

Dental attitudes: proximal basis for oral health disparities in adults

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Abstract – Objectives: Behavioral science postulates that underlying characteristics of populations, rather than sociodemographic groupings, are more proximal causes of oral health disparities through differing oral health behaviors. To our knowledge this is the first report in the literature that examines longitudinal correlates of oral health and dental care using groups of persons holding similar attitudes and beliefs. Methods: The subjects were 873 participants in the Florida Dental Care Study, a longitudinal study of oral health among dentate adults. Hierarchical cluster analysis identified four groups with similar dental attitudes that were labeled 'favorable attitudes about dental care', 'frustrated believers in dental care', 'negative attitudes and cost concerns', 'pessimistic about personal and professional oral care'. Results: The attitudinal groups cut across race, sex, and age with race and educational status the best discriminators among sociodemographic and economic variables. The negative attitude group reported the least preventive care and the largest oral health decrements on clinical examination at baseline and 24 months. The group with favorable attitudes about dental care reported the highest number of preventive and restorative visits and the lowest point-prevalence of toothache pain, temperature sensitivity, and painful gums. The frustrated believers have access to dental care equivalent to the favorable attitude group, but may delay seeking dental care until oral disease becomes more severe, based on their pattern of preventive, restorative, and dental extraction visits. Additional group differences on oral health and dental care are reported. Conclusion: This study takes a novel approach to examining oral healthy disparities. Differences in oral health behaviors support the validity of the groups.

The study of health has determined that certain subgroups of the population suffer a disproportionate burden of disease (1). Groups identified at high risk for oral health decrements include racial and ethnic minorities, females, those living in rural settings, and older adults (2–8). One problem with this approach is that within-group heterogeneity is typically larger than between-group differences. As postulated by models of health behavior, more proximal variables, such as the ability to access health care, attitudes and beliefs about disease, and the value of preventive and curative care, may be responsible for differing levels of health observed across these demographic groups (9–13).

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Specific attitudes and beliefs about oral health and dental care are known to predict oral disease (14–19), the use of dental services, (20–24) and selfcare (25–27). For example, Gilbert et al. (14) found that persons with less positive attitudes towards dentists and dental care were more likely to report tooth loss than those with more favorable attitudes. In a large community sample of adults residing in Sweden, convenience of recent care, satisfaction with dental care, and fear of dental treatment were associated with several clinical indices of oral health (17). Related to dental care, Tennstedt et al. (21) found that recency of a dental visit was associated with positive dental attitudes when controlling for a range of disease markers, demographic, and access related variables.

The statistical approach typically taken to associate attitudes and beliefs with various outcomes has been to use these variables as predictors in regression models. Weights or ratios are calculated that represent the increased risk associated with that characteristic while controlling for other variables in a statistical model. The strength of this method is that it identifies the independent contribution of each variable towards the outcome of interest. However, in reality, attitudes and beliefs do not operate independently of each other. Models of health postulate that individuals with a constellation of attitudes and beliefs are more or less likely to engage in preventive practices or to seek an oral examination at early stages in the progression of oral disease (12). Therefore, if persons were grouped on the actual characteristics that are thought to be risk factors (i.e. attitudes and beliefs), understanding the influences of attitudes and beliefs on oral health behaviors would be improved. An empirical methodology appropriate for this purpose is hierarchical cluster analysis. This is a statistical technique that assigns entities into groups based on common properties. Similar attitudes and beliefs about oral health and dental care are examples of properties in common. Thus, cluster analysis will allow us to form empirically derived clusters or groups of persons with a common set of attitudes and beliefs about oral health and dental care.

To our knowledge, no longitudinal studies have tested for differences in measures of oral health between groups of individuals with similar attitudes and beliefs about oral health and dental care. Therefore the purpose of this study is to: (i) use a hierarchal clustering algorithm to group dentate adults based on attitudes and beliefs about oral health and dental care; (ii) describe these groups based on common attitudes and beliefs; (iii) test for socioeconomic and demographic differences; and (iv) identify unique and common characteristics based on clinical signs, symptoms, and oral health behaviors.

