ACCESS TO DENTAL CARE FOR RURAL LOW INCOME AND MINORITY POPULATIONS

Working Paper Series

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EXECUTIVE SUMMARY

Using data from the 1999 National Health Interview Survey, this study examines the relationships between rural residence, income, race/ethnicity, and access to dental care. Multivariate models are used to assess the relative importance of rural residence and other factors on utilization of dental services, having problems affording needed dental care, and having dental insurance. The study confirms that rural-urban disparities in access to dental care persist, and finds significant differences by race/ethnicity and income within rural populations in utilization of dental care, affording needed dental care, and dental insurance.

Rural adults in each major race/ethnicity category (white, black, and Hispanic) are significantly less likely than their urban counterparts to have had a dental visit in the past year. Within rural areas, black and Hispanic adults are significantly less likely than white adults to have had a dental visit in the past year. Rural poor and near-poor adults are also significantly less likely than rural non-poor adults to have had a dental visit in the past year.

Rural white and black adults are significantly more likely than their urban counterparts to report having had a time in the past year when they needed dental care but couldn't afford it. Within rural areas, black adults are significantly more likely than white adults to report having had a time in the past year when they needed dental care but couldn't afford it. Rural poor and near-poor adults are significantly more likely than rural non-poor adults to report having had a time in the past year when they needed dental care but couldn't afford it.

Rural white and black adults are significantly less likely than their urban counterparts to have private dental insurance. Rural non-poor and near-poor adults are significantly less likely than urban adults in the same income categories to have private dental insurance. Rural Hispanic adults are significantly less likely than rural white adults to have private dental insurance, and are significantly more likely to cite cost of care or no insurance as a reason for not having a dental visit.

High proportions of rural and urban adults in all race/ethnicity and income categories report "no problems" with their teeth as a reason for not having a dental visit, suggesting that limited importance given to preventive dental care is a widespread problem. Very small proportions of rural and urban adults report the dentist is too far or they could not get to a dentist as reasons for not having a dental visit.

Controlling for multiple factors that influence utilization of dental services, including education, income, dental insurance status, loss of natural teeth, and race/ethnicity, rural residents are significantly less likely than urban residents to have had a dental visit in the past year and more likely to report having a time in the past year when they could not afford needed dental care. Controlling for multiple demographic and employment-related factors associated with insurance status, rural residents remain significantly less likely than urban residents to have private dental insurance.

The results of this study indicate that Federal, state, and local initiatives to improve access to dental care need to pay special attention to low income and minority rural populations, who are

especially vulnerable to oral health problems. Efforts to improve access to dental care for rural populations need to address factors in addition to the supply of dentists in rural areas and Medicaid reimbursement. Potential strategies for improving dental access among rural low-income and minority populations include expansion of public dental clinics, school-based dental services, and mobile dental services; integration of oral health and primary health care services; expanded practice for dental hygienists and assistants; recruitment and support of more dental school students from underserved communities; and implementation of dental placement services and incorporation of career and practice location decision issues into dental school curricula.

INTRODUCTION

Although the oral health of Americans has improved over the past several decades, several recent studies have documented continued poorer oral health status and extensive problems with access to dental care among low-income persons and racial/ethnic minorities.[1-8] Rural residents who have low incomes or are racial/ethnic minorities may be especially vulnerable to having difficulties accessing dental care.[9-14]

Much of the previous research in this area has focused access to care for children, especially those with Medicaid coverage. The relationship between employment-related characteristics, dental insurance and access to dental care for rural adults has not been examined. Previous research also has tended to be largely descriptive, rather than using multivariate models that control for multiple factors. This study makes a new contribution to the literature on rural/urban disparities in oral health by examining the relationships between rural residence, income, race/ethnicity, and access to dental care for adults, using multivariate models. We assess the relative importance of rural residence and other factors that influence utilization of dental services, such as household income and having dental insurance. We also analyze the relative importance of rural residence and other key factors that affect the likelihood of having dental insurance, including employment-related characteristics.

BACKGROUND

A lack of dental insurance and limited ability to pay the costs of dental care contribute to lower utilization of dental services, especially preventive services, by low-income individuals and families.[7,15-17] States are required to provide dental care for Medicaid-eligible children, but Medicaid coverage of dental care for adults is very limited. A few states do not cover adults at all while others limit dental coverage to categorically needy adults, and many states only cover

emergency dental care.[18] Even among Medicaid-eligible individuals, the limited supply of dentists who will accept Medicaid patients and other difficulties accessing care result in high levels of unmet dental need.[4, 5, 19]

Rural populations tend to have poorer oral health status than urban populations. They are less likely than urban residents to have private dental insurance and more likely to report having unmet dental needs than urban residents.[9-14] In addition, dentist-to-population ratios have historically been lower in rural areas than in urban areas, and continue to be much lower in rural counties.[20-22]

DATA AND METHODS

The study analyzes data from the 1999 National Health Interview Survey, an annual in-person survey of the civilian, noninstitutionalized population conducted by the National Center for Health Statistics at the Centers for Disease Control and Prevention. The NHIS data includes socio-demographic data on sample adults from the NHIS Basic Module and responses to periodic questions about dental care in the Adult Health Care Access and Utilization Section.

