Three categories of low, medium and high social relationships were then developed based on each individual's ranking in the total T score distribution. Current marital status was used as a control variable rather than as a component of the social relationships because of its absence of associations with each of the five items used in the social relationships variable. Also, it was inappropriate to develop a scale of social relationships because of very low inter-item correlations.

The overall or unadjusted effects of the number of health practices and the extent of social relationships were analyzed independently followed by the joint effects of these two independent variables on fair or poor dental perceptions. A joint effect is an adjusted effect of both explanatory variables on outcome variables without control variables in the model, whereas a net effect is an adjusted effect of each explanatory variable on outcome variables with control variables in the model. Control variables were then introduced sequentially into the modeling as follows: (i) perceived general health status to clarify whether or not dental health was a component of general health; (ii) socio-demographic characteristics, i.e., age, gender, ethnicity, education, income, marital status, labor force attachment, census region, location of residence, time lived at the current address, (iii) dental access, i.e., dental visits in the past 12 months, (iv) proxies for dental behaviors, i.e., gingival bleedings and periodontal pockets 3+ mm., and (v) related clinical dental status parameters, i.e., number of teeth, having untreated coronal caries (tooth decay), having untreated root caries (root decay), and having a defective or pathological tooth condition. Finally, two-way interactions between each independent variable and the other variables in the full model were assessed. Additional analyses to clarify the effect modification of each independent variable on other variables were executed.

Results

Characteristics of the Study Sample. About 30% of the study sample reported having fair or poor dental perceptions. With regard to healthy practices, 14% reported having very low (0-1 item) healthy prac-

tices. Those who reported having low (2 items), medium (3 items) and high (4-5 items) healthy practices shared about 27% - 30% each. With regard to social relationships, those who had low or high levels accounted for about 30% of the total sample each, whereas those who had medium level shared almost 40% of the total. Other selected characteristics of the study sample are shown in Table 1.

Overall and Joint Effects. Overall, the number of healthy practices and the extent of social relationships were associated independently with fair or poor dental perceptions. Those persons who rated their health practices as low or very low were, respectively, 2.8 times (odds ratio [OR] = 2.80; 99% confidence interval [CI] = 2.10, 3.73) and two times (OR = 2.35; 99% CI = 1.77, 3.13), more likely to have fair or poor dental perceptions than the reference group that had high scores of healthy practices. A gradient effect of the number of healthy practices on fair or poor dental perceptions was found such that fewer healthy practices were associated with a higher likelihood of having fair or poor dental perceptions. Similarly, there were negative associations between the extent of social relationships and unfavorable dental perceptions. Those who had low social relationships were about 1.5 times more likely (OR = 1.58; 99% CI = 1.26, 1.99) to have fair or poor dental perceptions than those who had high social relationships.

In a joint model of healthy practices and social relationships on unfavorable dental perceptions, both the number of healthy practices ($P<.001$) and the extent of social relationships ($P<.001$) continued to associate independently with fair or poor dental perceptions. The direction and the strength of association were somewhat similar to the overall effects of each independent variable on unfavorable dental perceptions (Table 2). A two-way statistical interaction between the two independent variables was non-significant.

The Net Effects. Preliminary investigations of each control variable on the net or adjusted effects of the

Table 1
Selected characteristics of the study sample (18-64 years)