Methods and materials

Sampling methods

Data were taken from the Florida Dental Care Study (FDCS), a prospective longitudinal study of oral health and dental care. A telephone screening methodology was used to identify persons who met eligibility criteria, from which a stratified random sample was selected to participate at baseline. The sampling methodology and selection are provided in an earlier publication (28). The 873 subjects who participated at baseline were a representative sample of the population defined as those who (1) resided in one of the four counties of interest, (2) were English-speaking, (3) capable of engaging in a cogent telephone conversation, (4) resided in a household, in contrast to a congregate facility, (5) reported race as non-Hispanic Black or non-Hispanic White, (6) had at least one remaining natural tooth. Four counties in north Florida were selected because they provided an urban/rural contrast, have large percentages of Blacks, older adults, and poor individuals, because they were geographically proximate, and near the administrative base for the project.

Interview methods

Trained interviewers administered a baseline interview that collected a wide range of information, including demographic data and attitudes towards and expectations about dental care. Test-retest coefficients ranged from 1.00 to 0.77 in a subset of 42 subjects, over an average interval of 4 days. Immediately after the baseline interview a clinical examination was performed. The examination protocol and clinical diagnostic criteria for the baseline examination have been described previously (29, 30). The baseline interview and clinical examination were followed by a telephone interview at 6, 12, and 18 months following the baseline. At 24 months after baseline, the interview was performed in person instead of by telephone, and was followed immediately by a clinical examination that was identical to the baseline examination.

Measures

Attitudinal variables

Quality of recent dental visit, Importance of preventing dental problems, eventuality of dental decline, cost has delayed dental treatment, cynicism toward dentists, effectiveness of dental care, personal influence on oral health, frustration about dental care. See Table 1 for item content.

Access variables

Present financial status. Response choices were: can not make ends meet; I manage to get by; I have enough to manage plus some extra; money is not much of a problem... I can buy whatever I want.

Influence of costs on past dental treatment The cost of dental care has affected the type of dental treatment I have received in the past In the past, I have had to delay dental treatment because of other expenses, such as medical care and household expenses Eventuality of dental decline You can get over almost any dental problem if you just wait long enough Regardless of how well you and your dentist take care of your teeth, you will eventually lose them It is more important to save a front tooth than it is to save a tooth in the back of the mouth Some people are just born with good teeth, and others are not I would rather have my teeth pulled than take the time and money trying to keep them Unless you are in pain, most dental work can be delayed in the long run Quality of recent dental care The overall quality of the dental care you received The way you were made to feel welcome by the dentist The way you were made to feel when you first arrived at the office The information the dentist provided about your mouth The manner in which the dentist explained things to you The cleanliness and neatness of the office Personal influence on dental disease I think that brushing and flossing my teeth at least once a day is necessary to keep from getting cavities, gum disease, or losing teeth Some dental treatment can be painful, but it's worth it in the long run I think that the condition of my teeth is an important part of my overall health I prefer to take an active part in decisions about my dental care Effectiveness of dental care Modern dentistry can solve most dental problems Regular checkups, even when nothing is wrong, will help prevent dental problems Dentistry can usually relieve or cure the problems that patients have Importance of dental visits to prevent dental problems How important is it to YOU PERSONALLY to see a dentist on a regular basis to: Prevent tooth decay Prevent gum disease Prevent tooth loss Frustration about dental care Have you ever had dental treatment that has not worked, or dental treatment that has not lasted as long as you thought it should have? How does this make you feel about dental care now? Cynicism towards dentists and dental care Some dentists are more interested in making money than in making sure people get good dental care Dentists often recommend treatment that you don't really need I prefer to rely on the judgment of my dentist for decisions about my dental care

Quality of recent dental care scale: 1, poor; 2, fair; 3, good; 4, very good; 5, excellent.

Importance of dental visits scale: 1, not at all important; 2, slightly important; 3, moderately important; 4, very important; 5, extremely important.

Eventuality of decline, influence of costs, cynicism towards dentists, effectiveness of care, and personal influence on decline scales: 1, strongly disagree; 2, somewhat disagree; 3, somewhat agree; 4, strongly agree.

Frustration: 1, extremely frustrated; 2, very frustrated, moderately frustrated; 4, a little frustrated; 5, not at all frustrated.