The statistical analyses use Stata software, which adjusts the standard errors to take into account the complex sample design used to obtain NHIS data. NHIS weights are used to weight the data. The NHIS MSA size variable is used to classify respondents residing in a non-MSA as rural, and all those residing in an MSA of any size as urban. (The NHIS MSA variable is based on the federal Office of Management and Budget metropolitan statistical area definition: a county that includes at least one city with 50,000 inhabitants or an urbanized area of at least 50,000 inhabitants and a total metropolitan population of at least 100,000.) Rural and urban respondents are classified in four race/ethnicity categories (white non-Hispanic, black non-Hispanic, Hispanic, and other non-Hispanic) and three income categories (based on household

income as a percentage of the federal poverty level adjusted for household size, with poor defined as below 100%; near-poor as 100-199%; and non-poor as 200% and over). A total of 30,801 adults aged 18 and over are included in the analysis.

First, bivariate comparisons are made across and within rural and urban categories by race/ethnicity and income. Stata's "survey significance" procedures are used to identify statistically significant differences in responses. The five sets of comparisons address:

- the amount of time since the last dental visit;
- having a time in the past year when dental care was not affordable;
- reasons for not having a dental visit (among persons who did not have a visit in the past year);
- reasons for the last dental visit (among persons who did have a visit in the past year); and,
- having private dental insurance.

Second, three logistic regression models are developed to examine the independent effect of rural residence, income, race/ethnicity, and other factors on the likelihood of :

- obtaining an annual dental visit;
- having a time during the past year when needed dental care was not obtained; and
- having private dental insurance.

In addition to the independent variables of primary interest, rural/urban residence, income, and race/ethnicity, all three models include additional demographic and health status variables, such as education, age, marital status, health status, and whether or not the respondent had all of their natural teeth. Based on the results of previous research, respondents who live in rural areas, have lower incomes, less education, poorer health status, or have lost their natural teeth were expected to be less likely to have had an annual dental visit and more likely to report having a time when they could not afford dental care.[7, 14, 16] Census Region variables (Northeast, Midwest, South, and West) are also included in the models, since previous research has found regional differences in use of dental services.[8]

The first and second logistic regression models (whether the respondent had obtained an annual dental visit, and had a time during the past year when needed dental care was not obtained) include measures of private dental insurance, Medicaid, and paid sick leave. Previous research has found that individuals with private dental insurance are more likely than those with Medicaid to utilize dental services, and both groups are more likely to receive care than uninsured individuals.[7, 15] We also hypothesize that individuals with paid sick leave will be more likely to obtain dental care, since difficulty getting time off work for appointments is a barrier to obtaining preventive medical services and dental services.[3, 23]

The third model, which assesses whether the respondent has private dental insurance, includes several employment-related variables, such as whether the respondent works full-time, whether he or she has held their current job for a year or more, employer size (small, medium, large, and very large), and the type of employment (government, private, and self-employment). Having dental insurance is expected to be positively related to urban residence, working full-time, having job tenure of a year or more, working for a large or very large employer, and working for a private or government employer. Dental insurance, even more than medical insurance, tends to be an employment-related benefit; insurers tend not to offer individual dental insurance products because the greater predictability of dental care needs (compared to medical needs) means that individuals are more likely to purchase coverage when they anticipate a need for major dental treatment.[24] Small and medium size employers are less likely than larger employers to offer health benefits. Consequently, rural residents, who are more likely to work for smaller employers or be self-employed, are less likely than urban residents to be offered health benefits through their employers.[25, 26]

Finally, we perform "method of recycled prediction" simulations to determine the impact of rural residence on the dependent variables in each of the three models after controlling for the covariates.[27, 28] These procedures are necessary since the logistic regression models, unlike normal ordinary least squares regression models, are nonlinear. Using the estimated coefficients from the first model, we estimate the probability of having a dental visit in the past 12 months if all the survey respondents are assumed to reside in an urban area, but otherwise keep the same values for all other variables. By taking the average of the individual predicted probabilities for all respondents, we derive an estimate of the simulated full sample average probability of an annual dental visit for urban residents. We then estimate the probability of having a dental visit in the past 12 months if all the survey respondents are assumed to reside in a rural area, and calculate a second simulated average probability.

The difference between these two simulated full sample average probabilities reflects the net effect of all the influences on having a dental visit that were not included in the multivariate model, since both share the same sample of respondents. This allows us to directly measure how important all other covariates are for explaining the original differences between rural and urban respondents. An analogous set of simulations are performed for the other two dependent variables: having a time during the past year when needed dental care was not obtained and having private dental insurance.

