

Subpar Utilization of Dental Care Among Americans With a History of Stroke

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Persons with poor oral hygiene are prone to periodontitis, an inflammatory gum disease independently linked to stroke. Regular dental examinations allow for early detection and treatment of oral conditions associated with the risk of further vascular events. Little is known about patterns of dental care among persons at risk for stroke. We assessed the prevalence and independent predictors of at least one visit to the dentist within the preceding 12 months among stroke survivors in the United States using data from the National Health Interview Survey (NHIS) 2006 survey. The 24,275 adults who completed the survey self-reported a total of 706 strokes, for an incidence of 3%. The rate of at least one visit to the dentist over the previous year among stroke survivors (mean age, 67 ± 15 years) was 46%. Factors independently associated with visiting the dentist were female sex (odds ratio [OR], 1.83; 95% confidence interval [CI], 1.31-2.57), being married (OR, 1.95; 95% CI, 1.37-2.77), having a high school or greater education (OR, 2.11; 95% CI, 1.51-2.93), and having contact with a primary care doctor in the previous year (OR, 1.74; 95% CI, 1.04-2.93). Factors independently associated with not visiting the dentist were black race (OR, 0.63; 95% CI, 0.43-0.92) and the presence of a significant medical comorbidity (OR, 0.69; 95% CI, 0.48-0.97). In 2006, less than half of stroke survivors in the United States received dental care, leaving substantial room for improvement. Stroke survivors need education about the importance of regular dental care, particularly minority groups. **Key Words:** Risk factors—oral care—access—National Health Interview Survey—periodontitis.

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There is a direct relationship among chronic inflammation, atherosclerosis, and symptomatic vascular events.¹ Individuals have higher rates of coronary and cerebrovascular

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events during acute infections, and chronic low-level infection has been shown to accelerate atherosclerosis. Recognition and treatment of inflammatory diseases associated with cardiovascular disease and stroke may be a way to decrease systemic inflammation and offer a new avenue for prevention.

Nine years ago, the US Surgeon General published a report on oral health in America² that underscored the importance of oral health to general health. Periodontitis, a chronic inflammation of tissues surrounding and supporting the teeth due mainly to poor oral hygiene, is significantly more common in patients with atherosclerosis,³ the underlying trigger for the majority of symptomatic vascular events,⁴ including stroke.^{5,6} Although the precise mechanisms of interaction between periodontal disease and vascular disease remain unclear, it is generally believed that the chronic low-level infection triggers an inflammatory response that can accelerate atherosclerosis and lead to cardiovascular events and stroke.

Poor oral hygiene leads to periodontitis and promotes atherosclerosis. Awareness of this relationship can help promote early surveillance and treatment through appropriate regular checkups.⁷ We are unaware of any previous data on the utilization of dental services by individuals with stroke or at risk for stroke.

The present study used nationally representative data to assess the frequency and predictors of recent use of dental services among adults with stroke in the United States.

Methods

The National Health Interview Survey (NHIS) is a national household survey of the civilian noninstitutionalized population of the United States, sponsored by the National Center for Health Statistics of the Centers for Disease Control and Prevention (CDC). The NHIS sample was selected through a complex sampling design involving stratification, clustering, and multistage sampling, with a nonzero probability of selection for each person. Further details on the NHIS methodology are available online.⁸

NHIS data are voluntarily collected and publicly available in deidentified form (ie, no direct identifiers, detailed locations, or exact dates) on the CDC website, with no possibility of being traced to the survey respondents. The present analysis used data from the Family Core, Person file and from the Sample Adult Core, Adult file from the 2006 survey. The Family Core collected information on all adult members of the household who were home at the time of the interview. In the Sample Adult Core, one adult per family was randomly selected to respond to an additional questionnaire. A total of 24,275 persons age 18 years and older were interviewed and completed the survey. Because both the Family and Adult questionnaires included data of interest to us, we merged data files by household serial number and person number for the randomly selected adult. We used final weights provided by the NHIS to account for unequal probability of selection, nonresponse, and oversampling of certain demographic groups, so that weighted estimates in this study could be generalized to the US adult civilian population. Stroke survivors were identified on the Adult questionnaire if they reported ever being told by a doctor or other health professional that they had experienced a stroke.

