# Patterns of Preventive Dental Behavior

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**Synopsis**

*Preventive dental behavior was examined using data from the National Health and Nutrition Examination Survey of 1971–75 conducted by the National Center for Health Statistics.*

*Most research to date has dealt with the use of all types of dental services, with relatively few studies focusing on utilization of dental services for preventive purposes or on preventive dental behavior.*

*Economic theory on the demand for health services and the Andersen model of health services utilization were applied to examine predisposing, enabling, and need characteristics which may influence use of preventive dental health services and preventive dental behavior. The associations between each of three measures of preventive dental behavior and the three sets of characteristics from Andersen's model were analyzed using multiple regression analysis.*

*The enabling factors (income and a regular source of care) were the most important determinants of use of preventive dental services. Need characteristics, measured by self-evaluated condition of teeth, were also significant determinants of use, while the predisposing variables were the least important of the three types. In contrast, for the home care measure, frequency of brushing, the predisposing variables were the most important, with gender and education ranking highest.*

*Consideration of these results may be useful to health educators and to those who formulate policies affecting the distribution of preventive dental services and dental insurance coverage.*

THIS ANALYSIS WAS CONDUCTED TO EXAMINE the characteristics associated with preventive dental behavior (PDB). There have been numerous studies of factors associated with the use of dental services in general, but few have focused on their use for prevention or on preventive dental behaviors. This is an important distinction, because different factors may be associated with use for symptoms as opposed to use for prevention. When need is great, as in the case of a severe toothache, almost everyone tries to see a dentist. In contrast, other factors such as attitudes or financial resources may be more crucial in determining preventive visits. Dental diseases constitute one of the few categories of diseases for which effective preventive measures exist. An understanding of the factors associated with use of the dentist for prevention and with other preventive dental behaviors would facilitate the development of health education programs targeted to reduce dental diseases. Our research focuses on PDB entirely, and we used three indicators. Two of these measures represent use of services and one is a measure of home care.

The Andersen model of health services use (*1*) and economic theory on the demand for health services were applied to our data to evaluate factors associated with PDB. Although Andersen used his model to examine factors associated with the use of dental services in general, he did not focus on use for preventive reasons alone. Moreover, even though his model was developed to study the use of health services, the variables included have been used by others in attempts to

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explain various preventive health behaviors (*2*). Thus, its application to behaviors other than utilization seems appropriate.

## Preventive Dental Behavior

With few exceptions (*3–8*), studies of PDB have been descriptive, lacking formal models and specific tests of hypotheses. Moreover, few attempts have been made to define explicitly PDB. Definitions of preventive health behavior, however, can be readily applied to this area of research. Kasl and Cobb's definition (*9*) seemed most relevant to our purposes, since it encompassed both utilization and other behaviors. Following them, we defined PDB as behavior aimed either at the prevention of dental disease or at the detection of dental disease in an asymptomatic state. This definition led to the selection of the 14 studies we have reviewed.

Although the range and types of measures of PDB vary widely, the most frequently used indicators are the reason for last dental visit and the recency of last visit (*3–6, 8, 10, 11*). Other indicators have been used less often. These include frequency of brushing, or flossing, or both (*7, 10*), visits to the dentist once a year for at least 3 years (*12*), an index of carious tooth salvage (*13*), and parent voting behavior in an election on fluoridation (*14*). In all but three studies, the dependent variable was based on self-report by the respondent. Nikias (*12*) used medical records to ascertain data on the use of dental services, while the data analyzed by Tyroler and co-workers (*13*) were based on dental examinations. Moen and Poetsch (*15*) analyzed data based on dentists' reports.

Several investigators analyzed data from national cross-sectional surveys conducted by the National Opinion Research Center (NORC) in 1959, 1961, and 1965 (*8, 11, 16, 17*). In one recent study (*10*) the researchers analyzed data from a national survey in which families were the sampling unit, while in another (*13*) they sampled families from North Carolina. Other researchers used employee populations, most of whom were enrolled in prepaid dental health plans (*3, 5, 6, 12*). Two study populations were drawn from school children in two northeastern cities (*7, 14*). Moen and Poetsch queried a sample of dentists in the United States (*15*). Only Kegeles in his 1963 study (*6*) used a longitudinal design and examined whether or not attitudes and practices at time one predicted behavior at time two. In one other study (*12*) Nikias collected data over a 5-year period but did not analyze it in this manner.

