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Dental Caries in Rural Alaska Native Children --- Alaska, 2008

Weekly

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In April 2008, the Arctic Investigations Program (AIP) of CDC was informed by the Alaska Department of Health and Social Services (DHSS) of a large number of Alaska Native (AN) children living in a remote region of Alaska who required full mouth dental rehabilitations (FMDRs), including extractions and/or restorations of multiple carious teeth performed under general anesthesia. In this remote region, approximately 400 FMDRs were performed in AN children aged <6 years in 2007; the region has approximately 600 births per year. Dental caries can cause pain, which can affect children's normal growth and development (*1*). AIP and Alaska DHSS conducted an investigation of dental caries and associated risk factors among children in the remote region. A convenience sample of children aged 4--15 years in five villages (two with fluoridated water and three without) was examined to estimate dental caries prevalence and severity. Risk factor information was obtained by interviewing parents. Among children aged 4--5 years and 12--15 years who were evaluated, 87% and 91%, respectively, had dental caries, compared with 35% and 51% of U.S. children in those age groups. Among children from the Alaska villages, those aged 4--5 years had a mean of 7.3 dental caries, and those aged 12--15 years had a mean of 5.0, compared with 1.6 and 1.8 dental caries in same-aged U.S. children (*2*). Of the multiple factors assessed, lack of water fluoridation and soda pop consumption were significantly associated with dental caries severity. Collaborations between tribal, state, and federal agencies to provide effective preventive interventions, such as water fluoridation of villages with suitable water systems and provision of fluoride varnishes, should be encouraged.

This Alaska region is comprised of 52 villages and has a population of approximately 25,000; 85% are Yup'ik Eskimo. The villages are small and remote, are commercially accessible only by air or boat, and have limited medical and dental resources; at the time of the investigation, four full-time dentists were working in the region. Sixteen villages (30%) have no in-home water and sanitation services, and only four (8%) have fluoridated water systems.

During October and November 2008, oral examinations were conducted on a convenience sample of children living in five of the 52 villages. Villages were chosen based on size, water fluoridation status, and willingness of village residents and village schools to participate. Two villages with fluoridated water and three villages without fluoridated water were selected. Village populations ranged from approximately 350 to 6,000 residents. All village children were invited

to participate. Families were notified by school officials, and signed parental consents were obtained. Children were examined for the presence of decayed teeth (untreated carious lesions) and filled and missing teeth (sequelae of decayed teeth) in their primary and permanent teeth by one experienced dentist using a visual and tactile protocol modified from the World Health Organization's oral health survey basic methods (*3*). The protocol was modified to match the diagnostic criteria used in surveys in the United States (*2*). Parents were interviewed, using questionnaires, to obtain risk factor information. All participants' families completed the questionnaire, and more than one child per family was allowed to participate.

The number of decayed primary teeth (dt), decayed and filled primary teeth (dft), decayed permanent teeth (DT), and decayed, missing, and filled permanent teeth (DMFT) were determined for each participant. Prevalence (having one or more tooth affected) and severity (mean dt, dft, DT, and DMFT) were determined by age group (4--5, 6--8, 9--11, and 12--15 years), sex, and village fluoridation status. An age-adjusted bivariate analysis was performed to assess risk factors for dental caries (dft >0 and DMFT >0). Risk factors included sociodemographic factors (e.g., sex), children's behaviors (e.g., tooth brushing, dental floss use, and soda pop consumption), parents' behaviors (e.g., tooth brushing), access to care, and water fluoridation status. Backward selection of risk factors that reached a significance level of $p \leq 0.25$, on age-adjusted bivariate analysis, were used to conduct multivariate logistic regression. Multivariate models were age- and sex-adjusted. In addition, dental caries severity for the region was compared with estimates for same-aged U.S. children from the National Health and Nutrition Examination Survey from 1999--2004 (*2*).

In total, 348 AN children aged 4--15 years were examined (39%--63% of the total age cohort in four participating villages; only 3% were examined in the other village, primarily for examiner calibration). The median age of the children was 9 years, and 52% of the children were male.