Variable	Category	Weighted Percent*
Fair or poor dental perception		
	Yes	31.2
	No	68.8
Number of healthy lifestyle practices		
	Very Low (0-1 item)	14.2
	Low (2 items)	27.7
	Medium (3 items)	30.5
	High (4-5 items)	27.6
Extent of social relationships		
	Low	30.6
	Medium	39.4
	High	30.0
Self-assessed general health		
	Fair or Poor	10.5
	Good	31.9
	Very good	34.3
	Excellent	23.3
Gender		
	Male	48.3
	Female	51.7
Ethnicity		
	Non-Hispanic White	78.1
	Non-Hispanic Black	12.3
	Mexican-American	3.7
	Other	5.9
Education		
	Less than high school	16.7
	High school	36.1
	More than high school	47.2
Ratio of annual family income to poverty threshold		
	Officially poor	11.3
	Near poor	18.1
	Lower middle	20.6
	Upper middle	19.9
	High	30.1
Marital status		
	Married	65.2
	Formerly or never married	34.8
Labor force attachment		
	Employed	80.0
	Unemployed or not in the labor force	20.0
Urbanization classification		
	Metro area	49.2
	Other	50.8
Dental visit in the last 12 months		
	Yes	54.9
	No	45.1
Having untreated coronal decay		
	Yes	27.1
	No	72.9
Having untreated root decay		
	Yes	10.5
	No	89.5
Having defective or pathological tooth condition		
	Yes	36.6
	No	63.4
Number of total teeth presented		
	1-24 teeth	33.4
	25-27 teeth	28.2
	=>28 teeth	38.4

Note. *The Sample Weight of NHANES III. *Source.* NHANES III, 1988-1994.

Table 2
The likelihood of having fair or poor dental perceptions among US dentate adults 18-64 years of age according to the unadjusted and joint effects of healthy practices and social relationships

Variable	Category	Unadjusted Effect OR; 99% CI	Joint Effect OR; 99% CI
Healthy practices*			
	Very Low	2.80; 2.10, 3.73	2.67; 2.03, 3.51
	Low	2.35; 1.77, 3.13	2.31; 1.74, 3.06
	Medium	1.62; 1.22, 2.15	1.58; 1.19, 2.11
	High	1.00	1.00
Social relationships*			
	Low	1.58; 1.26, 1.99	1.48; 1.16, 1.86
	Medium	1.16; 0.93, 1.44	1.14; 0.91, 1.43
	High	1.00	1.00

Note. OR = Odds Ratio
99% CI = 99% Confidence Interval
*$P<.001$ (P-value was computed based on the Satterthwaite adjusted F-statistic).
Source. NHANES III, 1988-1994.

associations between healthy practices and social relationships on unfavorable dental perceptions were performed. First it was found that self-assessed general health did not totally explain the relationships between the two independent variables and unfavorable dental perceptions. Although self-assessed general health ($P<.001$) related to dental perceptions, both independent variables continued to show a significant association with fair or poor dental perceptions for healthy practices ($P<.001$) and for social relationships ($P=.001$). To avoid an over controlling analysis, self-assessed general health was excluded from further analyses.

Sequentially, each block of control variables was introduced into the model of the effects of the two independent variables on fair or poor dental perceptions. Finally, in the full model, which included all blocks of control variables, healthy practices ($P<.01$) and social relationships ($P<.01$) retained similar patterns of association with unfavorable dental perceptions. However, the strength of associations was lower than those in the unadjusted models. In the full model, those who had reported very low or low healthy practices were about 1.5 times more likely (OR = 1.57; 99% CI = 1.17, 2.10 for very low; OR = 1.43; 99% CI = 1.05, 1.95 for low) to have fair or poor dental perceptions than those who had high healthy practices. The strength and direction of association between social relationships and unfavorable dental perceptions in the full model did not change much from the unadjusted models. Compared to those who had high social relationships, those who had low social relationships were about 1.4 times more likely (OR = 1.43; 99% CI = 1.04, 1.95) to have fair or poor dental perceptions. Besides the two independent variables, other variables that were significantly associated with unfavorable dental perceptions in the full model were education ($P<.001$), family income ($P<.001$), dental visits ($P<.001$), having untreated coronal decay ($P<.001$), having root decay ($P<.001$), having a defective or pathological tooth condition ($P<.001$) and the number of natural teeth ($P<.001$). Education and family income equally contributed to the association. Those who had less than high school or were officially poor were, respectively, almost two times more likely (OR = 1.90; 99% CI = 1.40, 2.57 for education; OR = 1.87; 99% CI = 1.30, 2.70 for family income) to have unfavorable dental perceptions, compared to those who had more than a high school education or had high family income. Those who reported not having any dental visits in the past 12 months were about 1.4 times more likely (OR = 1.38; 99% CI = 1.12, 1.73) to have unfavorable dental perceptions. Among related clinical dental status parameters, the number of natural teeth showed the highest odds ratio in the full model. Those who had less than 25 teeth were about three times more likely (OR = 3.13; 99% CI = 2.27, 4.31) to have unfavorable dental perceptions, compared to those who had 28+ teeth (Table 3). There were no two-way interactions between the independent variable and each control variable.