There is remarkable consistency in the findings for the demographic characteristics regardless of study design or study population. All investigators who examined socioeconomic status (SES) indicators found them to be positively associated with PDB even under the circumstances of prepaid dental care. Moreover, these associations persisted in the few studies that introduced controls in an attempt to explain this association (*4, 16*). Women more than men, whites more than blacks, and younger more than older respondents showed PDB.

Studies that used some variation of the Health Belief Model and included psychological variables showed general agreement on the direction of these associations. Anxiety and fear of pain were inversely associated with PDB in all studies that looked at these variables (*3, 5, 6, 8, 16*). Knowledge of prevention also was positively associated with PDB (*3, 16*). Studies showed inconsistent results for perceived benefit, with two showing a positive association (*3, 5*) and one showing no association (*8*). In a followup study by Kegeles (*6*), benefit as measured at time one was not associated with PDB at time two. Similarly, seriousness (*5, 8*) and negative appraisal of the dentist were positively associated with PDB in cross-sectional data but not longitudinally (*6*). Kegeles (*5, 6*) reported a positive association between susceptibility and PDB in both cross-sectional and longitudinal data while Tash and coworkers (*8*) found an unanticipated inverse association. Perceived financial barriers showed an inverse association with PDB in two studies (*3, 8*) and no association in one study (*16*). Investigators in two studies that used the same

data set (*8, 16*) reported different results, although they operationalized the variable somewhat differently. A shared limitation of all of these studies is that the analyses consisted of two-way cross-tabulations and, in a few instances, three-way comparisons between the dependent variables and each of the independent variables. Thus, the relative importance of the predictors was not ascertained.

From the research conducted to date, it appears that demographic and socioeconomic variables impact PDB. Psychological variables such as anxiety and fear of pain appear to impede visits to the dentist for preventive reasons, while findings for the motivating variables of perceived susceptibility, seriousness, and benefit are less consistent. Other variables, such as the enabling factors included in Andersen's model, have not been examined in relation to PDB.

Our study builds on previous studies by (*a*) going beyond the simple analytical techniques used by most previous investigators and assessing the relative importance of the independent variables and their interaction, (*b*) including three measures of PDB, one of which is a measure of home care, (*c*) using a conceptual model that specifies clearly defined sets of independent variables, and (*d*) using a national sample. Thus, we were able to extend as well as replicate aspects of previous research. Despite these advantages over previous studies, the analysis was limited in that we used a secondary data source. Because of this, we did not have available attitudinal and psychological variables that have been considered in some previous studies on this subject.

## Conceptual Model

The explanatory components of the Andersen model are labeled predisposing (the predisposition of the individual to use services), enabling (the ability to secure services), and need (the need for services). While this model of the determinants of health services use will guide our selection of variables, it must be adapted for the analysis of PDB. In particular, recent theoretical work in the health economics literature (*18*) on the demand for health will provide alternate interpretations of the role of some variables. These two approaches have previously been combined in a study of the use of medical care (*19*). The direction of association for many of the Andersen explanatory variables was determined using economic theory, which asserts that individuals combine medical care services and their own time and effort to produce health and other commodities in an effort to maximize overall personal utility or satisfaction. People are limited by both monetary and time constraints and, to some extent, make tradeoffs between good health and other commodities which may simply require time and resources that are not then available for investment in health or possibly pose a threat to health, such as smoking. Our analysis is limited by the availability of data on the variables defined in the theoretical model. Table 1 lists the available variables by category, how they were measured, the frequency distributions, and their expected effects on the dependent variables.