Among children aged 4--5, 6--8, and 9--11 years who lived in nonfluoridated villages, 71%--100% had one or more decayed or filled primary tooth (dft >0), and 40%--65% had one or more decayed primary tooth (dt >0). The mean dft ranged from 2.7 to 9.8. Among children aged 4--11 years from fluoridated villages, 67%--73% had one or more decayed or filled primary tooth (dft >0), and 44%--48% had one or more decayed primary tooth (dt >0). The mean dft among children aged 4--11 years from fluoridated villages ranged from 2.2 to 3.7 (Table 1, Figure).

Among children aged 6--8, 9--11, and 12--15 years from nonfluoridated villages, 57%--91% had one or more decayed, missing, or filled permanent tooth (DMFT >0), and 45%--68% had one or more decayed permanent tooth (DT >0). The mean DMFT ranged from 1.6 to 5.6. Among children aged 6--15 years from fluoridated villages, 31%--91% had one or more decayed, missing, or filled permanent tooth (DMFT >0), and 18%--68% had one or more decayed permanent tooth (DT >0). The mean DMFT among children aged 6--15 years from fluoridated villages ranged from 0.5 to 2.7 (Table 1, Figure).

Dental caries severity was greater in nonfluoridated villages. Children from nonfluoridated villages had 1.2--2.9 times higher mean dft or DMFT than children from fluoridated villages and 1.2--3.1 times the mean number of decayed teeth (Figure). Children from the Alaska region had 1.5--4.5 times the number of dft or DMFT than same-aged U.S. children and 1.6--9.0 times the number of decayed teeth (Figure). On age-adjusted bivariate analysis, only lack of water fluoridation, increased soda pop consumption, and infrequent brushing of teeth were

significantly associated with dental caries severity in primary and permanent teeth (all p-values <0.05).

On multivariate analysis, only lack of water fluoridation and soda pop consumption were associated with dental caries severity. The adjusted odds ratio (AOR) for lack of water fluoridation was 3.5 and 1.7 for primary teeth and permanent teeth, respectively. Odds of dental caries increased with increased soda pop consumption; AORs were 1.1 and 1.3 in children drinking one soda pop per day in primary and permanent teeth, respectively, and 1.5 and 2.0 in children drinking three or more soda pops per day for primary and permanent teeth, respectively (p≤0.02 for trend). No other risk factor, including infrequent brushing or lack of dental floss use, was associated with dental caries severity (Table 2).

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Editorial Note

Based on archeologic evidence, approximately 1% of the AN population had dental caries in the mid-1920s (*4*). Starting in the 1940s, air transportation into Alaskan villages became more frequent, as did the transport of processed foods. This led to gradual dietary changes among the AN population, from a diet of fish and game, to a diet high in carbohydrates. By 1999, an Indian Health Service dental survey found that 64% of American Indian (AI) and AN children aged 6--14 years, throughout the United States, had dental caries in their permanent teeth (*5*). In 2005, the Alaska DHSS determined that 75% of AN kindergarteners, statewide, had dental caries (*6*).

In contrast, since the beginning of the 20th century, the prevalence and severity of dental caries in the United States has decreased among most age groups (*1*) as a result of water fluoridation, use of fluoride toothpaste and other topical fluorides, and other factors. Approximately 72% of the U.S. population receives fluoridated water from public water systems (*7*). Water fluoridation is one of the most cost-effective methods of preventing and controlling dental caries (*7*). Optimally fluoridated water can decrease dental caries by 30%--50% (*7*), potentially resulting in substantial cost savings from averted treatment costs. The average cost of an FMDR is approximately $6,000 per case, whereas the yearly operational cost of fluoridating AN villages that have piped water distribution is approximately $4 per person (*7*). However, 40% of the villages in the Alaska region lack piped water systems suitable for fluoridation, and additional piped water systems need to be built.

Increased use of fluoride varnishes might provide additional preventive benefits (*8*). Fluoride varnishes are easily applied to teeth by health-care professionals in dental and nondental settings after minimal training. In Alaska, dental health aide therapists, community health aides, and community health practitioners are providing fluoride varnishes in remote villages that have

limited access to dentists. Even with an optimally fluoridated water supply, fluoride varnish applied at least four times from ages 9 to 30 months reduced caries prevalence by approximately 35% among AI children in one small, observational study (*9*). Soda pop consumption, an important risk factor for dental caries in the region, has been linked to other prevalent medical conditions among the AN population, including obesity and type II diabetes (*10*). Multiple health benefits in AN populations might result from decreasing soda pop consumption.

