# Dental Care Visits among Dentate Adults with Diabetes and Periodontitis

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## Abstract

**Objectives:** Two national surveys have shown that dentate adults with diabetes are less likely to visit a dentist than are those without diabetes; one survey showed this association only among women. We hypothesize that periodontal health among those with diabetes could explain this disparity. This report investigates the influence of periodontitis on the association between diabetes and dental care visits. It also tests whether disparities are limited to women. Methods: Data from the 1999-2004 National Health and Nutrition Examination Survey were used. Covariates included age, sex, race/ethnicity, poverty status, education level, dental insurance, and periodontitis status. Weighted analyses were limited to dentate adults aged  $\geq$  25 years. **Results:** Overall, 56.8 percent of dentate adults with diabetes reported having a dental care visit in the preceding year compared with 64.7 percent for those without diabetes. In a multivariable model, diabetes status was significantly associated with having a dental care visit, independent of periodontitis status and covariates. Neither periodontitis status nor sex served as effect modifiers for the association between diabetes status and dental care visits. Conclusions: These data revealed that dental care visits for dentate adults with diabetes were unrelated to their periodontal health. suggesting that fear of periodontal therapy did not influence visit patterns. These data also showed that dental care visit disparities existed for all adults with diabetes, not just women. Future research should investigate whether factors that are indirectly related to diabetes status, such as competing costs, attitudes, and knowledge, are influencing dental care visit patterns among dentate adults with diabetes.

Key Words: Adult, diabetes mellitus, health surveys, periodontitis, dental care, United States

#### Introduction

Diabetes is associated with several health complications, including kidney disease (1), neuropathies relating to the foot (2), diabetic retinopathy (3), and periodontitis (4,5). Studies indicate that the link between diabetes and periodontitis is bidirectional, as unresolved periodontal infections may place a person at risk for poor glycemic control (6,7) and other diabetic complications (8-10).

Although the link between diabetes and periodontitis is strong, recent studies have shown that dentate adults with diabetes are not seeking dental care services at a rate that is consistent with their periodontitis risk. In an analysis of data from the 1995-1998 cycles of the Behavioral Risk Factor Surveillance Survey (BRFSS), Tomar and Lester (11) showed that dentate adults with diabetes were 18 percent less likely to have visited a dentist in the preceding year than were dentate adults without diabetes, even after controlling for age, race/ethnicity, education level, household income, and dental insurance status. Using data from the 2003 National Health Interview Survey (NHIS), Macek and colleagues (12) also showed that dentate adults with diabetes were underutilizing dental care services, although their findings revealed a statistically significant difference in visit patterns only among women.

Given the established relation between diabetes and periodontitis, it is surprising that persons with diabetes are less likely to visit a dentist than are those without diabetes. In explaining the results from the 2003 NHIS, Macek and colleagues (12) hypothesized that fear of uncomfortable periodontal therapy could have deterred dental care visits for those with diabetes. Although this hypothesis was compelling, it was never tested by Macek and his co-authors because the 2003 NHIS did not contain data on clinical periodontal status.

The current study investigated the influence of periodontitis on the association between diabetes status and dental care visits among dentate adults in the United States. Specifically, it tested whether periodontitis status acted as an effect modifier for the association between diabetes status and dental care visits. Noting that the 2003 NHIS data showed a sex-specific association between diabetes status and dental care visits whereas the BRFSS data did not, the current report also tested whether sex acted as an effect modifier for the association between periodontitis and dental care visits.

#### Methods

Data for this report came from the 1999-2000, 2001-2002, and 2003-2004 cycles of the National Health and Nutrition Examination Survey (NHANES), a cross-sectional survey of physical health status administered annually by the National Center

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for Health Statistics. The majority of NHANES data was collected in mobile examination centers (MECs) that consisted of four interconnected tractor trailers containing examination rooms, interview stations, and laboratory facilities. For those unable to travel to the MECs, data were gathered in participants' homes.

NHANES consisted of three components: face-to-face health status interview, physical examination, and laboratory assessment. Variables for this report came from the *Demographics*, *Diabetes*, *Health Insurance*, and *Oral Health* sections of the face-to-face health status survey; as well as the *Oral Health Dentition* and *Oral Health Periodontal* sections of the physical examination. The laboratory assessment component of NHANES was not used in this report.

The target population for NHANES was the civilian, non-institutionalized population of the United States. NHANES used a stratified, multistage probability sampling method to select study participants. Low-income persons, adolescents, persons  $\geq 60$  years of age, African Americans, and Mexican Americans were oversampled so that prevalence estimates for these population groups would be reliable. A detailed description of the NHANES methodology is available elsewhere (13).