*The strength of the association of income both with utilization for prevention and with home care is notable, although the interpretation of its effect may differ for the utilization and the home care measures. Clearly, income may be viewed as an enabling factor in the use of health services, while for frequency of brushing this conceptualization seems less applicable.'*

**Predisposing.** The Andersen model asserts that some individuals are predisposed to use care, and this attitude can be predicted by demographic, social, structural, and health belief characteristics that exist prior to onset of illness. Demographic groups, characterized by age and sex, experience different illnesses and, therefore, different patterns of medical care use. Social structural variables, such as education and ethnicity, are associated with lifestyle and with the physical and social environment of the individual, which may affect behavior patterns, including medical care utilization. Belief in the efficacy of medical care is also expected to influence the pattern and amount of medical care used.

The available predisposing variables include education, gender, family size, race, marital status, and age. Except for marital status, each variable has a predicted relationship with the indicators of PDB: reason for last dental visit, length of time since last cleaning, and frequency of brushing (table 1).

*'Of particular interest were our findings regarding the associations between frequency of brushing and the three types of independent variables. For this measure of PDB the rank order of the three types of independent variables differed, with the predisposing factors of gender and education being the most important.'*

*Age.* Older persons have different patterns of dental illness than do younger persons, which may result in different use of preventive dental services and behavior. However, it is difficult to predict the effect of age from this perspective. According to the economic theory of the demand for health (*18*), age is directly associated with an increasing rate of depreciation of health and, therefore, an increasing cost of obtaining health improvements through investment in prevention. Thus, older persons are expected to demand less prevention.

*Gender and race.* While neither economic theory nor the Andersen model generates clear predictions for these factors, they have long been empirically associated with medical care utilization and preventive behavior as discussed. Women and whites tend to use more preventive services and engage in more self-directed preventive behavior compared with men and nonwhites. We expect to obtain similar results, based on the past empirical findings.

*Education.* Lifestyle varies with educational level, and it may influence dental behavior toward more prevention due to knowledge of the efficacy of prevention and concern about status and appearance of the teeth. Similarly, an economic interpretation would predict a positive relationship. Education improves the ability of the individual to guard his or her dental health through "proper" combination of self-care and preventive dental care utilization.

*Family size.* As the number of persons increases, income per capita and discretionary time available in the household declines. Thus, use of preventive dental services is expected to decline along with home preventive measures, such as frequency of brushing. These are strictly economic rationales, which would ordinarily fit under the enabling category in the Andersen model, even though family size is listed as a predisposing variable.

**Enabling.** Resources "enable" the individual to obtain the health services or engage in the behavior that he feels is needed. These include family resources such as income, insurance, and the existence of a regular source of care. Community availability of health resources can also enable utilization by reducing travel and waiting time.

The available enabling variables include family income and a regular dentist. Both economic theory and the Andersen model would predict a direct relationship between these factors and the use of preventive dental care because of the time and cost associated with these activities. While brushing also requires time and money, the quantity is so low that enabling factors are not expected to be strongly associated with brushing behavior.

**Need.** Individuals with poor health, either perceived or professionally evaluated, are expected to use more curative health care services. In contrast, those who practice more prevention should have less illness and, therefore, exhibit an inverse relationship between need and preventive behavior through reverse causality. Thus, we expect to find our two measures of need, condition of teeth and conditions of gums, to be directly associated with PDB.

The dependent variables which were used to represent PDB were reason for last visit, length of time since last cleaning, and frequency of brushing. Reason for last visit to the dentist was coded to represent PDB by comparing the category "regular checkup and cleaning" with all other categories combined (table 1 shows original categories). Length of time since last cleaning was coded for preventive behavior by contrasting the category "within the past year" with the category "more than 1 year ago." Frequency of brushing was coded by contrasting the category "two times a day or more often" with the category "less than twice a day."

## Data Source and Methods

The data source for this analysis was the U. S. National Health and Nutrition Examination Survey of 1971–75 (NHANES 1). NHANES 1 is a multistage, stratified, probability sample of persons in selected geographic clusters of households (about

6) and was designed to obtain information on the health and nutritional status of the United States population through standardized interviews and physical and physiological measurements (*20*). The data analyzed in this study were from the NHANES 1 Medical History Supplement which collected data from 6,913 respondents 25 to 74 years of age.