Ability to pay an unexpected \$500 dental bill. Response choices were: able to pay comfortably; able to pay but with difficulty; Not able to pay the bill. *Dental insurance*. Some people have dental insurance that pays for part of their dental bills, such as from an employer, Medicaid, or the VA. Are you covered by any such dental insurance program? *Educational achievement*. What was the highest level of formal school you completed? Respondents were categorized as having completed high school or not having completed high school. *Annual income* was assessed using the following 10 point scale: 1 = under \$2500, 2 =\$2500 but <\$5000, 3 =\$5000 but <\$10 000, 4 =\$10 000 but <\$15 000, 5 =\$15 000 but <\$20 000, 6 =\$20 000 but <\$35 000, 7 =\$35 000 but <\$50 000, 8 =\$50 000 but <\$75 000, 9 =\$75 000 but less than \$100 000, 10 =\$100 000 or more.

Oral health behaviors

History of dental care was assessed using the following questions that were asked as part of the follow-up interviews performed at 6, 12, 18,

24 months following baseline. Have you been to see a dentist since we talked with you last on (date of last interview)? How many times did you go to this dentist since we talked with you last? The respondent was asked for the reason for each visit. Approach to dental care. Which of the following statements best describes your approach to dental care: (a) I never go to a dentist; (b) I go to a dentist when I have a problem or when I know that I need to get something fixed; (c) I go to a dentist occasionally whether or not I have a problem; or (d) I go to a dentist regularly. The response to this question was coded as problem oriented attender (a or b) or a regular attender (c or d). *Tooth brushing*. Coded as daily or less than once a day. Smoking status. Coded as current smoker or not a current smoker. Flossing index. Coded as using floss twice a day or more, once a day, once every few days, once a week, less than once a week, or never. Unless otherwise stated above, these variables were assessed at the baseline interview only.

Statistical methods

All results were weighted estimates that reflect the population of interest, rounded to the nearest whole number. Weights were developed using special tabulations provided by the U.S. Census Bureau that detailed the distribution of target populations provided by age, sex, race, and poverty status (31). In cluster analysis*, multicollinearity among a large number of the discriminating variables can bias the interpretation of the final solution because it can be biased by the subset of correlated variables (32). Several studies have demonstrated relatively high intercorrelations between the attitudes and beliefs scales used in the FDCS (33); therefore we have used principal components analysis to create independent dimensions for use in the clustering procedure. Ward's clustering method with squared Euclidean distances as the similarity measure was chosen in order to be sensitive to differences in elevation as well as profile shape (34). Mean standardized scores for the individual attitude and belief scales will be used descriptively. Differences across clusters on oral health and oral health behaviors were tested using the Pearson chi-square test for dichotomous variables, the Mantel–Haenszel chi-square trend test for ordinal variables, and Analysis of Variance for continuous variables.

Results

Subjects

Thirty-four of the 873 respondents who participated in the baseline interview did not answer all of the attitudes and beliefs items; therefore 839 respondents are included in this report. By 24 months, 739 of these persons remained in the study, of whom 723 received the 24-month clinical examination and provide 24-month dental health follow-up data. There was no difference in the dropout rates across the four attitudinal groups.

Persons who participated at 24-months were more likely to have been regular dental care attenders, above the 100% poverty threshold, in better self-rated general health, white, and free of active dental caries at baseline than those who did not receive the 24-month examination. No differences in participation were observed with respect to age group, sex, area of residence, ability to pay an unexpected \$500 dental bill, or present financial situation. The possible effect of this attrition on pain prevalence is suggested by differences in baseline prevalence of toothache pain. At baseline, 12.0% of persons reported current toothache pain. If the baseline had only included persons who ultimately participated at 24 months, then that figure would have been 11.8%. This difference was not statistically significant.

Factor analysis

Principal components analysis of the eight dental attitudes resulted in a three-factor solution based on the eigenvalue greater than one criterion and scree test. The eigenvalues for the first three factors extracted were 1.65, 1.62, and 1.17 and accounted for 55.7% of the total variance. The first factor represented quality of recent dental care and cost delaying care, which we labeled 'overall quality of oral health care'. The second factor consisted of beliefs about the importance of active use of both personal and professional oral care that we labeled 'importance of oral care for oral health'. The third factor reflected frustration with ineffective dental treatment and cynicism about dentists, which we labeled 'negative attitudes about outcome'.

