Participant Knowledge of Fluoride in Drinking Water Based on a National Survey

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Abstract:

The Nutrient Data Laboratory (NDL) at the Agriculture Research Service, US Department of Agriculture (USDA) is coordinating development of a National Fluoride Database as a critical element of the comprehensive National Fluoride Database and Intake Study (NFDIAS). Assessment of fluoride intake is important to prevention of dental caries, skeletal fluorosis, and, possibly, other health issues. The fluoride contents of the chief contributors to fluoride intake have been determined based on a national sampling and analytical program. Since drinking water accounts for approximately 75% of dietary fluoride intake, sampling of drinking water was conducted in 144 nationally representative residential locations nationwide. The distribution of fluoride does vary due to local fluoridation practices. The use of well water, commercial bottled waters, home purifiers and filter systems also affects variability in fluoride content of drinking water and impacts on estimates of daily intakes for individuals. Following federal OMB approval in February 2003, we collected water samples and a one-page survey from the 144 participants on questions regarding their knowledge of fluoridation of their water, the composition of water pipes in the home, and the use of water purification and/or water softening systems. The results of the survey provided insight on what participants know about fluoridation and their drinking water. Supported by the NIH – National Institute of Dental and Craniofacial Research and National Heart, Lung and Blood Institute (Agreement Y3-HV-8839)

Overview of National Fluoride and Intake Assessment Study

•The National Fluoride Database is being developed by Nutrient Data Laboratory (NDL) [Website at ww.nal.usda.gov/fnic/foodcomp] and will be adapted to support fluoride assessment methodology developed by the Nutrition Coordinating Center (NCC) under the collaborative National Fluoride Database and Intake Assessment Study (NFDIAS).

•The study will estimate F concentrations and variability in a U.S. nationwide sampling of bottled and municipal drinking waters, beverages, and foods. This multi-center effort has collected more than 2,000 samples of over 50 foods and beverages at up to 144 locations. Product sampling, purchasing, and review of quality control are being handled by USDA/ARS. Samples have been processed and prepared by Food Analysis Laboratory Control Center Virginia Polytechnic Institute (FALCC-VPI). Analyses are being conducted by University of Iowa using a fluoride ion specific electrode direct read method for analysis of clear liquid samples and a micro-diffusion method for analysis of the remaining food samples.

Significance of Study

Assessment of F intake is not only critical to ensure adequacy to prevent dental caries, but reliable estimates of F are important to prevent excessive F intake and the resulting dental and skeletal fluorosis. Past F intake research has been hindered by the lack of a database for food and beverage F levels. The National Fluoride Database is critical to dietary F intake assessments supporting grant work for the National Institute of Dental and Craniofacial Research, and the National Heart, Lung, and Blood Institute. Results will assist future research concerning F intake by providing national average F levels and variability in drinking water and many foods and beverages obtained by standardized approaches, allowing quantitative estimates of F intake for individuals.

Sampling Plan

Step 1. Pilot study[1], Food Composition Lab/Nutrient Data Lab, USDA

•3 pickups (over 3 seasons)
•Residential water sampling in 24 locations

Step 2. Mixed Model Analysis/ANOVA of pilot study results:

• Most variability from:
  –among geographically close locations
  –over time
  –not among regions
• At least 288 samples needed for 90% confidence level.

Step 3. Prepared Sampling Frame Data

• County and state code, name and 2000-1 Census
• Code, name, popn; 2000 Census consolidated metropolitan statistical areas (CMSAs)
• Local urbanicity indices (applied within CMSA)

Step 4. Sampling Design Development

•US population from 2000 Population Census ordered
  –1 county selected from each zone - probability minimum replacement
  –2 locations (residential/retail) selected in each sampled county
  –Samples collected at 2 different times

Step 5. Census State Ordering

•Sort by Census regions, division, state
•Sort counties serpentinely by gCMSA size
•Within gCMSA, sort serpentinely by urbanicity
•gCMSA in
  –Odd numbered states, decrease in size
  –Even numbered states, increase in size
• Similar pattern for urbanicity within gCMSAs

Step 6. Survey approval, Office of Management and Budget

•Federal Register announcement
•OMB approval February 2003

Step 7. Subject recruitment

•Pickups (2003)
1. Feb - March
2. April - June

•Phone call recruitment/vehicle emergency pack incentive
•NDL's researchers made ~ 1,500 phone calls, over a 3 week period in January 2003, to recruit the 144 participants for 2 pickups.
•Phone listings clustered by neighborhood to assure likeness between primary contact (1st in list) and alternates (refusal conversion script)
•Follow-up letters sent confirming date of pickup
•Superior, Inc. agents contracted to pick up samples/issue survey

Step 8. Sample pickup / survey

•Administered by pickup agents at the door of each participant's home with each pickup

Step 9. Fluoride analysis

•Completed by University of Iowa, College of Dentistry

Step 10. Quality Control review of data by:

•The NFDIAS Quality Control Panel

Step 11. Data aggregation and analysis

•NDL is finalizing
•NDL will continue to examine variability

Step 12. Special Interest Database release summer 2004

ww.nal.usda.gov/fnic/foodcomp

NDL Fluoride County Sample

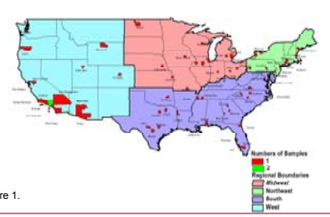


Figure 1.