These were the questions asked of respondents to the Health Needs Questionnaire (Part B, Sample Person Supplement):

1. How many times a day do you usually brush your teeth?
2. When was the last time your teeth were cleaned?
3. What was the main reason for your last visit or talk with a dentist at either his office or at a clinic?

Asking these questions was conditional on a response of "no" to the questions, Have you lost all your teeth in your upper jaw? Have you lost all your teeth in your lower jaw?

Not all respondents were asked the questions about PDB. If respondents were edentulous, questions about frequency of brushing and about recency of last visit for cleaning were skipped. Approximately 1,300 respondents had no teeth and were omitted from our analysis. An additional 300 respondents did not answer the question on income, and there were missing values on several other variables. The number of respondents for whom information on all of the independent variables was available differed somewhat for the three dependent measures. The frequency distributions of the independent variables for each of the dependent measures were very similar, so we used a deletion procedure which maximized the use of the available data. Table 1 shows the frequency distributions of the independent variables for the respondents who answered the question on frequency of brushing. The PDB for that category had the maximum number of respondents ($N=5,046$) Table 1 also shows the numbers of respondents for the dependent variables and the response categories for these variables.

Ordinary least squares (OLS) multiple regression was employed to examine the interrelationships between the explanatory variables and each of the dependent variables. Because the dependent variables were dichotomous, the usual assumptions of normality and homogeneity of variances of OLS multiple regression analysis do not hold (*21*). OLS multiple regression analysis has been demonstrated, however, to yield the same results as logistic regression when values of the dichotomous variable are not extreme, that is, less than 10 percent or greater than 90 percent, according to an unpublished manuscript, "Binary Regression—Alternative to Logistic Regression?" by R. Forthofer, et al. The principal author was previously with the University of Texas School of Public Health. The ratio of each estimated regression coefficient and its estimated standard error (Beta divided by standard error), was used to rank the relative statistical significance of the factors. This ratio is commonly used to judge the relative statistical significance of each variable and was employed in the following discussion. Due to the large sample size, the distribution of the ratios probably resembles a normal distribution. Values of 2.576 and greater were considered significant at the .01 level. Because of the large sample size, small differences were statistically significant; thus, some of these differences may not be of practical importance.

Prior to testing for the main effects of the independent variables, we evaluated the two-way interactions for the following pairs of variables: race and education, race and income, education and income, income and condition of teeth, income and condition of gums, age and condition of teeth, and age and condition of gums. The only interaction term that was statistically significant was race and income and only for the two utilization measures. An examination of the cross-tabulations of race and income for these two dependent variables showed that for whites there was a marked positive association of income with both utilization measures, while for blacks there was no clear linear trend. Thus, in most of the analyses only the main effects are considered.

## Results

Table 2 summarizes the results of the analysis of the three dependent variables. For the reason for the last visit to the dentist, the need dimension of the model (as represented by self-perceived evaluation of teeth) was the most significant variable. Those rating the condition of their teeth as excellent or good were more likely to visit the dentist for preventive reasons. One unexpected result was the negative effect of the need variable

Table 1. Frequency distributions of dependent and independent variables in the study of preventive dental behavior of respondents to the National Health and Nutrition Examination Survey I Medical History Supplement, 1971–75