^{*}The term in cluster analysis for each empirically derived group is cluster. We will use the term 'cluster' in the results section as we describe the cluster formation or interpretation – but use the term 'group' elsewhere when describing characteristics of the persons in each cluster.

Cluster analysis

The three principal components of the eight dental attitudes and beliefs were subjected to hierarchical clustering analysis using the Ward's Method clustering algorithm. Inspection of the agglomeration coefficients following the clustering procedure indicated that the percentage change is large between the four- and three-cluster solutions, after relatively small changes across the previous steps. This suggests that dissimilar clusters would have been combined at the three-cluster solution; therefore the four-cluster solution was accepted as the most appropriate (25).

Cluster interpretation

The first step in cluster interpretation was to examine the mean values for each cluster on the attitude scales to assess the distinctiveness and describe each cluster (see Table 2). Ideally, we would obtain very different means across clusters for most of the variables used in the analysis. The attitude scale scores for cluster one are notable for positive ratings of recent dental care, dental care is important in maintaining oral health, and cost had not delayed dental treatment. Therefore, cluster one was labeled as 'favorable attitudes about oral care'. Attitude scale scores for cluster two also indicate they are moderately cynical about dentists, but believe that dental care is important to maintain oral health. We have labeled cluster two 'frustrated believers in dental care'. On the attitude and belief scales, respondents within cluster three reported that the quality of recent dental care was poor, they hold negative attitudes about dentists, costs have delayed dental care, and they believe that oral decline is inevitable. This cluster was labeled 'negative attitudes and cost concerns'. Participants in the fourth cluster are best characterized by the scales that reflect that they believe that personal and dental care is not effective in maintaining oral health; however, they were not frustrated by poor care in the past. Therefore, we labeled this cluster 'pessimistic about personal and professional oral care'.

The next step in cluster interpretation was to examine differences on external variables. Socioeconomic and demographic variables are presented for each the four clusters Tables 3 and 4 respectively. Objective and subjective measures of oral health are presented in Table 5 for baseline and the 24-month follow-up. Oral health behaviors are presented in Table 6.

Discussion

This study was the first to identify empirical groups of dentate adults with similar attitudes and beliefs about dentists and oral health. Consistent with the notion that attitudes and beliefs are important determinates of oral health decrements (12, 13, 23, 24); the groups differed on a range of measures of objective and subjective oral disease. In addition, differences in patterns of oral hygiene and use of preventive and treatment related dental visits were identified. The four groups cut across race, sex, and age.

Favorable attitudes about dentists and dental care

The first cluster was the largest, and although predominately White, higher levels of education was the most defining characteristic as 90% of this group reported at least a high school education.

	Cluster no. 1. Favorable attitudes	Cluster no. 2. Frustrated believers	Cluster no. 3. Negative attitudes	Cluster no. 4. Pessimistic about oral care
Cluster size	351	101	214	173
Quality of recent dental visit	0.46	-0.28	-0.90	-0.14
Importance of prevention	0.40	0.37	-0.29	-0.90
Eventuality of oral decline	-0.49	-0.28	0.97	0.29
Personal influence on oral health	0.30	0.19	0.28	-1.08
Cost has delayed treatment	-0.43	0.13	0.94	0.11
Cynicism towards dentists	-0.37	0.35	0.65	0.18
Effectiveness of oral care	0.34	-0.07	0.14	-0.89
Frustrated with ineffective care	-0.34	2.16	-0.31	-0.21

Table 2. Mean standardized scores for the attitude and belief scales by cluster

Values represent standardized scores with a mean = 0 and standard deviation (SD) = 1. A value of +0.6 would indicate that a group is 0.6 SD above the mean on the respective attitude scale. As an example, the favorable attitudes and frustrated believers differed on 'Quality of recent dental visit' by 0.74 SD.