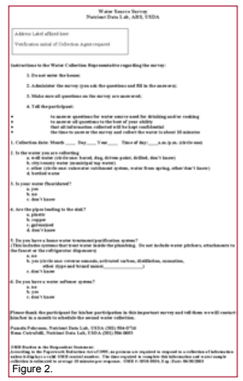


Figure 2.

Water Source

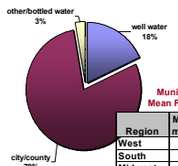


Figure 7.

Municipal vs. Well: Mean Fluoride Content

Region	Municipal mcg/100g	Well mcg/100g
West	51	24
South	93	10
Midwest	91	53
Northeast	74	9

Is Your Water Fluoridated?

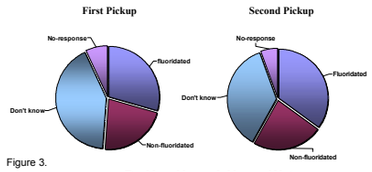


Figure 3.

What Material Is The Pipes Leading To The Sink?

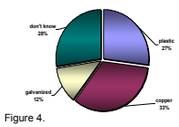


Figure 4.

Do You Have A Home Water Treatment/Purification System?

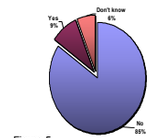


Figure 5.

Do You Have A Water Softener System?

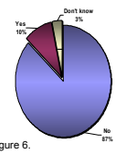


Figure 6.

Distribution of Fluoride in Drinking Water

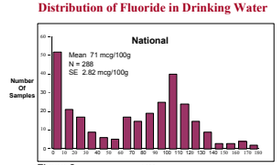


Figure 8.

Fluoride in all water samples

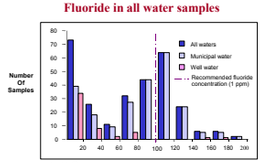
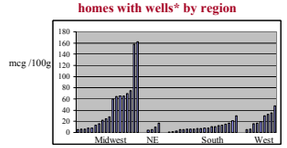


Figure 9.

Fluoride levels: Water from individual homes with wells* by region



*Most homes with wells were sampled twice

Figure 10.

Distribution of fluoride in drinking water

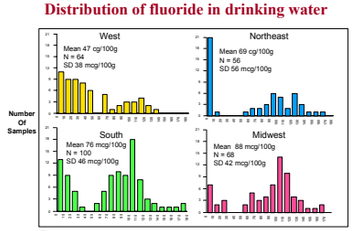


Figure 11.

Conclusions: This participant knowledge survey provides insight on what consumers know about fluoridation and their drinking water. The distribution of fluoride may vary drastically across populations, due to the composition of soil and because the choice to fluoridate municipal waters is a local political decision. Fluoridation reached 66%, in 2000, of the US population on public water supplies – more than 162 million people.[1] NDL obtained drinking water samples from 144 nationally representative locations (2 locations in each of 72 counties) in the continental US using a self-weighted, nationally representative sampling approach for quantification of the variation in fluoride. Water samples were picked up twice in 2003. Obtaining samples in 2 locations per county and at 2 different pickup times will allow NDL to examine within-county and over time variability. Collection of the drinking water samples was handled through Superior Product Pickup, Inc. with the participants drawing the samples from their kitchen water tap. OMB allowed the participant survey (Figure 2.) which was administered by the pickup agent at the time of collection. Survey results revealed that about 49% in the first pickup and 42% of participates in the second pickup (Figure 3.) did not know whether their drinking water is fluoridated or not. This information may be applicable to dental and nutrition education programs for consumers. NDL checked with each participant's municipal water supplier and found that ~ 88% of participants responding yes were correct and ~ 80% of participants responding no were correct in their response on local municipal water fluoridation. NDL obtained information on fluoridation levels from the municipal water suppliers and will correlate participant responses and reported municipal fluoridation levels to our analyzed F levels. The use of wells, home purifiers and water filtering systems also plays a major role in the variability of fluoride in drinking water making it very difficult to estimate daily fluoride intakes for individuals. NDL has relied on participant identification (Figure 2., question no. 2) of well water in our water data aggregations and analyses. Eighteen percent of participants report that they have well water (Figure 7.). In all regions, municipal water F levels are higher than well water F levels (Figure 7.). Natural fluoride content varies with regions and this is reflected in the regional well water values (Figure 7.). Twenty-eight percent of participants (Figure 4.) did not know what type of pipes (Figure 2., question no. 4) are used to supply water in their homes. Based on participant responses (Figure 2., questions no. 5 and 6: Figures 5. and 6.) about 10 % of households have water softener and/or water treatment/purification systems indicating that consumer awareness of these systems in their households is high. The optimum water fluoridation level is 1 ppm (0.7 to 1.2 ppm).[2] 1 ppm = 100 mcg/100 grams. The maximum contaminant level for F has been established as 4 mg/liter (400 mcg/100 grams).[3] NDL will include F water data along with F data for other beverages and foods in the National Fluoride Database to be released on www.nal.usda.gov/fnic/foodcomp in the summer of 2004.

[1] Miller-Ihli, N.J., Pehrsson, P.R., Cutrufelli, R.L. and Holden, J.M. 2003. Fluoride content of municipal water in the United States: what percentage is fluoridated? J Food Comp Anal, 16(5):621-628

[2] CDC MMWR Weekly Feb. 22, 2002/51(07);144-7.

[3] US Public Health Service (1962). *US Public Health Service drinking water standards*. PHS publication #956, Government Printing Office, Washington, DC.

[4] Federal Register, Vol. 65, No. 87, 26008, Thursday May 4, 2000