| Variable | Measure | Frequency: Number | Frequency: Percent | Predicted effect on PDB |
|---|---|---|---|---|
| *Dependent variables* | | | | |
| Reason for last visit: | | | | |
| Regular checkup & cleaning | 1 | 2,079 | 43.9 | ..... |
| Denture | 0 | 453 | 9.6 | ..... |
| Toothache | 0 | 1,292 | 27.3 | ..... |
| Fillings | 0 | 913 | 19.3 | ..... |
| Length of time since last cleaning: | | | | |
| Within the past year | 1 | 2,076 | 45.3 | ..... |
| More than 1 year ago | 0 | 2,509 | 54.7 | ..... |
| Frequency of tooth-brushing: | | | | |
| 1 time per day | 0 | 1,995 | 39.5 | ..... |
| 2 times per day | 1 | 2,525 | 50.0 | ..... |
| 3 times per day | 1 | 526 | 10.4 | ..... |
| *Independent variables, predisposing* | | | | |
| Age (in years): | | | | |
| 25–34 | Actual | 1,634 | 32.4 | ..... |
| 35–44 | Actual | 1,207 | 23.9 | ..... |
| 45–54 | Actual | 1,117 | 22.1 | ..... |
| 55–64 | Actual | 712 | 14.1 | Negative |
| 65–74 | Actual | 376 | 7.5 | ..... |
| Gender: | | | | |
| Male | 1 | 2,346 | 46.5 | Female |
| Female | 0 | 2,700 | 53.5 | ..... |
| Race: | | | | |
| White | 1 | 4,511 | 89.4 | White |
| Black | 0 | 535 | 10.6 | ..... |
| Education (in years): | | | | |
| 0–8 | Actual | 672 | 13.3 | ..... |
| 9–11 | Actual | 709 | 14.1 | ..... |
| 12 | Actual | 2,010 | 39.8 | Positive |
| Greater than 12 | Actual | 1,655 | 32.8 | ..... |
| Marital status[1]: | | | | |
| Married | Dummy (0,1) | 4,030 | 79.9 | ..... |
| Widowed | Dummy (0,1) | 260 | 5.2 | ..... |
| Never married | Dummy (0,1) | 332 | 6.6 | ..... |
| Divorced | Dummy (0,1) | 285 | 5.6 | ..... |
| Separated (reference) | Dummy (0,1) | 139 | 2.8 | ..... |
| Family size: | | | | |
| 1 person | Actual | 474 | 9.4 | ..... |
| 2–3 persons | Actual | 2,230 | 44.2 | ..... |
| 4–5 persons | Actual | 1,682 | 33.3 | ..... |
| 6 or more persons | Actual | 660 | 13.1 | Negative |
| *Enabling* | | | | |
| Regular dentist: | | | | |
| Yes | 1 | 3,860 | 76.5 | Positive |
| No | 0 | 1,186 | 23.5 | ..... |
| Income[2]: | | | | |
| Less than $4,000 | ..... | 520 | 10.3 | ..... |
| $4,000–6,999 | ..... | 659 | 13.1 | ..... |
| $7,000–9,999 | ..... | 1,005 | 19.9 | ..... |
| $10,000–14,999 | ..... | 1,328 | 26.3 | ..... |
| $15,000 or more | ..... | 1,534 | 30.4 | ..... |
| *Need* | | | | |
| Condition of teeth: | | | | |
| Excellent or good | 1 | 2,800 | 55.5 | ..... |
| Fair or poor | 0 | 2,246 | 44.5 | Positive |
| Condition of gums: | | | | |
| Excellent or good | 1 | 3,937 | 78.0 | ..... |
| Fair or poor | 0 | 1,109 | 22.0 | Positive |

[1] Separate F tests were done for each marital status category, using "separated" as the referent. This procedure was chosen because it would indicate where the differences in marital status existed.

[2] Income was recorded from the original continuous categories. The midpoint of each original category was chosen with actual values used in the regression equation: 11 = 1,000, 12 = 1,500, 13 = 2,500, 14 = 3,500, 15 = 4,500, 16 = 5,500, 17 = 6,500, 18 = 8,500, 19 = 12,500, 20 = 17,500, 21 = 22,500, 22 = 30,000.

condition of gums, which showed that persons who evaluated their gums as fair or poor were more likely to go to the dentist to have their teeth cleaned.

Of the enabling factors, both income and a regular source of care were statistically significant. Income showed a positive association and was the second most important factor in the model, with regular source of care ranked third. As expected, the enabling factors were less strongly related to frequency of brushing than to the other measures of PDB.

Four of the six predisposing factors were statistically associated with visiting a dentist for preventive reasons. Their rank order of importance was education, race, gender, family size, marital status, and age. Consistent with other research, males were less likely to seek preventive care than were females, and blacks were less likely to visit the dentist for preventive reasons than were whites. Education was positively associated with preventive behavior. As family size increased, the likelihood of a preventive dental visit decreased. Marital status and age were not significant, although age showed a negative association, which is consistent with the findings of others.