We examined demographic characteristics of stroke survivors, including age, sex, race (white, black, other) highest educational level achieved (<high school vs \geq high school), current employment status (employed vs retired or unemployed), and marital status (married or living with partner vs not married) by whether or not the survivor had visited a dentist at least once during the previous 12 months. On the survey, subjects were asked about the date of their last dentist visit. For the purpose of this analysis, subjects who reported seeing

a dentist within the previous 6 months or within the previous year were categorized as having visited a dentist in the previous 12 months, whereas those who reported never having seen a dentist or having seen a dentist more than 1 year before the survey were categorized as not having seen a dentist in the previous 12 months.

Possible predictors of a dentist visit in the previous 12 months were modeled individually using logistic regression methods, and crude odds ratios (ORs) and corresponding 95% confidence intervals (95% CIs) were estimated from models. Those factors individually associated with a dentist visit at $P < .10$ were modeled simultaneously in an additional model, and multivariate ORs mutually adjusted for other factors were estimated. Census regions were as defined by the NHIS (Northeast, Midwest, South, and West). Respondents were classified as having a comorbid condition if they reported being diagnosed with any of the following chronic medical conditions: coronary heart disease, heart failure, chronic obstructive pulmonary disease (emphysema), diabetes, end-stage renal failure, chronic liver disease, or cancer. These conditions were selected because of the likelihood that they would increase contact with health care professionals and increase the number of hospital visits, thereby increasing the opportunity of being referred to a dentist.

Current health status was based on the self-reported rating of general health (excellent, very good, good, fair, or poor). Indicators of access to health care included having a usual source of care (yes/no), having health care coverage (yes/no), having dental care coverage (yes/no), and having contact with a primary care physician or medical specialist in the previous 12 months (yes/no). Adults who were covered by health insurance or dental insurance were identified based on self-report of having health insurance or dental insurance at the time of the interview, under private health insurance, Medicare, Medicaid, a state-sponsored health plan, another government program, or a military health plan. In respondents who reported visiting a dentist within the previous 12 months, we also recorded whether the dentist visit was made in response to symptoms or for preventive reasons.

We used SAS version 9.1 (SAS Institute, Cary, NC) for all analyses. We used weights provided by the NHIS to adjust variance estimates for sampling variability and ensure consistency with the complex survey design. We calculated crude prevalence rates of the dentist visits in the entire 2006 NHIS Adult Core sample and in the subgroup of stroke survivors. Among stroke survivors, we compared demographic, clinical, and care accessibility factors by dentist visit. We used χ^2 or t tests to assess whether or not these factors differed significantly between stroke survivors who had visited the dentist. We then entered factors that were significantly individually associated with recent dentist visit at $P < .10$ one-by-one into a multivariate logistic regression model to identify which factors were significant independent predictors of visiting

Table 1. Characteristics of self-reported stroke survivors (n = 706) from the 2006 NHIS

Characteristic	Mean \pm SD or number (percentage)
Age, years	66.7 \pm 14.5
<50	94 (13.3)
50-59	111 (15.7)
60-69	164 (23.2)
70-79	168 (23.8)
\geq 80	169 (23.9)
Female sex	397 (56.2)
Race	
White	491 (69.6)
Black	178 (25.2)
Other	37 (5.2)
Marital status	
Married, living with partner	306 (43.3)
Single, divorced, separated, widowed	400 (56.7)
Highest educational level	
Less than high school	348 (49.6)
High school or greater	354 (50.4)
Census region	
Northeast	101 (14.3)
Midwest	171 (24.2)
South	299 (42.4)
West	135 (19.1)
Employment status	107 (15.2)
Retired	591 (83.7)
Employed	105 (14.9)
Volunteer/Looking for work	10 (1.4)
Covered by health insurance (n = 508)‡	475 (92.6)
Had a usual source of care	675 (95.6)
Medical comorbidity present*	465 (65.9)
Had contact with primary care physician (n = 700)†	616 (87.3)
Had contact with medical specialist (n = 697)†	388 (65.0)
Total number of physician office visits (n = 685)†	
\leq 5	302 (44.1)
6-15	252 (36.8)
\geq 16	131 (19.1)
Total number of ER visits (n = 694)†	
None	379 (54.6)
1	137 (19.7)
\geq 2	178 (25.7)
Seen dentist in previous 12 months (n = 689)**	317 (46.0)