The Effect Modification of Social Relationships. A clear gradient effect of healthy practices on fair or poor dental perceptions showed the protective effects of healthy practices only in the low social relationship group. This pattern was not profound at the medium level of social relationships and was not found at the high level of social relationships. Among the low social relationship group, those who had very low, low, and medium healthy practices were consecutively, five times (OR = 5.07; 99% CI = 3.24, 7.91), more than three times (OR = 3.61; 99% CI = 2.22, 5.87), and more than two times (OR = 2.24; 99% CI = 1.37, 3.67), more likely to have unfavorable dental perceptions, compared to those who had reported high healthy practices and high social relationships. This pattern of effect continued even after controlling for all control variables in the full model. However, the strength of associations decreased from five to three times (OR = 3.30; 99% CI = 2.01, 5.41) among those with very low healthy practices, and from more than three to two times (OR = 2.06; 99% CI = 1.15, 3.69) in the low healthy practice group (Table 4).

Discussion

The findings of this study showed that the Alameda key findings can be applied to oral health. Both the number of healthy practices and the extent of social relationships showed net or adjusted effects on fair or poor dental perceptions after controlling for

Table 3
The likelihood of having fair or poor dental perceptions among US dentate adults 18-64 years of age according to the adjusted effects of healthy practices and social relationships

Variable in the Model	Category	OR	99% CI
Healthy lifestyle practices*			
	Very low	1.57	1.17, 2.10
	Low	1.43	1.05, 1.95
	Medium	1.19	0.86, 1.65
	High	1.00	
Social relationships*			
	Low	1.43	1.04, 1.95
	Medium	1.14	0.86, 1.50
	High	1.00	
Age	NS		
Gender	NS		
Ethnicity	NS		
Education†			
	Less than high school	1.90	1.40, 2.57
	High school	1.35	1.08, 1.68
	More than high school	1.00	
Family income/poverty threshold†			
	Officially poor	1.87	1.30, 2.70
	Near poor	1.63	1.13, 2.36
	Lower middle	1.25	0.89, 1.76
	Upper middle	0.99	0.68, 1.42
	High	1.00	
Marital status	NS		
Labor force attachment	NS		
Urbanization classification	NS		
Census region	NS		
Time lived at this address	NS		
Dental visit in the past 12 months†			
	No	1.38	1.12, 1.73
	Yes	1.00	
Having untreated coronal decay†			
	Yes	2.02	1.49, 2.73
	No	1.00	
Having untreated root decay†			
	Yes	1.79	1.27, 2.54
	No	1.00	
Having defective tooth condition†			
	Yes	1.46	1.17, 1.82
	No	1.00	
Number of natural teeth†			
	1-24 teeth	3.13	2.27, 4.31
	25-27 teeth	2.24	1.52, 3.31
	=> 28 teeth	1.00	
Having gingival bleeding	NS		
Having periodontal pocket =>3 mm.	NS		

Note. OR = Odds Ratio
99% CI = 99% Confidence Interval
*$P<.01$ (P-value was computed based on the Satterthwaite adjusted F-statistic).
†$P<.001$ (P-value was computed based on the Satterthwaite adjusted F-statistic).
NS = Non-significant in the model
Source. NHANES III, 1988-1994.