RESULTS

Time Since Last Dental Visit

The proportion of adults reporting a dental visit in the past year varies significantly by rural/urban location, race/ethnicity, and income (Table 1). (The one year time frame was chosen because *Healthy People 2010* Objective 21-10 is to increase the proportion of children and adults

Table 1

Adults 18 and Over Who had a Dental Visit in Past Year by Rural/Urban Location, Race/Ethnicity, and Income (n=30,801)

	Rural (1)	Urban (2)	Significant Pairwise Comparisons
Race/Ethnicity			
A. White Non-Hispanic	54.4%	67.4%	(A1, A2) (A1, B1) (A1, C1) (A2, B2) (A2, C2)
B. Black Non-Hispanic	38.0%	53.4%	(A2,D2)all***
C. Hispanic	38.9%	50.7%	(B1, B2) (B1, D1) (B2, D2)all*** (B2, C2)*
D. Other Non-Hispanic	57.8%	60.6%	(C1, C2) (C1, D1) (C2, D2)all***
Income[1]			
E. Non-Poor	63.2%	71.2%	(E1, E2) (E1, F1) (E1, G1) (E2, F2) (E2, G2)all***
F. Near-Poor	39.7%	46.8%	(F1, F2)***
G. Poor	37.6$	47.8%	(G1, G2)***

* p <.05; ** p <.01; *** p <.001

[1]Based on household income as a percentage of the federal poverty level adjusted for household size, with poor defined as below 100%; near-poor as 100-199%; and non-poor as 200% and over.

who use the oral health care system each year.)[29] Rural adults in each major race/ethnicity category (white, black, and Hispanic) and in each income group are significantly less likely than their urban counterparts to have had a dental visit in the past year. Within rural areas, black and Hispanic adults are significantly less likely than either white or other non-Hispanic adults to have had a dental visit in the past year. Both poor and near-poor rural adults are significantly less likely than non-poor rural adults to have had a dental visit in the past year.

Obtaining Needed Dental Care

Table 2 shows the proportion of adults who report having had a time in the past year when they needed dental care but couldn't afford it, by rural/urban location, race/ethnicity, and income. Rural white and black adults are significantly more likely than their urban counterparts to report having had a time in the past year when they needed dental care but couldn't afford it. In the "other" race/ethnicity category, rural adults are also significantly more likely than urban adults to have had a time they couldn't afford dental care. Within rural areas, black adults are significantly more likely than white adults to have had affordability problems.

Both rural poor and near-poor adults are significantly more likely than their urban counterparts to report problems affording needed care. Within rural areas, poor adults are significantly more likely than either near poor adults or non-poor adults to report problems; near poor adults are also significantly more likely than non-poor adults to report problems. These results suggest that rural environments may provide less opportunities for low income adults to obtain low-cost dental care than urban settings, with the most negative results for rural adults with the lowest incomes.

Reasons for Not Having a Dental Visit in Past Year

Adults without a dental visit in the past year report a variety of reasons for not having a visit, including being afraid or nervous, the cost of care, not having dental insurance, not

Table 2

Adults Who Had a Time During the Past Year When They Needed Dental Care but Couldn't Afford It by Rural/Urban Location, Race/Ethnicity, and Income (n=30,801)

	Rural (1)	Urban (2)	Significant Pairwise Comparisons
Race/Ethnicity			
A. White Non-Hispanic	10.2%	7.7%	(A1, A2)*** (A1, B1)(A2, B2)both**
B. Black Non-Hispanic	14.5%	9.2%	(B1, B2)***
C. Hispanic	11.4%	8.5%	
D. Other Non-Hispanic	14.6%	7.1%	(D1, D2)*
Income[1]			
E. Non-Poor	6.5%	6.5%	(E2, F2) (E2, G2)both***
F. Near-Poor	16.9%	14.2%	(F1, F2)* (F1, G1)**
G. Poor	21.8%	15.5%	(G1, G2)***

* p <.05; ** p <.01; *** p <.001

[1]Based on household income as a percentage of the federal poverty level adjusted for household size, with poor defined as below 100%; near-poor as 100-199%; and non-poor as 200% and over.

knowing a dentist, difficulty getting to a dentist, not having problems with their teeth, and lack of importance. Table 3 indicates that a high proportion of rural and urban adults across all race/ethnicity and income categories report not having problems with their teeth as a reason for not having a dental visit, reflecting a limited importance placed on preventive dental care.

Rural Hispanic adults are more likely than urban Hispanic adults to report "no problems" as a reason for not having a dental visit in the past year. Within rural areas, Hispanic adults are significantly more likely than white, black or other race adults to mention "no problems." In both rural and urban areas, poor adults are significantly more likely than either near-poor or non-poor adults to cite "no problems" as a reason for not having a dental visit.