Table 2 also shows the results of the regression analysis for length of time since last cleaning. The enabling factor of a regular source of care was the most important variable in predicting a visit to the dentist in the past year for a cleaning. Income, the other enabling factor, also had a strong positive effect on PDB, ranking third among all variables. Condition of teeth, a need variable, ranked second in importance; those rating their teeth as "excellent or good" were more likely to have gone

Table 2. The effects of enabling, predisposing, and need variables on the measures of preventive dental behavior

| Predictor group and variable | Reason for last visit to the dentist[1] | | Length of time since last cleaning[1] | | Frequency of brushing[1] | |
|---|---|---|---|---|---|---|
| | Beta | Beta ÷ standard error[2] | Beta | Beta ÷ standard error[2] | Beta | Beta ÷ standard error[2] |
| Enabling: | | | | | | |
| Income | 0.9477 e-05 | 9.4000 | 0.9320 e-05 | 9.3000 | 0.5034 e-05 | 5.0000 |
| Regular dentist | 0.1563 | 9.3906 | 0.3560 | 21.0764 | 0.2771 | 1.6510 |
| Need: | | | | | | |
| Condition of teeth | 0.2085 | 15.0928 | 0.1725 | 11.8720 | 0.0523 | 3.6492 |
| Condition of gums | −0.0556 | −3.2465 | −0.0353 | −2.0470 | 0.0185 | 1.0854 |
| Predisposing: | | | | | | |
| Education | 0.0218 | 8.5506 | 0.0176 | 6.6599 | 0.0157 | 6.1602 |
| Gender | −0.0464 | −3.4179 | −0.0537 | −4.0050 | −0.2826 | −20.9103 |
| Family size | −0.0096 | −2.3157 | −0.0237 | −5.5336 | −0.0167 | −3.9720 |
| Race | 0.1072 | 4.5841 | 0.0654 | 2.5271 | −0.2728 | −1.2042 |
| Marital status: | | | | | | |
| Divorced | 0.0739 | 1.5342 | 0.2326 | 4.6282 | 0.0234 | 0.4848 |
| Never married | 0.0822 | 1.7417 | 0.1631 | 3.3105 | 0.0422 | 0.8890 |
| Married | 0.0444 | 1.0878 | 0.1260 | 2.9109 | −0.0054 | −0.1311 |
| Widowed | 0.0212 | 0.4248 | 0.1273 | 2.4078 | −0.6528 | −1.2970 |
| Age | −0.0003 | −0.5170 | 0.0005 | 0.8812 | −0.0004 | −0.8259 |
| Constant | −0.2054 | −3.3999 | −0.3471 | −5.4216 | 0.5256 | 8.6656 |
| $r^2$ | −0.18 | ..... | 0.23 | ..... | 0.11 | ..... |
| Number of respondents | 4,737 | ..... | 4,585 | ..... | 5,046 | ..... |

[1] See table 1 for definition and coding of the dependent variables.
[2] Ratio vaues were ranked to determine relative statistical significance. Values of 2.576 and greater were statistically significant at the 0.01 level.

recently for a cleaning. Of the predisposing factors, education was the most important, followed by family size, marital status, gender, race, and age. The direction of the associations was similar to those for reason for last visit, although the relative importance of the predisposing factors differed somewhat.

The dependent variable, frequency of brushing, showed a somewhat different pattern of results (table 2). In contrast to the results for the other two measures, the predisposing factors were the most important, with gender and education showing the strongest associations. Females and persons with more education demonstrated more preventive dental behavior as measured by brushing two or more times per day. Family size also was significant among the predisposing variables, indicating that as family size increased, the frequency of brushing decreased. Of the enabling variables, only income was significant, and it showed a positive effect. Persons who evaluated their teeth as excellent or good (the need variable) were more likely to brush two or more times per day.

In summary, the need variable "condition of teeth" and the two enabling factors showed the strongest associations with use of services for prevention. In contrast, the predisposing factors were the most important for our measure of home care. Despite differences in the relative importance, however, the direction of the associations was consistent across the three measures and largely consistent with theoretical expectations.