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Table 3. Relative risk for sociodemographic characteristics by cluster

	Favorable attitudes	Frustrated believers	Negative attitudes	Pessimistic about oral care
Black/white	0.5	0.9	3.3	1.0
Female/male	1.1	0.7	1.1	0.8
Older/younger	1.1	0.7	1.0	0.9
Rural/urban	0.7	0.9	1.6	1.1
HS education	2.3	1.3	0.3	1.0

Values represent the probability of the target characteristic occurring in members of that attitudinal group. As an example, Black respondents are 50% as likely to be members of the 'Favorable attitude' group as Whites.

Table 4. Socioeconomic characteristics by cluster

	Favorable attitudes	Frustrated believers	Negative attitudes	Pessimistic about oral care
Income 0–10 scale	6.0^{a} (2.0)	6.0 ^a (2.3)	3.9 (1.8)	5.2 ^a (2.1)
Dental insurance (%)	39 ^a	44 ^a	20	27
Unexpected \$500 dental bill (%)				
Able to pay comfortably	67	27^{a}	31 ^a	36 ^a
Able to pay, but with difficulty	29	44	46	52
Not able to pay the bill	4	29	23	12
Present financial status (%)				
Money is not much of a problem,	27 ^a	22 ^a	2 ^b	8^{b}
I can buy about whatever I want				
I have enough to manage, plus some extra	44	40	27	28
I manage to get by	27	36	62	60
Can not make ends meet	2	2	17	4

Values that share superscripts are not different at P < 0.05. Using dental insurance as an example, the percentages of favorable attitudes and frustrated believers with dental insurance were not different, but all other possible pair-wise comparisons were statistically different. Baseline data, n = 839; 24-month data, n = 739. Means are followed by their standard deviations.

Table 5.	Objective	and subje	ective indicator	s of ora	l disease b	y cluster a	at baseline and	d 24-month fol	llow-up
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	Favorable attitudes	Frustrated believers	Negative attitudes	Pessimistic about oral care
Number of surfaces decayed	1.9 (7.0)	4.1 (8.4)	7.9 ^a (13.3)	7.4 ^a (11.9)
Has unfilled decayed surfaces	34%	55%	71% ^a	63% ^a
Millimeters of lost periodontal (gum) attachment	5.6 ^a (2.1)	5.8 ^a (2.4)	7.4 (2.9)	6.3 ^a (2.5)
Number of surfaces filled	35.4 ^a (23.6)	29.3 ^{ab} (23.4)	11.5 (17.4)	22.6 ^b (21.2)
Number of teeth	23.3 ^a (6.4)	22.5 ^a (6.6)	19.0 (7.8)	21.8 ^a (7.3)
Toothache pain	6%	22% ^a	18% ^a	12%
Temperature sensitivity	23% ^a	41% ^b	41% ^b	$28\%^{a}$
Painful gums	$7\%^{a}$	22% ^b	21% ^b	$8\%^{a}$
Pain reduced normal activity	11%	$17\%^{a}$	19% ^a	20% ^a
Pain caused sleep difficulty	17%	$41\%^{a}$	38% ^a	25%
Number of surfaces decayed	1.3^{a} (4.4)	3.0^{a} (7.1)	7.8 ^b (16.8)	7.5 ^b (17.7)
Has unfilled decayed surfaces	30%	41%	$64\%^{a}$	61% ^a
Millimeters of lost periodontal (gum) attachment	5.3 ^a (1.9)	5.2 ^a (2.0)	7.3 (3.0)	5.9 ^a (2.7)
Number of teeth lost during 24 months	0.4 (1.4)	$0.9^{\rm a}$ (1.7)	1.0 ^a (2.2)	0.7^{a} (1.7)
Lost at least one tooth 0–24	16%	38% ^a	32% ^{ab}	27% ^b
Toothache pain	12%	42% ^a	36% ^a	19%
Temperature sensitivity	20%	32% ^a	38% ^a	28%
Painful gums	11%	28% ^a	29% ^a	18%

Values that share superscripts are not different at P < 0.05. Baseline data, n = 839; 24-month data, n = 739, 24-month oral examination, n = 723. Means are followed by their standard deviation.