A high proportion of rural and urban adults across all race/ethnicity and income categories report "cost of care/no insurance" as a reason for not having a dental visit in the past year (Table 4). Within rural areas, Hispanic adults are significantly more likely than white adults to cite "cost of care/no insurance." Rural poor adults also are significantly more likely than either near-poor or non-poor adults, and near-poor adults are significantly more likely than non-poor adults to give "cost of care/no insurance" as a reason for not having a dental visit in the past year.

The proportions of rural and urban adults in all race/ethnicity and income categories who report "the dentist is too far" or they "could not get to a dentist" as reasons for not having a dental visit are quite small (Table 5). Although rural areas have a smaller supply of dentists and distances between dental providers are greater, rural respondents are not more likely to report that the dentist is too far or that they could not get to a dentist as reasons for not having a dental visit. In fact, urban Hispanic and other race respondents are significantly more likely than their rural counterparts to report these reasons, suggesting that lack of reliable transportation may be a problem for these urban adults.

Table 3

Adults Who Reported "No Problems" as a Reason for Not Having a Dental Visit in the Past Year by Rural/Urban Location, Race/Ethnicity, and Income (n=11,880)

	Rural (1)	Urban (2)	Significant Pairwise Comparisons
Race/Ethnicity			
A. White Non-Hispanic	41.9%	39.8%	(A1, C1) (A2, C2) (A2, D2)all*** (A2, B2)**
B. Black Non-Hispanic	45.5%	44.4%	(B1, C1) (B2,D2)** (B2,C2)*
C. Hispanic	58.6%	48.7%	(C1, D1) (C1,C2)both**
D. Other Non-Hispanic	38.7%	53.6%	(D1, D2)*
Income[1]			
E. Non-Poor	32.1%	36.2%	(E1,G1) (E2,G2)both*** (E1, E2)
F. Near-Poor	41.9%	40.7%	(E1,F1)both**
G. Poor	48.6%	43.0%	(F1,G1)*** (F2,G2)*

* p <.05; ** p <.01; *** p <.001

[1]Based on household income as a percentage of the federal poverty level adjusted for household size, with poor defined as below 100%; near-poor as 100-199%; and non-poor as 200% and over.

Table 4

Adults Who Reported "Cost of Care/No Insurance" as a Reason for Not Having a Dental Visit in the Past Year by Rural/Urban Location, Race/Ethnicity, and Income (n=11,880)

	Rural (1)	Urban (2)	Significant Pairwise Comparisons
Race/Ethnicity			
A. White Non-Hispanic	26.4%	24.6%	(A1, C1) (A2, C2)both***
B. Black Non-Hispanic	31.3%	27.1%	(B2, C2)***
C. Hispanic	37.7%	33.5%	(C2, D2)***
D. Other Non-Hispanic	31.7%	24.4%	
Income[1]			
E. Non-Poor	20.4%	21.6%	(E1, F1) (E1, G1) (E2, G2) (E2, F2)all***
F. Near-Poor	33.4%	33.1%	(F1, G1)** (F2, G2)*
G. Poor	42.1%	37.0%	

* p <.05; ** p <.01; *** p <.001

[1]Based on household income as a percentage of the federal poverty level adjusted for household size, with poor defined as below 100%; near-poor as 100-199%; and non-poor as 200% and over.

Table 5

Adults Who Reported "dentist too far/can't get there" as a Reason for Not Having a Dental Visit in the Past Year by Rural/Urban Location, Race/Ethnicity, and Income (n=11,880)

	Rural (1)	Urban (2)	Significant Pairwise Comparisons
Race/Ethnicity			
A. White Non-Hispanic	1.5%	2.1%	(A1, C1)***
B. Black Non-Hispanic	1.9%	2.2%	(B1, C1)*
C. Hispanic	0.2%	1.8%	(C1, C2)***
D. Other Non-Hispanic	0.7%	3.6%	(D1, D2)*
Income[1]			
E. Non-Poor	2.8%	2.3%	(E2, F2) (E2, G2)both*
F. Near-Poor	0.6%	1.4%	(F1, G1)* (F2, G2)***
G. Poor	1.6%	3.6%	

* p <.05; ** p <.01; *** p <.001

[1]Based on household income as a percentage of the federal poverty level adjusted for household size, with poor defined as below 100%; near-poor as 100-199%; and non-poor as 200% and over.

Reason for Last Dental Visit

The 1999 NHIS asks adults who had at least one dental visit in the past year about the reason for their last visit. Possible reasons include something was wrong with their teeth, they went for a checkup on their own, they were called for a checkup by the dentist, to treat a condition found at a checkup, or another reason. Table 6 shows the proportion of adults who reported that the reason for their last dental visit was "something was wrong" by rural/urban location, race/ethnicity, and income.