Study Variables. The main outcome variable for this analysis was having had a dental care visit in the preceding 12 months. Data for this variable came from a survey item that asked, "About how long has it been since you last visited a dentist? Include all types of dentists, such as, orthodontists, oral surgeons, and all other dental specialists, as well dental hygienists." Responses as "6 months or less" and "More than 6 months, but less than 1 year ago" were combined to represent the outcome of interest.

The main predictor variable was diabetes status. Data for this variable came from a question that asked, "(Other than during pregnancy), have you ever been told by a doctor or health professional that you have diabetes or sugar diabetes?" Only an affirmative response was coded as "Has diabetes." Responses of "Borderline" and "No" were coded as "Does not have diabetes." Although NHANES included laboratory assessments of diabetes status, these were not used for this study because the assessments were administered to only a small subset of survey participants.

Periodontitis status was defined according to criteria used by the Centers for Disease Control and Prevention and the American Academy of Periodontology (14). According to those criteria, moderate periodontal disease was defined as having at least two teeth with interproximal attachment loss of  $\geq 4$  mm or at least two teeth with  $\geq 5 \text{ mm}$  of pocket depth at interproximal sites. Severe periodontal disease was defined as having at least two teeth with interproximal attachment loss of  $\geq 6 \text{ mm}$ and at least one tooth with  $\geq 5 \text{ mm}$ of pocket depth at interproximal sites. Interproximal refers to the area between two adjacent teeth.

Covariates for this report included age (25-44 years, 45-64 years, ≥65 years), sex, poverty status [unknown, <100 percent of the federal poverty level (FPL), 100%-199% FPL, ≥200% FPL], education level (<12 years, 12 years, >12 years), dental insurance status (does not have coverage, has coverage), and race/ethnicity (Mexican-American, non-Hispanic Black, non-Hispanic White, other). The "Other" race/ethnicity category included persons of "Other race," "Other Hispanic ethnicity," and "Mixed race." Dental insurance survey questions did not differentiate between having private coverage and having public coverage (such as Medicaid, Medicare, or other government sources). As such, the "has coverage" category includes any type of dental insurance.

**Analysis.** In order to maximize the likelihood that respondents were making their own decisions about whether to visit a dentist, as opposed to a parent or guardian, analyses were restricted to adults aged 25 years or older. In addition, analyses were restricted to adults who received an oral examination as part of the NHANES protocol. Those who did not receive an oral examination included persons with specific health conditions (e.g., rheumatic fever, kidney disease requiring dialysis, hemophilia, and certain heart problems) placing them at risk of adverse events secondary to the examination. Participants with unknown diabetes status (n=3), education level (n=11), dental insurance status (n = 322), or dental visit history (n = 17) also were excluded from the analysis. The final sample included 8,541 dentate persons, representing 121.4 million US adults.

The stratified, bivariate, and multivariable analyses generated in this study were weighted so that parameter estimates would be representative of the target population. In order to compensate for the stratified, multistage NHANES sample design, SUDAAN statistical software for Windows, Version 9.1 (15) was used to calculate parameter estimates. For all analyses, statistically significant differences were based on an alpha value of 5 percent.

# Results

Compared with those without diabetes, dentate adults with diabetes were older, and were more likely to be members of a racial/ ethnic minority group, have health insurance coverage, have low socio-economic status, and have periodontitis (P < 0.05) (Table 1). There was no statistically significant association between sex and diabetes status (P = 0.20) among the study population.

Overall, 56.8 percent [standard error (SE) = 3.1] of dentate adults with diabetes reported having had a dental care visit in the preceding year, whereas 64.7 percent (SE = 1.0) of dentate adults without diabetes reported a visit. This bivariate difference was statistically significant (crude odds ratio = 0.72; 95 percent confidence interval: 0.53-0.96).

Upon adjusting for periodontitis status and other relevant covariates (age, sex, race/ethnicity, poverty status, education level, and dental

Characteristic	Diabetes status			
	Has diabetes		Does not have diabetes	
	Sample size	Weighted % (standard error)	Sample size	Weighted % (standard error)
Overall	725	100.0 (n/a)	7,816	100.0 (n/a)
Age				
25-44 years	116	21.6 (2.1)	3,880	54.1 (1.2)
45-64 years	323	50.2 (2.6)	2,489	35.4 (1.1)
65 years or older	286	28.2 (2.4)	1,447	10.5 (0.3)
Sex				
Male	382	52.3 (2.4)	3,797	49.2 (0.6)
Female	343	47.7 (2.4)	4,019	50.8 (0.6)
Race/ethnicity				
Mexican American	220	8.2 (1.3)	1,771	7.3 (0.9)
Other*	65	14.7 (2.9)	583	9.4 (1.2)
Non-Hispanic Black	179	15.9 (2.1)	1,415	9.9 (0.9)
Non-Hispanic White	261	61.2 (3.2)	4,047	73.4 (1.6)
Education level				
<12 years	297	24.1 (1.9)	2,127	16.2 (0.6)
12 years	154	26.1 (1.9)	1,819	25.1 (0.9)
>12 years	274	49.8 (2.3)	3,870	58.7 (1.1)
Poverty status				
Unknown	59	8.8 (1.8)	613	6.5 (0.5)
<100% FPL <sup>†</sup>	130	12.2 (1.6)	1,035	9.3 (0.5)
100%-199% FPL <sup>†</sup>	212	21.9 (1.9)	1,631	16.2 (0.7)
$\geq 200\%$ FPL <sup>†</sup>	324	57.2 (2.6)	4,537	68.0 (1.0)
Dental insurance status			, -	
Does not have coverage	371	48.0 (2.8)	3,765	43.0 (0.8)
Has coverage	354	52.0 (2.8)	4,051	57.0 (0.8)
Periodontitis status	-		, -	
Has periodontitis	129	13.5 (1.4)	641	6.0 (0.4)
Does not have periodontitis	596	86.5 (1.4)	7,175	94.0 (0.4)