*Includes coronary heart disease, myocardial infarction, cancer, diabetes, emphysema, chronic kidney, or liver condition.

**Reported seeing a dentist within the previous 6 months or within the previous year were categorized as having visited a dentist in the previous 12 months, whereas those who reported never having seen a dentist or having seen a dentist more than 1 year before the survey were categorized as not having seen a dentist in the previous 12 months.

†During the 12 months before the interview.

a dentist within the previous year among stroke survivors. Those factors that remained statistically significant predictors of visiting the dentist at $P < .05$ when simultaneously adjusted for the effects of other variables were retained in the model. Given the strength of correlations among clinical factors, which would introduce collinearity of terms in the multivariate model, we ran separate multivariate models for these factors. We used regression models to estimate ORs and 95% CIs associated with each factor. Our analysis of the NHIS data was approved by our local Institutional Review Board.

Results

Of the 24,275 adults who completed the 2006 NHIS survey, 14,516 (59.8%) reported seeing a dentist at least once during the previous 12 months. These respondents had a total of 706 self-reported strokes, for an incidence of 2.9%. The mean age of the respondents reporting a stroke was 66.7 \pm 14.5 years; 56.2% were women; 69.6% were white, 25.2% were black, and 5.2% were of another race; and 46% reported seeing a dentist at least once during the previous 12 months. Table 1 summarizes demographic, health, and health care-related characteristics of stroke survivors.

Table 2 reports ORs and 95% CIs associated with factors that were predictors of at least one dentist visit in the previous year among stroke survivors. The multivariate logistic regression model identified factors independently associated with at least one dentist visit in the preceding year. Age, census region, employment status, and health insurance status were not determinants of a dentist visit among stroke survivors. Factors independently associated with a dentist visit were female sex (OR, 1.83; 95% CI, 1.31-2.57), being married (OR, 1.95; 95% CI, 1.37-2.77), having a high school or greater education (OR, 2.11; 95% CI, 1.51-2.93), and having contact with a primary care doctor in the previous year (OR, 1.74; 95% CI, 1.04-2.93). Factors independently associated with not visiting the dentist were black race (OR, 0.63; 95% CI, 0.43-0.92) and the presence of a significant medical comorbidity (OR, 0.69; 95% CI, 0.48-0.97).

Discussion

Although there is ample evidence linking poor oral hygiene and periodontitis with stroke, there are no published reports of utilization of dental care among stroke survivors. We found a low rate of dental visits during the previous year among stroke survivors in the United States. This finding is consistent with the observation that poor oral health is associated with stroke and may have implications for stroke prevention. The lack of oral health care in persons

‡Self-report of having health insurance or dental insurance at the time of the interview, under private health insurance, Medicare, Medicaid, a state-sponsored health plan, another government program, or a military health plan.