Rural white and Hispanic adults are significantly more likely than their urban counterparts to report that the reason for their last dental visit was "something was wrong;" rural other race adults are also more likely than urban other race adults. Over 35 percent of rural Hispanic and one-third of rural black adults report that the reason for their last dental visit was that "something was wrong;" both groups are significantly more likely than rural whites to report this reason for their last dental visit. There are significant differences between rural and urban near-poor and rural and urban non-poor adults in reporting "something was wrong" as the reason for their last dental visit. Both poor and near-poor adults in rural areas are significantly more likely than non-poor adults to report this reason for their last visit. A variety of factors, including low rates of dental insurance, limited income to pay out-of-pocket for dental services, and cultural issues, may account for these differences.

Private Dental Insurance

In every race/ethnicity and income category, the percentage of rural residents with private dental insurance is lower than that of their urban counterparts (Table 7). Rural white adults are significantly less likely than urban white adults to be insured; similarly, rural black adults are significantly less likely than urban blacks. Within rural settings, Hispanic adults are significantly

Table 6

Adults with One or More Dental Visits in Last Year Who Reported "something wrong" as Reason for Last Visit by Rural/Urban Location, Race/Ethnicity, and Income (n=18,263)

	Rural (1)	Urban (2)	Significant Pairwise Comparisons
Race/Ethnicity			
A. White Non-Hispanic	25.4%	18.4%	(A1, A2)*** (A1, B1)* (A1, C1)** (A2, B2) (A2, C2)both***
B. Black Non-Hispanic	32.4%	26.5%	(B2, C2)* (B2, D2)***
C. Hispanic	35.3%	23.4%	(C1, C2)** (C2, D2)*
D. Other Non-Hispanic	30.7%	18.5%	(D1, D2)*
Income[1]			
E. Non-Poor	23.6%	18.3%	(E1,E2) (E1, F1) (E1, G1) (E2, F2) (E2, G2)all***
F. Near-Poor	35.9%	30.2%	(F1,F2)*
G. Poor	34.0%	29.0%	

* p <.05; ** p <.01; *** p <.001

[1]Based on household income as a percentage of the federal poverty level adjusted for household size, with poor defined as below 100%; near-poor as 100-199%; and non-poor as 200% and over.

Table 7

Adults Who Report Having Private Health Insurance that Pays Any Dental Costs by Rural/Urban Location, Race/Ethnicity, and Income (n=21,064)

	Rural (1)	Urban (2)	Significant Pairwise Comparisons
Race/Ethnicity			
A. White Non-Hispanic	30.4%	37.7%	(A1, A2) (A1,C1) (A2, B2) (A2,C2)all***
B. Black Non-Hispanic	26.6%	33.7%	(B1, B2)** (B2, C2)***
C. Hispanic	22.3%	25.6%	(C1, D1)* (C2, D2)***
D. Other Non-Hispanic	33.1%	34.5%	
Income[1]			
E. Non-Poor	41.6%	46.1%	(E1, E2) (E1,F1) (E1, G1) (E2,F2) (E2,G2)all***
F. Near-Poor	16.9%	20.3%	(F1, F2)* (F2, G2)**
G. Poor	15.4%	16.7%	

* p <.05; ** p <.01; *** p <.001

[1]Based on household income as a percentage of the federal poverty level adjusted for household size, with poor defined as below 100%; near-poor as 100-199%; and non-poor as 200% and over.

less likely than white or other race adults to have dental insurance. Rural non-poor and near-poor adults are significantly less likely than urban adults in the same income categories to have dental insurance. Non-poor adults in both urban and rural settings are significantly more likely than either near-poor or poor adults in the same settings to have dental insurance.

Likelihood of Having a Dental Visit in the Past Year

Table 8 shows the results of the first logistic regression model, with a dichotomous (yes/no) dependent variable indicating whether or not the individual had a dental visit in the past year. With the exception of the West Census Region ($p<.08$) and Age 45-64 ($p<.05$), all of the independent variables in the model are statistically significant at the $p< .001$ level. The number of significant variables is not surprising given the large sample size. The strongest positive effects on having a dental visit are having some college education or a college degree and having private dental insurance, while the strongest negative effect is having lost all of one's natural teeth.

Similar to the bivariate results, rural residence and minority race/ethnicity continue to have significant negative effects on having a dental visit in the past year. Non-poor individuals are more likely, but near-poor are less likely, than poor individuals to have a dental visit. Adults (45 years and over) are more likely to have a visit than 18 to 24 year olds, while 25 to 44 year olds are less likely. Married individuals and those in excellent health are more likely to have a visit. Having Medicaid and paid sick leave are also positively related to having a dental visit in the past year. Compared to residents of the South Census Region, those in the Midwest and the Northeast are significantly more likely to have a dental visit.

