



Water Fluoridation and Dental Health Indicators in Rural and Urban Areas of the United States

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Background:

Dental caries is the most common chronic disease among children; it is, for example, 5-8 times more common than asthma.¹ The main causes of tooth loss among adults are periodontitis and caries.¹ Caries and tooth loss are important public health problems because of associated health care costs. In addition, caries results in pain, loss of tooth structure and function, reduced quality of life, and can lead to tooth loss and even acute systemic infection. Water fluoridation is recognized as one of the most successful public health interventions ever enacted in the United States.² An adequate level of fluoride in public drinking water is an effective, safe and inexpensive method to reduce dental caries, especially in children. Rural populations are more likely than urban counterparts to rely on untreated domestic wells that are unfluoridated, and not all public water systems have adequate fluoridation, raising the possibility that rural populations are less likely to be protected against dental caries. This study investigated the availability of fluoridated water across urban-rural settings, and relates measures of fluoride availability to national survey measures of dental health in adults and children.

Methods:

Hypotheses: Study hypotheses are: 1) Rural populations are more likely than urban populations to have inadequately fluoridated drinking water. 2) Inadequate fluoridation will be statistically associated with poorer dental health outcomes among both rural and urban adult and child populations.

Design and Rural-Urban Designations: Statistical comparisons were made between differences in the proportion of populations with access to fluoridated water in rural and urban settings. Then, dependent variables (e.g., adult tooth loss, caries in children) were statistically associated with adequate water fluoridation in the context of controlling for important covariates (e.g., age, race/ethnicity, dental health care, etc.)

The design includes comparative findings for rural and urban areas. Rural setting is defined using US Department of Agriculture urban-influence codes (UICs) to identify metropolitan (codes 1,2) and non-metropolitan (codes 3-12) areas.³ Analyses also compared metropolitan (codes 1,2), micropolitan (codes 3,5,8) and non-core areas (codes 4,6,7, and 9-12), and summarized water fluoridation rates across all urban influence codes.

Fluoridation data were drawn from the CDC’s “My Water’s Fluoride” database. Dental health outcome data came from 2006 Behavioral Risk Factor Surveillance System (BRFSS) survey data for adults, and 2007 National Survey of Children’s Health (NSCH) data for children. Other variables were measured from the Area Resource File.

Results:

Hypothesis 1: Rural populations were significantly more likely than urban populations to have inadequately fluoridated drinking water. The percent of the population with fluoridated public drinking water was 72.6% in metropolitan areas, and 63.3% in non-metropolitan areas (F=45.93, df=1, 3045, p<.0001). Differences between metropolitan, micropolitan, and non-core areas were also significant (F=30.41, df=2, 3044, p<.0001) and post-hoc means tests to correct for Type I error showed that all three groups were significantly different from each other. These results are summarized in Table 1.

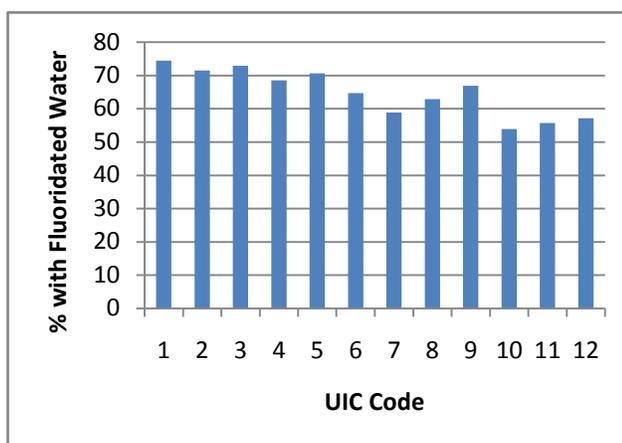
Table 1: The percent of the population with adequate fluoridation levels in metropolitan, micropolitan, and non-core counties.

	Metropolitan	Micropolitan	Non-Core
Number of counties	1035	655	1357
Percent of population with fluoridated water*	72.6	67.7	61.2

*F test comparing group means = 30.41; df=2, 3044; p<.0001.

Differences between fluoridation rates across all 12 urban-influence codes were also significant (F=9.06, df=11, 3035, p<.0001). Figure 1 summarizes these differences. There was a trend for declining fluoridation rates along the UIC continuum from most urban to most rural, although the effect is not strictly linear. The lowest rates were found for UIC codes 10-12 which represent the most rural areas; for each of these codes, less than 60% of the population had access to adequately fluoridated water.

Figure 1: Fluoridation Rates across UICs



Hypothesis 2: Controlling for covariates, a greater degree of water fluoridation was related to lower risk of adult tooth loss in metropolitan counties (p<.003). However, when the model was run for non-metropolitan counties greater fluoridation was not statistically associated with dental health scores for adults. For children’s dental health measures, it was found that fluoridation rates were not significantly related to the measures of either caries or overall condition of the teeth for urban or rural areas. Lack of findings probably reflects the crudeness of the fluoride exposure measure or the self-report measures of dental health, or efforts undertaken by adults and parents to provide topical fluoride when drinking water is not adequately fluoridated.

Other findings: In addition to lower fluoridation population coverage, rural areas, compared to urban areas, had a lower supply of dentists, less dental care received for both adults and children, and greater tooth loss for adults. The percentage of children with caries, and parental rating of the condition of the teeth were not significantly different between rural and urban areas. These results are summarized in Table 2.

Table 2: Rural-Urban Comparisons of dental health and health care.

	Rural Areas	Urban Areas	P-value*
	Mean or % (95% CI)	Mean or % (95% CI)	
% children with caries	19.8 (18.6, 21.0)	19.3 (18.2, 20.4)	0.5626
% children with less than very good teeth	28.8 (27.5, 30.1)	29.4 (27.7, 31.2)	0.5715
% children with dental care delayed or not received	3.4 (2.8, 3.9)	2.8 (2.4, 3.1)	0.0640
Number of children's dental visits (Percent)			0.0043
0	23.6 (22.2, 25.0)	21.0 (19.9, 22.1)	
1	28.0 (26.6, 29.4)	27.7 (26.7, 28.8)	
2 or more	48.4 (46.9, 49.9)	51.3 (50.0, 52.7)	
% adults with tooth loss	51.5 (50.3, 52.7)	43.5 (42.6, 44.3)	<0.0001
% adults with dental care within last two years	64.4 (63.4, 65.3)	70.5 (69.5, 71.5)	<0.0001
Dentists per 1,000 population (Mean (95% CI))	0.33 (0.32, 0.34)	0.51 (0.48, 0.53)	< 0.0001

*p value for t-test for group mean differences, or chi-square for percent difference.

Conclusions: Rural populations have significantly poorer access to adequately fluoridated public drinking water compared to urban populations. Population access to fluoridated water is lowest in the most rural areas of the country. Efforts to improve access to adequately fluoridated public water for rural populations are indicated by these findings. Where rural families rely on unfluoridated well water, education programs to encourage safe levels of topical fluoride use may be valuable. Policies to improve access to dental care in rural areas are also indicated by the results. Appropriate policy responses may include efforts to improve dental health insurance coverage, and to improve the supply of dentists practicing in rural areas. This may be accomplished through loan repayment programs or other strategies to encourage dentists to practice in rural areas, or improving reimbursement levels for dentists to treat children on public assistance programs such as Medicaid. Other policy initiatives may include programs to encourage pediatricians and family physicians at wellness visits to refer infants to a dental home when the first tooth emerges. Finally, efforts may be undertaken to expand the Women, Infants and Children program to include a dental education component on brushing children's teeth, and strengthening the Head Start program to allow caregivers to brush children's teeth.

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