Table 1Sample Size and Weighted Prevalence of Selected Characteristics for Dentate Adults Aged $\geq$ 25 Years, by Diabetes Status: United States, 1999-2004 (n = 8,541)

\* Includes persons of "other race" (including mixed race) and "other Hispanic" ethnicity.

<sup>†</sup> Federal poverty level.

Note: Persons with unknown diabetes status, education level, dental insurance status, and dental visit history were excluded from the analysis.

insurance status) in a multiple logistic regression model, dentate adults with diabetes remained significantly less likely than those without diabetes to have had a dental care visit in the preceding year (Table 2). Persons with periodontitis also were significantly less likely than those without periodontitis to have had a dental care visit, independent of diabetes status. Beyond diabetes status and periodontitis status, the multiple logistic regression model also revealed that race/ethnicity, poverty status, education level, and dental insurance status were significantly associated with dental care visits. Analysis also showed that periodontitis did not serve as an effect modifier for the association between diabetes status and dental care visits in the multiple logistic regression model (Wald-F P = 0.82).

To test whether disparities in dental care visits between those with and without diabetes were limited to women, sex was also tested as an effect modifier between diabetes status and dental care visits in the multiple logistic regression model. The results of this test showed that sex was also not an effect modifier (Wald-F P = 0.16). Differences between dental care visits patterns for those with and without diabetes were unrelated to sex..

Table 3 describes the prevalence of past-year dental care visits, stratified by diabetes status and periodontitis status. The results show that, regardless of periodontitis status, those with diabetes were less likely to have had a dental care visit in the preceding year than were those without diabetes.

#### Discussion

It has been established that adults with diabetes are more likely to have periodontitis than are those without diabetes. Periodontitis requires regular assessment, treatment, and management by dental professionals. Given their greater susceptibility to periodontitis, one would expect that those with diabetes would be more likely to visit a dentist than would those without diabetes. At the very least, those with diabetes would be just as likely to visit a dentist as those

Characteristic	Adjusted* odds ratio	95% confidence interval	P value	
Diabetes status				
Has diabetes	0.71	0.50-1.00	< 0.05	
Does not have diabetes	Reference	_	_	
Periodontitis status				
Has periodontitis	0.70	0.57-0.86	< 0.01	
Does not have periodontitis	Reference	_	_	
Age				
25-44 years	0.47	0.40-0.54	< 0.01	
45-64 years	0.69	0.57-0.85	< 0.01	
65 years or older	Reference	_	-	
Sex				
Male	0.68	0.61-0.75	< 0.01	
Female	Reference	_	_	
Race/ethnicity				
Mexican American	0.70	0.57-0.86	< 0.01	
Other <sup>†</sup>	0.79	0.63-1.00	< 0.05	
Non-Hispanic Black	0.61	0.52-0.73	< 0.01	
Non-Hispanic White	Reference	_	_	
Education level				
<12 years	0.45	0.37-0.55	< 0.01	
12 years	0.56	0.49-0.65	< 0.01	
>12 years	Reference	_	-	
Poverty status				
Unknown	1.05	0.81-1.37	0.71	
<100% FPL <sup>‡</sup>	0.57	0.46-0.70	< 0.01	
100%-199% FPL <sup>‡</sup>	0.61	0.50-0.76	< 0.01	
≥200% FPL <sup>‡</sup>	Reference	_	_	
Dental insurance status				
Does not have coverage	0.55	0.47-0.63	< 0.01	
Has coverage	Reference	_	_	

Table 2Adjusted\* Odds of Having had a Dental Care Visit in the Preceding Year for Dentate Adults Aged  $\geq 25$ Years, by Selected Characteristics: United States, 1999-2004 (n = 8,541)

\* Odds ratio values control for all other variables in the table.