The results of the "method of recycled prediction" simulation (Table 9) indicate that about half (54%) of the raw difference in the unadjusted means between rural and urban

Table 8

Logistic Regression Model of Having a Dental Visit in the Past Year (n=30,801)

Independent Variables[a]	Coef.	Std.Err.	t	P>|t|	[95% Conf. Interval]
Rural	-0.252	0.0409	-6.18	0.000	(-0.279, -0.172)
Black	-0.336	0.0441	-7.63	0.000	(-0.423, -0.250)
Hispanic	-0.303	0.0474	-6.4	0.000	(-0.397, -0.210)
Age 25-44	-0.195	0.0539	-3.62	0.000	(-0.301, -0.089)
Age 45-64	0.121	0.0545	2.21	0.028	(0.013, -0.228)
Age 65 and over	0.425	0.0622	6.83	0.000	(0.302, -0.547)
HS graduate	0.426	0.0417	10.23	0.000	(0.344, -0.508)
Some college	0.813	0.0427	19.03	0.000	(0.729, -0.897)
College graduate	1.115	0.0507	21.98	0.000	(1.015, 1.215)
100-199% Poverty	-0.239	0.0395	-6.04	0.000	(-0.316, -0.161)
200% Poverty and over	0.167	0.0334	4.99	0.000	(0.101, 0.233)
Married	0.229	0.0291	7.89	0.000	(0.172, 0.287)
Good health	-0.217	0.0313	-6.94	0.000	(-0.279, -0.156)
Fair health	-0.366	0.0489	-7.48	0.000	(-0.462, -0.270)
Poor health	-0.487	0.0795	-6.13	0.000	(-0.643, -0.331)
No teeth	-1.648	0.0575	-28.64	0.000	(-1.761, -1.534)
Dental insurance	0.514	0.0303	16.94	0.000	(0.454, 0.574)
Medicaid	0.247	0.0560	4.42	0.000	(0.137, 0.357)
NE census region	0.277	0.0396	7.0	0.000	(0.199, 0.355)
MW census region	0.182	0.0408	4.47	0.000	(0.102, 0.263)
West census region	0.072	0.0424	1.71	0.089	(-0.011, 0.156)
Paid sick leave	0.256	0.0355	7.21	0.000	(0.186, 0.325)

[a]Omitted categories are urban; white/other race; age 18 to 24; less than high school graduate; household income below 100% of federal poverty level; excellent health; and South census region.

Table 9

Results of Method of Recycled Prediction Simulation: Influence of Rural and Urban Residence on Having a Dental Visit in the Past Year

	Rural	Urban	Difference	Significance
Unadjusted means	52.6%	63.7%	11.1%	p<.001
Adjusted means	57.3%	62.4%	5.08%	p<.001

residents (11.1%) was explained by accounting for the differences between urban and rural residents in the covariates included in the model. The adjusted difference of 5.08% represents differences between rural and urban residents not explained by the other covariates in the model, and remains very significant.

Affordability of Needed Dental Care

Table 10 shows the results of the second logistic regression model, with a dichotomous (yes/no) dependent variable indicating whether or not there was a time during the past year when the respondent could not afford needed dental care. The majority of independent variables in the model are statistically significant at the $p < .001$ level. The strongest positive effect (i.e., making it more likely to have a time when care was not affordable) is being in poor or fair health; the strongest negative effects are being age 65 and over, and having dental insurance.

Rural residents remain more likely than urban residents to have a time when dental care was not affordable. After controlling for other covariates in the multivariate model, black and Hispanic adults are less likely than white adults to report problems affording care. Near-poor are more likely than poor individuals to report affordability problems, while college graduates, married individuals, and those without natural teeth are less likely. Having Medicaid and paid sick leave are also negatively related to having dental affordability problems.

The seemingly contradictory results regarding race/ethnicity in this model may be due in part to the subjective nature of this survey question, which requires the respondent to make a judgment about whether dental care was "needed." Given the higher proportions of black and Hispanic respondents reporting "no problems" as a reason for not having a dental visit in the past year, black and Hispanic respondents may have been less likely than white respondents to

Table 10

Logistic Regression Model of Having a Time in Past Year When Respondent Could Not Afford Needed Dental Care (n=30,801)

Independent Variables[a]	Coef.	Std.Err.	t	P>|t|	[95% Conf. Interval]
Rural	0.182	0.063	2.9	0.004	(0.058, 0.305)
Black	-0.155	0.067	-2.31	0.021	(-0.286, -0.023)
Hispanic	-0.385	0.084	-4.58	0.000	(-0.550, -0.219)
Age 25-44	0.129	0.076	1.69	0.092	(-0.021, 0.279)
Age 45-64	-0.283	0.078	-3.65	0.000	(-0.435, -0.130)
Age 65 and over	-2.006	0.113	-17.77	0.000	(-2.228, -1.784)
HS graduate	0.093	0.068	1.38	0.169	(-0.040, 0.226)
Some college	0.125	0.070	1.79	0.075	(-0.013, 0.263)
College graduate	-0.229	0.090	-2.54	0.012	(-0.406, -0.052)
100-199% Poverty	0.563	0.072	7.84	0.000	(0.422. 0.705)
200% Poverty and over	-0.031	0.060	-0.52	0.603	(-0.150, 0.087)
Married	-0.494	0.054	-9.2	0.000	(-0.600, -0.389)
Good health	0.579	0.049	11.71	0.000	(0.482, 0.676)
Fair health	1.194	0.076	15.76	0.000	(1.045, 1.343)
Poor health	1.473	0.104	14.17	0.000	(1.269, 1.678)
No teeth	-0.635	0.108	-5.87	0.000	(-0.848, -0.422)
Dental insurance	-0.909	0.058	-15.59	0.000	(-1.024, -0.795)
Medicaid	-0.320	0.092	-3.49	0.001	(-0.501, -0.140)
NE census region	-0.059	0.085	-0.7	0.484	(-0.226, 0.107)
MW census region	0.097	0.067	1.46	0.145	(-0.034, 0.229)
West census region	0.382	0.070	5.49	0.000	(0.245, 0.519)
Paid sick leave	-0.453	0.059	-7.71	0.000	(-0.569, -0.337)