The findings in this report are subject to at least one limitation. This investigation used a small convenience sample, which limits the statistical power and the generalizability of the results. The small sample size might explain why some known protective factors, such as brushing with fluoridated toothpaste, were only marginally significant in the multivariate model.

In this investigation, AN children, including children from fluoridated communities, had much higher dental caries prevalence and severity than same-aged U.S. children. Thus, additional risk factors (e.g., diet), some of which might not have been captured in this investigation, contributed to higher levels of disease. The investigation suggests that fluoridating village water systems likely would decrease the prevalence and severity of dental caries among AN children in the region who live in villages without fluoridated water. Collaborations between the villages and state and federal agencies to implement preventive interventions should be encouraged.

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What is already known about this subject?

Childhood dental caries can cause pain, which might affect growth and social interactions with others.

What is added by this report?

Alaska Native (AN) children in a remote region of the state had a high prevalence and severity of dental caries. Those living in communities with fluoridated water had fewer and less severe dental caries than those in communities without fluoridation. Reported soda pop consumption was associated with an approximately 30% increased risk for caries in permanent teeth for each soda pop consumed per day.

What are the implications for public health practice?

Water fluoridation is an effective and relatively inexpensive method of reducing dental caries; however, many rural AN villages have no in-home water or sanitation services, which prevents these villages from fluoridating. Because of this, additional preventive services, such as providing fluoride varnishes, are necessary to improve the dental health of rural AN children. In addition, decreasing soda pop consumption might result in fewer dental caries in primary and permanent teeth.

TABLE 1. Dental caries prevalence and prevalence of decayed teeth* among children from five villages in rural Alaska, 2008

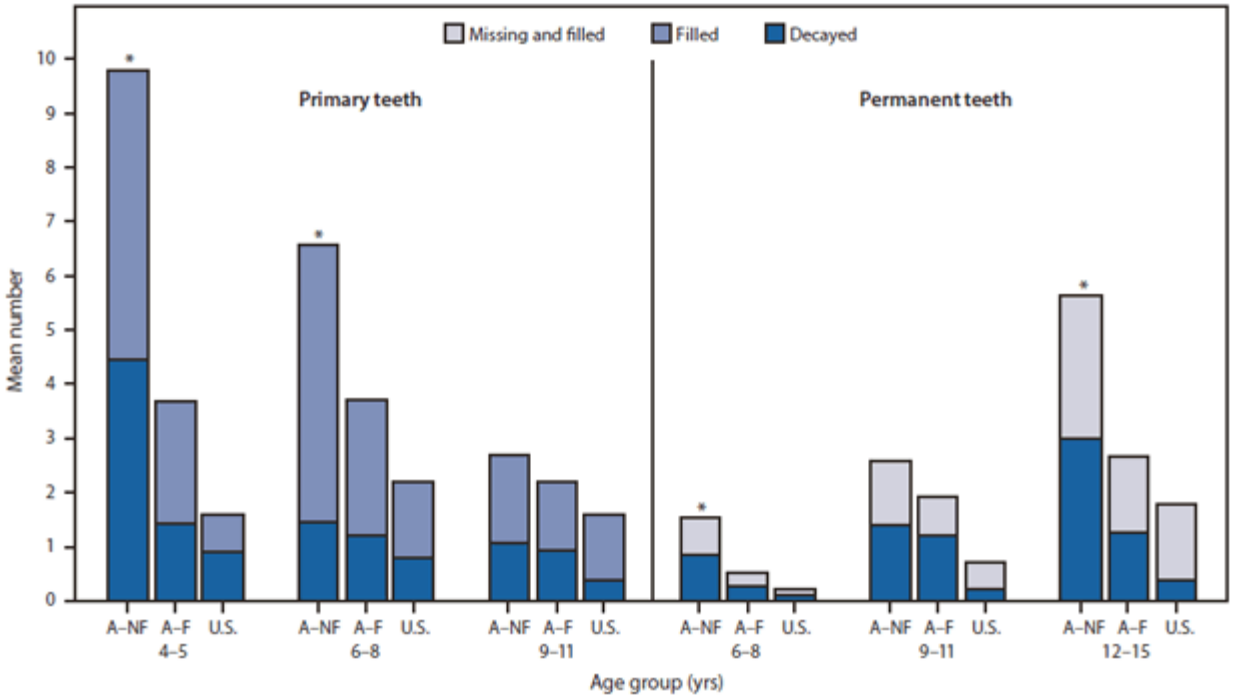
	Children from nonfluoridated villages					Children from fluoridated villages				
Age group (yrs)	No.	Primary teeth		Permanent teeth		No.	Primary teeth		Permanent teeth	
		% dft >0	% dt >0	% DMFT >0	% DT >0		% dft >0	% dt >0	% DMFT >0	% DT >0
4--5	26	100	65			18	67	44		
6--8	65	97	54	57	45	45	73	47	31	18
9--11	65	71	40	86	66	31	68	48	65	52
12--15	76			91	68	22			91	68