Table 2. ORs and 95% CIs from logistic regression models of factors that predict a dentist visit within the previous 12 months among 706 stroke survivors from the 2006 NHIS

Characteristic	Crude OR (95% CI)	Adjusted OR (95% CI)*
Age, years		
<65	1.0 (reference)	
≥65	0.92 (0.68-1.25)	
Sex		
Male	1.0 (reference)	1.0 (reference)
Female	1.39 (1.03-1.89)	1.83 (1.31-2.57)
Race		
White	1.0 (reference)	1.0 (reference)
Black	0.58 (0.41-0.83)	0.63 (0.43-0.92)
Other	0.72 (0.36-1.44)	0.80 (0.38-1.67)
Marital status		
Single, divorced, separated, widowed	1.0 (reference)	1.0 (reference)
Married, living with partner	1.48 (1.09-2.00)	1.95 (1.37-2.77)
Highest educational level		
Less than high school	1.0 (reference)	1.0 (reference)
High school or greater	1.84 (1.35-2.49)	2.11 (1.51-2.93)
Census region		
Northeast	1.0 (reference)	
Midwest	1.13 (0.68-1.86)	
South	0.91 (0.58-1.45)	
West	1.49 (0.88-2.52)	
Employment status		
Retired or not employed	1.0 (reference)	1.0 (reference)
Currently employed	1.45 (0.95-2.19)	1.43 (0.91-2.25)
Health insurance status		
Not covered	1.0 (reference)	
Covered	1.65 (0.82-3.30)	
Contact with primary care physician		
No	1.0 (reference)	1.0 (reference)
Yes	1.69 (1.05-2.72)	1.74 (1.04-2.93)
Contact with medical specialist		
No	1.0 (reference)	1.0 (reference)
Yes	1.44 (1.06-1.95)	1.41 (1.01-1.97)
Had a usual source of care		
No	1.0 (reference)	
Yes	1.84 (0.82-4.13)	
Medical comorbidity		
Absent	1.0 (reference)	1.0 (reference)
Present	0.69 (0.50-0.94)	0.69 (0.48-0.97)
Total number of physician office visits		
≤5	1.0 (reference)	
6-15	1.15 (0.82-1.61)	
≥16	1.40 (0.93-2.12)	
Total number of ER visits		
None	1.0 (reference)	
1	0.84 (0.56-1.25)	
≥2	0.99 (0.69-1.41)	

*Adjusted for other factors listed.

known to have elevated risk of recurrent stroke, such as African-Americans, is particularly notable. It should be noted that the overall rate of national dental care utilization is only 60%, leaving much room for improvement.

Chronic infection is recognized to promote atherosclerosis and is associated with symptomatic vascular events,

such as stroke.⁹ Active periodontitis involves a destructive infection of the periodontal tissues caused primarily by gram-negative bacteria.¹⁰ The presence of these bacteria is known to trigger a more widespread inflammatory response with up-regulation of cytokines, increased levels of white blood cells, and changes in protein conformation

associated with the acute-phase response.⁹ Repeated activation of the acute-phase response may lead to a chronic low-level inflammation that persists for long periods. The Atherosclerosis Risk in Communities study found an association between clinically detected chronic periodontitis and carotid artery intima-media thickness in a study of 6017 adults.¹¹

Previous studies linking oral health and stroke have used various means of measurement. Periodontitis as measured clinically and/or radiographically, gingivitis, and severe radiologic bone loss have been independently associated with the risk of cerebral ischemia, whereas the presence of caries has not been.^{6,12} In the original National Health and Nutrition Examination Survey (NHANES) and its follow-up study, baseline periodontitis was found to be a significant risk factor for subsequent stroke (OR, 1.66 95% CI, 1.15-2.39), particularly ischemic stroke (OR, 2.11 95% CI, 1.30-3.42).⁵ Of note, the NHANES did not find any significant association with gingivitis and edentulousness.

As in chronic inflammation, there is evidence of increased risk for stroke during acute infections. Acute exacerbation of inflammatory processes in the periodontium might be a trigger for cerebral ischemia.¹³ Individuals who do not maintain oral hygiene with regular brushing and flossing are at increased risk for acute oral infections and have a higher rate of stroke.

In general, studies of dental care rates have shown that non-Hispanic whites tend to have a higher dental care utilization rate than Hispanics and blacks. The independent association of significant medical comorbidity with lack of dental care is notable. The same individuals with a medical morbidity who are more likely to use medical care are less likely to see the dentist. Dental care might be a low priority for these individuals, a possibility that merits further exploration.