socio-demographic characteristics, dental access, proxies for dental behaviors and related clinical dental status parameters. However, it should be noted that the Alameda Study was a panel design, while this study used the NHANES data, which was cross-sectional in nature. The Alameda County Study also included marital status in the social relationships index, but this study found that current marital status was not associated with dental perceptions and so used it as a control variable. In the bivariate analysis male and female were not different on dental perceptions. Thus, gender was modeled as a control variable. Moreover, snacking between meals and having seven to eight hours sleep per night were included in the original seven Alameda healthy practices, whereas these two variables were not collected in NHANES III andtherefore could not be included in this study. Finally, the Alameda measured objective health outcomes, including mortality and physical health changes, whereas this study used subjective general health and subjective oral health measures (8, 23).

Similar to findings of other studies, perceived general health was significantly associated with perceived dental health (24-26). However, this study also showed that a part of the dental perceptions of this population group tended to be specific and could not be explained entirely by perceived general health status. Relationships between general health and oral health have been discussed elsewhere (24-33).

Approximately 30% of this study sample reported fair or poor dental status. The pattern of dental perceptions found in this study was similar to those reported earlier (25, 26). Furthermore, this study confirmed that global dental perceptions are valid. From the preliminary investigations of each control variable on the relationships of healthy practices and social relationships on unfavorable dental perceptions this study found that dental perceptions were significantly associated with clinical dental parameters ($P<.001$) including un-

Table 4
The likelihood of having fair or poor dental perceptions among US dentate adults 18-64 years of age according to the effect modification of social relationships on healthy practices

Group	Joint Model OR	Joint Model 99% CI	Full Model OR	Full Model 99% CI
Low social relationships				
Very Low healthy practices	5.07	3.24, 7.91	3.30	2.01, 5.41
Low healthy practices	3.61	2.22, 5.87	2.06	1.15, 3.69
Medium healthy practices	2.24	1.37, 3.67	1.56	0.83, 2.96
High healthy practices	1.51	0.91, 2.49	1.46	0.76, 2.81
Medium social relationships				
Very Low healthy practices	2.88	1.77, 4.69	1.51	0.80, 2.85
Low healthy practices	2.66	1.60, 4.43	1.69	0.91, 3.13
Medium healthy practices	2.03	1.36, 3.02	1.61	0.94, 2.75
High healthy practices	1.31	0.80, 2.13	1.26	0.72, 2.19
High social relationships				
Very Low healthy practices	2.45	1.35, 4.45	1.38	0.73, 2.62
Low healthy practices	2.65	1.61, 4.37	1.74	1.06, 2.87
Medium healthy practices	1.77	1.03, 3.03	1.24	0.65, 2.36
High healthy practices*	1.00		1.00	

Note. OR = Odds Ratio
99% CI = 99% Confidence Interval
*Reference group.
Source. NHANES III, 1988-1994.

treated tooth decay, untreated root decay, a defective or pathological tooth condition, and the number of natural teeth. Because of its simplicity, global dental perception can be a tool to encourage communities to engage in an oral health care program as well as in participatory research.

This study also showed an effect modification of social relationships on the relationships between healthy practices and unfavorable dental perceptions. Those who had low social relationships were most vulnerable to having fair or poor dental perceptions when they had poor healthy practices. The direction of the relationships was such that fewer healthy practices predicted more fair or poor dental perceptions. However, the classification of social relationships in this study was derived from statistical distributions. This statistical classification might not accurately reflect the levels that separated people with high, medium and low levels of social relationships. Because the lack of information in NHANES III about positive functional supports of social relationships, i.e., information, instrumental, appraisal and emotional support (1-3), mechanisms related to how social relationships moderated the effects of healthy practices on unfavorable dental perceptions could not be verified. Despite the absence of empirical explanation on how social relationships and healthy practices related to dental perceptions, it seems reasonable to encourage dental health professions to engage in general health behavior modifications as well as relevant social actions to foster social relationships. In the absence of explanations on several oral health disparities reported earlier, these two constructs, i.e., healthy practices and social relationships, may help explain those gaps. However, further analyses are needed.

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