Table 6. Oral health behaviors and dental treatment from baseline to 24-month examination by cluster

	Favorable attitudes	Frustrated believers	Negative attitudes	Pessimistic about oral care
Current smoker	14%	21% ^a	27% ^a	22% ^a
Brush daily	$74\%^{\mathrm{a}}$	70% ^a	53% ^b	57% ^b
Flossing scale	2.5 (1.6)	1.9 (1.6)	1.0 (1.5)	1.5 (1.3)
Regular attenders	79%	56%	20%	30%
Had cleaning or check up 0–24	82%	64%	41%	53%
Had restoration/root canal 0-24	$34\%^a$	30% ^a	13%	23%
Had extraction 0–24	15%	$28\%^{a}$	25% ^a	22% ^a
Had fixed/removable denture visit 0–24	7%	13% ^a	$12\%^{a}$	13% ^a
Did not have a visit 0–24	10%	17%	39% ^a	35% ^a
Number of visits 0-24 months*	4.7 ^a (2.8)	5.1 ^a (3.6)	3.6 ^b (2.6)	3.9 ^b (2.7)

Mean values are followed by their standard deviation.

Values that share superscripts are not different at P < 0.05.

*Among those who did visit a dentist. Baseline data, n = 839; 24-month data, n = 739.

This group reported the most favorable attitudes about dentists and dental care. Their belief that cost had not delayed dental treatment was consistent with their higher socioeconomic status (SES) and a pattern of preventive and restorative visits. Consistent with this conclusion is the fact that 82% of this group reported at least one cleaning or check up visit during the 24-month period following baseline. On the objective markers of oral health, the favorable attitude group had superior oral health. Their point-prevalence for toothache pain of 6% and sore gums of 7% is below the National Health Interview Survey estimate for US adults for these symptoms (12.2% and 8.4%, respectively; 35). These findings suggest that for this group, dental care is accessible and that oral health problems may be identified early as the result of regular dental visits.

Frustrated believers in dental care

This group tended to comprise younger males and consisted of approximately equal proportions of Black and Whites. Similar to the favorable attitude group, this group subscribed to the importance of oral care to prevent tooth decay, gum disease, and tooth loss. However, they reported a history of frustration associated with unreliable dental work. Regarding issues of access to care, they reported a similar level of income as the favorable attitude group and were actually more likely to have dental insurance (45-39%). An interesting discrepancy occurred regarding subjective measures of SES. They gave the highest ratings of present financial status and family income but scored the lowest on a question about the ability to pay an unexpected dental bill, suggesting reduced financial priority for dental care.

This group was notable for reporting the highest point-prevalence across all of the oral pain symptoms. One possible explanation is that the oral pain was related to unsuccessful restorative dental treatment and may also explain their high rate of extractions. An earlier report from the FDCS indicated that frustration with dental care was a significant predictor of 24-month tooth loss (26) but not dental care (24). These findings may also be interpreted to suggest that the frustrated believers have access to dental care that is equivalent to access among the favorable attitude group, but delay seeking oral health care until oral disease becomes more severe.

Negative attitudes about dentists and cost concerns

This group primarily consisted of rural Black adults and had the lowest percentage of high school graduates (68% of Blacks in this group were without a high school education). However, of the White adults in this attitude and belief grouping, 76% reported receiving a high school diploma. Supplementary analysis indicated that the oral health outcomes between Blacks and Whites in this group were very similar. This group also had the highest percentage of rural residents. This group is notable for its overall negative attitudes and beliefs about dentists and dental care, and appear to be the antithesis of the favorable attitude group. This group had the poorest oral health across most markers. Consistent with the low scores on the income variables, this group also reported delaying dental services because of issues related to cost. This finding supports evidence that SES gradients account for large differences in oral health. For example, Drury and associates (36) found that

respondents in the lower SES category were more than six times as likely to have untreated coronal decay and seven times more likely to have untreated root decay than those in the higher SES category.

The negative attitude group reported oral health behaviors that were the least conducive to good oral health, as they were the most likely to be current smokers and the least likely to floss or brush daily. The negative attitude group clearly did not compensate for less dental care by having more frequent or more positive selfcare behaviors. Their dental care history is consistent with their belief about the inevitability of poor oral health, as they were the least likely to report a cleaning, checkup, or a visit in which restorative work was performed. The negative attitude group was the only group to report a higher probability of extraction visits than restorative visits. Gilbert and colleagues (15) have speculated that negative attitudes related to the value of dental care would have the largest influence on preventive or diagnostic types of dental services.