## Discussion

Our findings regarding the sociodemographic factors are in general agreement with those reported by other investigators who have studied PDB. Both indicators of SES (education and income) were positively associated with PDB as were being female and being white. Moreover, our findings regarding the patterns of association between the two dependent variables representing use of services and the predisposing, enabling, and need factors are consistent with results recently reported by others (*22*). Although they did not use a measure of PDB, Evashwick and co-workers (*22*) used Andersen's model to study the use of dental services by the elderly. They found that education, the presence of a regular source of care, and the person's perception of the extent of his or her oral health problems were the most important factors associated with length of time since last visit. The major difference with our results was the impor-

tance of income in our study—a difference that may be explained by the limited range of income in their sample.

Andersen and co-workers (*23*) found that toothache (a need variable) was the most important factor predicting both number of dental visits (for any reason) and percentage of people seeing a dentist. The predisposing factors of age, education, and race also were important predictors for seeing a dentist, while family income, an enabling factor, was the second most important variable for number of visits. In contrast, Andersen (*1*) found that need was relatively unimportant in explaining expenditures for dental services; however, the need variables in his early study were not specific to dental problems. Although most of their analysis did not focus on PDB, Andersen and co-workers (*23*) did examine racial and income differences in reasons for seeing a dentist. More whites than blacks visited a dentist only for preventive care, with income making little difference in this pattern. Even though our dependent measures differed from those used by Andersen and co-workers (*23*) in that we focused on preventive behavior, our findings with respect to the relative importance of the predisposing, enabling, and need factors are in general agreement. It appears that use of services for prevention does not show a very different pattern of association compared with use in general; however, use in general includes use for prevention. It would be preferable to compare constellations of independent variables separately by specific reason for visits.

Of particular interest were our findings regarding the associations between frequency of brushing and the three types of independent variables. For this measure of PDB the rank order of the three types of independent variables differed, with the predisposing factors of gender and education being the most important. Antonovsky and Kats (*3*) noted that, in their attempt to form a composite measure of PDB, the questions dealing with home care did not correlate well with checkup behavior. Similarly, we found a higher correlation between the two utilization measures (.32) than between the home care measure and either utilization measure (.12 for the correlation between home care and length of time since last cleaning and .13 for home care and reason for last visit). Thus, our finding is consistent with the results of other studies (*3, 24, 25*) which support the view that each preventive behavior may be influenced by different variables and that each variable may not be of equal importance.

Although there was consistency in the direction of associations between all three dependent measures and the independent variables, the difference in the rank order of importance among the independent variables has implications for program planning and health education efforts. The strong association between having a regular source of care and the utilization measures is consistent with an interpretation that the dentist is important in maintaining the utilization behavior of the consumer, as Kriesberg and Treiman (*16*) found. It is possible, although we could not evaluate it in this study, that the dentist plays a major role in determining whether his patients come in for preventive visits, since most dentists use recall systems to remind patients to come in for checkups. In contrast, having a regular source of care was not a major predictor for frequency of brushing, an indication that dental health education may be obtained away from the professional dental office. Toothbrushing is a convenient and relatively inexpensive prophylactic process that has been advocated for years by health professionals and is easily taught by nonprofessionals (*10*).

The strength of the association of income both with utilization for prevention and with home care is notable, although the interpretation of its effect may differ for the utilization and the home care measures. Clearly, income may be viewed as an enabling factor in the use of health services, while for frequency of brushing this conceptualization seems less applicable.

Lowering this barrier with insurance coverage of preventive dental services might increase utilization by certain subgroups. Data analyzed by Manning and Phelps (*26*) comparing the use of dental services by a sample of elderly persons in the Group Health Insurance with the United States population in the same age group suggests that this might be the case. However, the strong association between education and all three measures of preventive dental behavior, especially frequency of brushing, leads us to suggest that financial constraints may not be the only barrier to engaging in PDB. Others (*4,11*) who have observed similar patterns have suggested that persons of lower socioeconomic status may view dental problems as less important or believe that dental visits are ineffective in preventing disease. If this is the case, programs designed to increase knowledge of the importance and effectiveness of preventive dental behavior may have some impact on these groups. We caution against this effort as a panacea, however, because it has been noted that the

correlation between knowledge or attitudes and actual behavior is modest (*11, 14*).