Abbreviations: dft = decayed and/or filled primary teeth; dt = decayed primary teeth; DMFT = decayed, missing because of caries, and/or filled permanent teeth; DT = decayed permanent

teeth.

* % dft >0 is the proportion of children with one or more decayed or filled primary tooth; % dt >0 is the proportion of children with one or more decayed primary tooth; % DMFT >0 is the proportion of children with one or more decayed, missing or filled permanent tooth; and % DT >0 is the proportion of children with one or more decayed permanent tooth.

FIGURE. Mean number of decayed, filled, and missing primary and permanent teeth among children, by age group and village water fluoridation status, in five rural Alaska villages and the United States, 2008



Abbreviations: A--NF = Alaska nonfluoridated water system, A--F = Alaska fluoridated water system, U.S. = total for the United States, based on National Health and Nutrition Examination Survey 1999--2004 results.

* $p<0.05$ for comparison between Alaska region fluoridated and nonfluoridated water systems; no statistical comparison could be made between the Alaska region and the total United States because of differences in survey methodology.

Alternate Text: The figure above shows the mean number of decayed, filled, and missing primary and permanent teeth among children, by age group and village water fluoridation status, in five rural Alaska villages and the United States in 2008. The mean decayed and filled primary teeth among children aged 4-11 years from fluoridated villages ranged from 2.2 to 3.7, for children aged 6-15 years from fluoridated villages, the mean decayed, missing, or filled permanent teeth was 0.5 to 2.7.

TABLE 2. Multivariate analysis* of risk factors associated with dental caries severity in primary (dft) and permanent teeth (DMFT) among children from five

villages in rural Alaska, 2008

Risk factor	Primary teeth (dft)		Permanent teeth (DMFT)	
	AOR (95% CI)	p-value	AOR (95% CI)	p-value
Water fluoridation				
Fluoridated	Referent		Referent	
Not fluoridated	3.5 (2.8--4.3)	<0.001	1.7 (1.4 -- 2.1)	<0.001
Soda pop/day				
0	Referent		Referent	
1	1.14 (1.03--1.31)		1.27 (1.18--1.37)	
2	1.30 (1.06--1.66)		1.61 (1.39--1.87)	
≥3	1.49 (1.10--2.13)	0.02†	2.04 (1.63--2.56)	<0.001†
Brushed teeth (days/wk)				
1	1.33 (0.99--1.79)			
2	1.27 (0.99--1.62)			
3	1.21 (0.99--1.47)			
4	1.15 (0.99--1.34)			
5	1.10 (0.99--1.21)			
6	1.05 (0.99--1.10)			
7	Referent	0.06†		

Abbreviations: AOR = adjusted odds ratio; CI = confidence interval; dft = decayed and/or filled primary teeth; DMFT = decayed, missing because of caries, and/or filled permanent teeth.

* The regression model was performed using backward selection of risk factors; no ORs are listed for tooth brushing in permanent teeth because this variable was not included in the final model after backward selection.

† p-value for trend.

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