Pessimistic about personal and professional oral care

Group four was somewhat more likely to be males but was the group to most equally cut across education levels, race, age and living setting. They generally held pessimistic views about oral health care; however they did not report a history of negative experiences during visits to their dentists. On the income scale they were similar to the favorable attitude and frustrated believers. Therefore, we suggest that oral health decrements experienced by this group are more a function of their attitudes and beliefs about dental care than an issue of access to care.

The pessimistic group was similar to the negative attitude group with a high count of untreated caries; however a significantly higher number of filled surfaces was found. It should be noted that these measures capture somewhat different aspects of caries disease. The number of filled surfaces also reflects the caries history of the person, being less relevant for active caries but possibly being more relevant for social and behavioral factors related to caries (17). The most notable finding for this group was the lower point-prevalence of oral pain and behavioral impact than both the negative attitude and frustrated believers groups. One would think, given their objective findings and relatively poor oral hygiene (i.e. brushing and flossing), that they would have reported a higher prevalence of oral pain.

Implications

In terms of public health research, these data support findings from previous studies that indicate attitudes and beliefs about oral health and dental care are important determinants of oral disease (14–19), the use of dental services, (20–24), and preventive self-care (25-27). The primary difference is that we have associated groups of persons with common attitudes and beliefs with these outcomes. The existence of oral health disparities are well documented (37), but oral health is a complex outcome and models that examine limited predictors may over-state or under-state true causal relationships (38, 39). We argue that this novel approach that uses more proximal predictor variables warrants further development.

It is important to keep in mind that these interrelationships are complex. Although education and access to care differed across the attitude and belief clusters, is it likely that they have reciprocal effects (40). Because oral health can be a dynamic process, oral symptoms can influence future attitudes and beliefs and access variables (i.e. financial status). It is also possible that these relationships differ across attitudinal groups; however, no studies have examined models of oral health behavior across such groups. Although these data documented associations between behaviors and outcomes and persons grouped on dental attitudes, given the chronic nature of oral diseases and associated symptoms and impacts, these findings may also generalize to other chronic medical conditions (12). Consequently, this approach may be useful in identifying proximal determinants of health disparities for medical conditions such as diabetes, coronary heart disease, hypertension, and others (41).

These findings have clinical implications for caregivers. Certainly it would be time consuming for a practicing dentist to administer questionnaires to each patient and assign them to predetermined clusters, although the methodology exists for this (32). We suggest that these finding argue for increased discussion with patients about their attitudes towards oral health and oral health care (42) and to not draw conclusions based on very limited information. Rather, view each patient as a profile of attitudinal and social influences and provide educational interventions when possible. In addition, realize that increased awareness of attitudinal or communication styles of patients may help minimize miscommunication and deficiencies in oral health care that lead to patient mistrust of providers (43). A patient who is able to trust a dental care provider is more likely to reveal important information (44) and report having a regular dentist (45).

There are several methodological issues that should be considered when interpreting these results. It should be noted that dental treatment and the pain-related variables are based on selfreport and subject to an individual's interpretation. The specific reasons for treatment choices are unknown and may reflect the role of patients' choices of treatment as well as the recommendations made by their dentists. In addition, we did not ask about attitudes and beliefs related to specific dental treatments.

Conclusion

This study identified four groups of dentate adults with similar attitudes and beliefs about dentists and oral health. They differed on a range of attitudes and beliefs that included perceived quality of dental care, the importance of both personal and professional oral care, and cynicism about dentists. The finding of differences across the four groups on measures of clinical signs, subjective symptoms, and history of oral health care argues for the usefulness of the attitude-based groups and supports their further examination. The primary advantage to this methodology is that groups are formed on variables more proximal to oral health than those used by traditional oral epidemiology (e.g. race, age). This way, rather than controlling for these differences we are examining their effects. Once we better understand models of health behavior, outreach programs should focus on variables that are amenable to change (i.e. attitudes about care), with the ultimate goal of facilitating access to care and equitable delivery of services.

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