One approach to improving the utilization of dental care could be to include dental care as part of hospital discharge orders, along with primary care follow-up. Patient education regarding the importance of good dental hygiene also might favorably influence dental care utilization.

Limitations of this study include the use of self-reported stroke and dental visit data, a lack of information on the timing and severity of stroke, and the nature of the NHIS sample. In general, however, self-reporting of physician visits is known to be a reliable, highly sensitive, and moderately specific measure, and self-reporting of stroke is moderately sensitive and highly specific in various populations.^{14,15} The NHIS excluded nursing home residents and other institutionalized populations, and thus only individuals from households surveyed could be evaluated.

In conclusion, the rate of dental care utilization among stroke survivors appears to be low. Preventive care is the

most effective way to reduce the societal burden of all diseases, and stroke survivors need to receive optimal general health care, including screening for risk factors (eg, hypertension), provision of basic dental care, and appropriate diagnostic studies (ie, colonoscopy). Recognition and treatment of periodontitis can interrupt activation of the cycle of inflammation underlying atherosclerosis and predisposing to ischemia. Whether good dental care can reduce the risk of stroke is unclear, however. Final proof of stroke reduction through prevention of dental infectious/inflammatory mechanisms is lacking and awaits prospective studies.

References

- Hansson GK. Inflammation, atherosclerosis, and coronary artery disease. *N Engl J Med* 2005;352:1685-1695.
- Oral health in America: A report of the Surgeon General. *J Calif Dent Assoc* 2000;28:685-695.
- Desvarieux M, Demmer RT, Rundek T, et al. Relationship between periodontal disease, tooth loss, and carotid artery plaque: The Oral Infections and Vascular Disease Epidemiology Study (INVEST). *Stroke* 2003;34:2120-2125.
- Morrison HI, Ellison LF, Taylor GW. Periodontal disease and risk of fatal coronary heart and cerebrovascular diseases. *J Cardiovasc Risk* 1999;6:7-11.
- Wu T, Trevisan M, Genco RJ, et al. Periodontal disease and risk of cerebrovascular disease: The first National Health and Nutrition Examination Survey and its follow-up study. *Arch Intern Med* 2000;160:2749-2755.
- Grau AJ, Buggle F, Ziegler C, et al. Association between acute cerebrovascular ischemia and chronic and recurrent infection. *Stroke* 1997;28:1724-1729.
- Rose LF, Mealey B, Minsk L, et al. Oral care for patients with cardiovascular disease and stroke. *J Am Dent Assoc* 2002;133(Suppl):37S-44S.
- Centers for Disease Control and Prevention. National Health Interview Survey. Available at: <http://www.cdc.gov/nchs/nhis.htm>. Accessed September 27, 2009.
- Lindsberg PJ, Grau AJ. Inflammation and infections as risk factors for ischemic stroke. *Stroke* 2003;34:2518-2532.
- Desvarieux M, Demmer RT, Rundek T, et al. Periodontal microbiota and carotid intima-media thickness: The Oral Infections and Vascular Disease Epidemiology Study (INVEST). *Circulation* 2005;111:576-582.
- Beck JD, Elter JR, Heiss G, et al. Relationship of periodontal disease to carotid artery intima-media wall thickness: The Atherosclerosis Risk in Communities (ARIC) Study. *Arterioscler Thromb Vasc Biol* 2001;21:1816-1822.
- Grau AJ, Becher H, Ziegler CM, et al. Periodontal disease as a risk factor for ischemic stroke. *Stroke* 2004;35:496-501.
- Christof ED, Heiko B, Christoph MZ, et al. The association of gingivitis and periodontitis with ischemic stroke. *J Clin Periodontol* 2004;31:396-401.
- Engstad T, Bonna KH, Viitanen M. Validity of self-reported stroke: The Tromso Study. *Stroke* 2000;31:1602-1607.
- Horner RD, Cohen HJ, Blazer DG. Accuracy of self-reported stroke among elderly veterans. *Aging Mental Health* 2001;5:275-281.