<sup>†</sup> Includes persons of "other race" (including mixed race) and "other Hispanic" ethnicity.

<sup>‡</sup> Federal poverty level.

Note: Persons with unknown diabetes status, education level, dental insurance status, and dental visit history were excluded from the analysis.

without diabetes. Surprisingly, three different national datasets have shown the opposite to be true; those with diabetes are less likely to visit a dentist than are those without diabetes (true only for women according to the 2003 NHIS) (12).

In an attempt to explain these unexpected findings, this study set out to test whether periodontitis was acting as a deterrent to dental care; the argument being that those with diabetes were avoiding dental care because of potentially uncomfortable or expensive periodontal therapy. In other words, instead of leading those with diabetes to a dentist, perhaps having periodontitis was keeping them away.

This study showed that diabetes status and periodontitis status, in

fact, acted independently of one another, as evidenced by two statistically significant associations in a multiple logistic regression model. This study also showed that there was no significant interaction between the two variables, implying that having diabetes had no more impact on dental care visit patterns for those with periodontitis than it did for those without periodontitis, as reflected by the results in Table 3.

Although the results of this study eliminated periodontitis status as one of the deterrents for dental care visits among persons with diabetes, other explanations remain unidentified. It is reasonable to presume that factors indirectly related to diabetes would be likely candidates. Future studies should identify whether dental care visit patterns among dentate adults with diabetes are associated with such indirect factors as competing health-care costs, negative attitudes about health and the health-care system, and knowledge of the link between diabetes and periodontitis.

Also unidentified is the reason why two national datasets (1995-1998 BRFSS and 1999-2004 NHANES) showed no sex-specific association between diabetes status and dental care visits whereas one did show a sex-specific association (2003 NHIS). Questions concerning diabetes status and dental care visits were asked similarly across all three surveys, so it is unlikely that survey methodology explained the differences. Future analyses of NHIS surveys conducted after 2003 should reveal whether the Table 3 Weighted Prevalence of a Dental Care Visit in the Preceding Year among Dentate Adults Aged  $\geq$ 25 Years, by Periodontitis Status and Diabetes Status: United States, 1999-2004 (n = 8,541)

Periodontitis status/ diabetes status	Weighted % (standard error)
Has periodontitis Has diabetes Does not have	46.5 (6.9) 51.6 (2.6)
diabetes Does not have	
periodontitis Has diabetes Does not have diabetes	58.4 (3.0) 65.5 (1.0)

Note: Persons with unknown diabetes status, education level, dental insurance status, and dental visit history were excluded from the analysis.

interaction between sex and diabetes status detected by Macek and colleagues (12) was simply an anomaly.

Although it is remains unclear why dentate adults with diabetes are avoiding dental care, it is plain that avoiding dental care has the potential to negatively affect their health. Until researchers understand what is behind the dental care visit patterns of those with diabetes, practitioners and public health officials are urged to encourage their patients to seek regular dental care. Physicians and other health-care providers should know that periodontitis is a complication of diabetes and should inform their patients of the same. Accessing dental care services may be difficult for those without dental insurance; however, adults with diabetes need to realize that early diagnose and prompt treatment of their oral problems is especially important for maintaining their general health. In addition, dental practitioners must also recognize that those with diabetes are less likely to present for regular dental visits. As such, dentists and dental hygienists should be especially diligent when a patient with diabetes is in the office. Initial examinations should include thorough assessments of periodontal

health so that any problems are detected promptly. Follow-up dental examinations should include special attention to oral hygiene instruction, assessment of disease progression, and definitive therapy for any problems that are identified.

Earlier in the discussion, suggestions for future research were presented in the context of competing health-care costs, negative attitudes about health care, and knowledge. Researchers should also explore the referral patterns of dental and nondental practitioners and the relation of these patterns to knowledge of the diabetes-periodontitis connection. For instance, it would be interesting to know whether practitioners who recognize the relation between diabetes and periodontitis are more likely to make appropriate referrals for oral health care.

This study was subject to a number of limitations. NHANES did not ask questions about the type of dental care services that were provided during the dental care visits. It is possible that some adults with diabetes who visited a dentist did not receive any kind of periodontal assessment or treatment. Consequently, the disparity in receipt of necessary periodontal care between those with and without diabetes could have been greater than was described. Another limitation was the cross-sectional nature of the study. Because diabetes status and periodontitis status were measured at one point in time, it was impossible to know whether the onset of one disease preceded the other, potentially blurring the interpretation of dental care visit patterns and their relation to either diabetes or periodontitis.

Despite these limitations, this study provided additional evidence of underutilization of dental care services by dentate adults with diabetes. It also provided guidance for researchers interested in finding explanations for these findings. Diabetes represents a bridge between systemic health and oral health. Researchers should continue to explore the determinants of dental care visits among those with diabetes so that improvements in overall health are gained.

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