Self-evaluated condition of teeth, a need variable, was significant in all models. Our data showed that persons who considered their teeth to be in excellent or good condition demonstrated more PDB than those rating the condition of their teeth as fair or poor. In contrast, the need variable "condition of gums" showed the opposite pattern for the utilization measures. It may be that the condition of one's gums is associated with serious dental problems such as bleeding and pain which motivate one to visit the dentist for remedial care. In contrast, a person's perception of his teeth as excellent or good may reflect a behavioral pattern of preventive care. We would thus expect that visits to the dentist for preventive reasons and other preventive behavior such as home care would be related to the perception of one's teeth as in good condition. It would be useful to attempt replication of these findings in a prospective study using a more objective measure of need, such as a dentist's evaluation.

It is important to note some limitations of our measures of PDB. Appropriate PDB differs for different dental diseases. The available data indicate that toothbrushing is not particularly effective against dental caries but is recommended to control periodontal diseases (*27,30*). Dental caries occur primarily during childhood and adolescence and are most effectively controlled through water fluoridation, use of self-applied fluoride tablets, and reduced consumption of sugar (*28,30*). Periodontal diseases, which primarily afflict adults, can be controlled to some extent through effective personal oral hygiene such as toothbrushing and the use of dental floss, augmented by professional prophylaxes (*28,30*). The efficacy of toothbrushing in controlling periodontal diseases, however, depends on the removal of plaque from the teeth, which is not necessarily related to the frequency of brushing. Leske and colleagues (*28*) note that plaque can be removed by physical or chemical means. Physical methods include toothbrushing, flossing, and the use of water irrigating devices, while chemical methods include the use of antibiotics, antimicrobial agents, and enzymes. We had only one of these measures, toothbrushing, available in our data set.

Length of time since last cleaning also is limited as a dependent variable in that it is difficult to determine an ideal cutoff point. Once a year may be no better than once every year and a half. Moreover, Leske and colleagues (*28*) note that there is no evidence that cleaning twice a year results in a significant improvement in oral health (*31*). Thus, our measures relate imperfectly to what is known about the prevention of dental diseases.

The low proportion of variation explained in our study and in those of others may be due to limitations in the theoretical frameworks used. The models we used clearly demonstrate the importance of certain characteristics, but they omit other variables which undoubtedly play a part. In addition to including more of the standard variables from the Andersen model, future research should examine the role of the family and other social groups in promoting the oral health behaviors of individuals. In addition, the use of prospective study designs would permit us to examine which factors were related to changes in PDB over time.

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# Model System of Ongoing Care for Native Americans —a 5-Year Followup

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## Synopsis

*In 1979, continuing care from a personal physician was identified as a priority at the Indian Health Service site in Zuni, NM, a rural hospital and ambulatory care center serving 7,000 Zuni people. To encourage such care, a system was established that assigned each patient to a regular physician and organized physicians into teams. Three teams, each consisting of three clinicians and other support personnel, served specific geographic regions of the village.*

*Five years later, the ongoing care provided for active randomly selected prenatal, diabetic, and general clinic patients was evaluated. The physician staff of the site had gone through a complete turnover during the previous five years. Based on a chart review for the year prior to patient identification, patients saw their regular physician from 48 to 61 percent of the time in all their visits, and their regular physician or his or her team colleague from 71 to 82 percent of the time in all their visits.*

*Ongoing care from a personal physician or close colleague can be achieved in the Indian Health Service. Organization of physicians into teams appeared to be the critical element in promoting ongoing care at this site where physician turnover is high. Team physicians seldom all leave at once, and ongoing care as a priority is passed on by the attitude of other team physicians, by transfer of specific patients, and by patient expectation. Given the established benefits, ongoing care from a personal provider should be encouraged in the Indian Health Service as in other primary care settings.*