[a]Omitted categories are urban; white/other race; age 18 to 24; less than high school graduate; household income below 100% of federal poverty level; excellent health; and South census region.

Table 11

Results of Method of Recycled Prediction Simulation: Influence of Rural and Urban Residence on Having a Time in Past Year Respondent Could Not Afford Needed Dental Care

	Rural	Urban	Difference	Significance
Unadjusted means	10.7%	8.0%	2.7%	p<.001
Adjusted means	9.6%	8.2%	1.4%	p<.001

describe themselves as having unmet dental care needs, in the absence of serious dental problems that caused pain.

The results of the "method of recycled prediction" simulation for affordability of dental care (Table 11) indicate that about half (48%) of the raw difference in the unadjusted means between rural and urban residents (2.7%) was explained by accounting for the differences between urban and rural residents in the covariates included in the model. The adjusted difference of 1.4% represents differences between rural and urban residents not explained by the other covariates in the model, and remains very significant statistically due in part to the large sample, but it is not large practically.

Private Dental Insurance

Table 12 shows the results of the third logistic regression model, with a dichotomous (yes/no) dependent variable indicating whether or not the respondent had private dental insurance. The majority of independent variables in the model are statistically significant at the $p < .001$ level. The strongest positive effects are age (18-24 and 45-64 year olds are significantly more likely than those 65 and over to have private dental insurance), working full time, and education (individuals with a high school degree, some college, or a college degree have higher rates of dental insurance). The strongest negative effects are working for a small employer or being self-employed. Rural residence and Hispanic ethnicity also have significant negative effects on having dental insurance. Non-poor individuals are more likely, but near-poor are less likely, than poor individuals to be insured.

The results of the "method of recycled prediction" simulation for having dental insurance (Table 13) indicate that about half (52%) of the raw difference in the unadjusted means between rural and urban residents (6.0%) was explained by accounting for the differences between urban

Table 12

Logistic Regression Model of Having Private Dental Insurance (n=30,801)

Independent Variables[a]	Coef.	Std.Err.	t	P>|t|	[95% Conf. Interval]
Rural	-0.185	0.0425	-4.35	0.000	(-0.268, -0.101)
Black	-0.016	0.0817	13.24	0.000	(0.921, 1.242)
Hispanic	-0.318	0.0553	14.57	0.000	(0.697, 0.914)
Age 18-24	1.081	0.0539	13.96	0.000	(0.647, 0.859)
Age 25-44	0.805	0.0488	-0.34	0.736	(-0.113, 0.080)
Age 45-64	0.753	0.0504	-6.3	0.000	(-0.417, -0.218)
HS graduate	0.417	0.0463	9.01	0.000	(0.326, 0.508)
Some college	0.592	0.0497	11.91	0.000	(0.495, 0.690)
College graduate	0.605	0.0503	12.02	0.000	(0.506, 0.704)
100-199% Poverty	-0.175	0.0556	-3.15	0.002	(-0.285, -0.066)
200% Poverty and over	0.619	0.0383	16.15	0.000	(0.543, 0.694)
Full-time job	0.648	0.0378	17.13	0.000	(0.574, 0.723)
Small employer (<50 employees)	-0.598	0.0420	-14.24	0.000	(-0.681, -0.516)
Medium employer (50-249 employees)	-0.059	0.0526	-1.12	0.264	(-0.162, 0.045)
Large employer (250-999 employees)	0.256	0.0611	4.18	0.000	(0.135, 0.376)
No teeth	-0.231	0.0491	-4.71	0.000	(-0.328, -0.135)
Self -employed	-0.512	0.0720	-7.1	0.000	(-0.653, -0.370)
Government employee	0.165	0.0481	3.43	0.001	(0.071, 0.260)
Married	0.470	0.0323	14.57	0.000	(0.407, 0.534)
NE census region	-0.057	0.0433	-1.32	0.187	(-0.143, 0.028)
MW census region	0.227	0.0429	5.3	0.000	(0.143, 0.312)
West census region	-0.110	0.0478	-2.31	0.022	(-0.205, -0.016)
In current job 1 year or less	-0.262	0.0508	-5.15	0.000	(-0.361, -0.162)

[a]Omitted categories are urban; white/other race; age 65 and over; less than high school graduate; household income below 100% of federal poverty level; excellent health; very large employer (1000 employees or more), and private sector employee.

Table 13

Results of Method of Recycled Prediction Simulation:
Influence of Rural and Urban Residence on Having Dental Insurance

	Rural	Urban	Difference	Significance
Unadjusted means	29.9%	35.9%	6.0%	p<.001
Adjusted means	32.3%	35.2%	2.9%	p<.001

and rural residents in the covariates included in the model. The adjusted difference of 2.9% represents differences between rural and urban residents not explained by the other covariates in the model, and remains very significant.

CONCLUSIONS

This study shows that rural-urban disparities in utilization of dental services, unmet needs for dental care, and private dental insurance persist, even after controlling for multiple other factors related to access to dental care. Overall, the magnitude and direction of the statistically significant differences in the three multivariate models were as expected and consistent with the results of previous research. The results confirm the significant effect of dental insurance, along with key demographic factors such as the level of education, in predicting the likelihood of having an annual dental visit and having a time in the past year when the respondent could not afford needed care. In addition, the results show the importance of employment-related characteristics, including the size of the employer and type of employment, in predicting the likelihood that a respondent will have private dental insurance.

The bivariate results show large differences between non-poor respondents (those with household incomes over 200% of poverty) and the two lower income groups. In the three multivariate models, the higher level of dental access problems among near-poor than among poor individuals likely reflects the impact of some individuals in the lowest income group receiving dental care through Medicaid or other subsidized programs.

The covariates in all three models account for about half of the unadjusted differences between rural and urban residents in the study's three main dependent variables. The remaining differences in the last two models are modest, but remain significant.

It was not possible to include measures of dentist availability or distance to dental care in

the models - which we know are problems in many rural areas - because of the lack of county identifiers in the NHIS public use data set. While few rural respondents identified the lack of a dentist or distance to dental care as reasons for not having a dental visit, these results may be due to limitations of the NHIS data set. In particular, our inability to use more precise measures of rurality (e.g., urban influence codes based on population density and adjacency to metropolitan areas) as well as possible under-representation of residents living in more isolated rural areas in the NHIS may have resulted in a failure to identify potential problems with dentist availability or distance to dental care in more isolated rural or frontier areas.

Because of the lack of state identifiers for respondents, we also could not determine for respondents with Medicaid coverage whether the Medicaid program in their state covered dental care for adults. Previous research has suggested that American Indians have high needs for dental treatment,[30] but sample sizes were not sufficient to allow us to analyze access to dental care for rural and urban American Indian populations. Finally, all of the data used in the study is self-reported and thus subject to the limitations inherent in self-reported data, but we have no reason to think that errors arising from self-reporting differ between rural and urban respondents.

Historically, Federal and state efforts to improve access to dental care have focused on increasing the supply of dentists, provision of dental services in federally-funded community health centers (CHCs), and increases in Medicaid reimbursement. Scholarship and loan repayment programs, such as the National Health Services Corps, require dentists to practice for a few years in underserved areas. The demand for dentists in dental health professional shortage areas, however, far exceeds the number of available NHSC dentists.[1, 2] About half of the CHCs in rural areas provide subsidized dental services, but the capacity of CHCs is very limited, compared to the number of low-income persons in need of dental care.[1, 2] During the 1990s,

several states increased Medicaid reimbursement rates for dentists and included dental benefits in State Children's Health Insurance Programs to improve access to dental care.[31] However, severe state budget cuts in 2003 and 2004 have resulted in significant reductions in enrollment and service coverage in Medicaid, S-CHIP, and other state health insurance programs in the majority of states.[32]

The results of this study indicate that Federal, state, and local initiatives to improve access to dental care need to pay special attention to low income and minority rural populations, who are especially vulnerable to oral health problems. The study suggests that efforts to improve access to dental care for underserved rural populations need to address factors in addition to the supply of dentists and Medicaid reimbursement. The Surgeon General's report on oral health,[3] Mertz and O'Neil,[33] Ryan[24] and others have articulated the need for comprehensive changes in the organization and financing of the current dental care system to address worsening disparities in oral health status for underserved populations. Potential strategies for improving dental access among rural populations include:

- expansion of public dental clinics, school-based dental services, and mobile dental services;[24, 33, 34]
- integration of oral health and primary health care services;[4, 35-37]
- expanded practice for dental hygienists and assistants to increase use of preventive services and patient education;[33, 36, 38]
- recruitment of more dental school students from underserved communities, who are more likely to practice in those communities after completing their professional training;[3, 24, 39] and
- implementation of dental placement services and incorporation of career and practice location decision issues into dental school curricula.[40, 41]

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