Bottled, Filtered, and Tap Water Use in Latino and Non-Latino Children

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Objectives: To describe bottled, filtered, and tap water consumption and fluoride use among pediatric patients; to analyze differences between ethnic and socioeconomic groups; and to describe the frequency of physician-parent discussions regarding water consumption.

Design: Convenience sample survey.

Setting: An urban public health clinic.

Participants: Parents attending a public health clinic.

Outcome Measures: The primary outcome measure was the prevalence of tap, filtered, and bottled water use. The secondary outcome measures were supplemental fluoride use and the percentage of patients reporting discussions of water consumption with their physician.

Results: A total of 216 parents (80.5% Latino and 19.5% non-Latino) completed the survey. Of the parents, 30.1% never drank tap water and 41.2% never gave it to their children. Latino parents were less likely than non-Latino parents to drink tap water (odds ratio, 0.26; 95% confidence interval, 0.10-0.67) and less likely to give tap water to their children (odds ratio, 0.32; 95% confidence interval, 0.15-0.70). More Latinos believed that tap water would make them sick (odds ratio, 5.63; 95% confidence interval, 2.17-14.54). Approximately 40% of children who never drank tap water were not receiving fluoride supplements. Of the lowest-income families ($≤14,999 per year), 64.9% always gave bottled (32.9%) or filtered (32.0%) water to their children. Of the parents surveyed, 82.5% reported that their child’s physician had never discussed the type of water they should use.

Conclusions: Many Latino families avoid drinking tap water because they fear it causes illness. Unnecessary use of bottled and filtered water is costly and may result in adverse dental health outcomes. Physicians should provide guidance to families regarding the safety, low cost, and dental health benefits of drinking tap water.

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The consumption of bottled and filtered water has dramatically increased in the United States during the past decade, with bottled water sales tripling to about $4 billion a year. More than 50% of the US population drinks bottled water. Despite the fact that it is widely believed that 25% to 40% of bottled water is simply bottled tap water, “people spend from 240 to over 10,000 times more per gallon for bottled water than they typically do for tap water.”

An annual supply of bottled water for a person who consumes 8 glasses a day would cost approximately $200; the same amount of tap water would cost approximately $0.33. In general, women are more likely to drink bottled water than men, and Hispanic women are the group most likely to drink bottled water. The sale of water filters and related services to “improve” tap water increased from $3.1 billion in 1995 to $7.7 billion in 1998. Upper-income suburban homeowners in the Midwest are most likely to purchase home water treatment systems. Water filter use ranges from 3.9% to 14.8% of the population across the country. The type of water filter used impacts the amount of fluoride and bacteria removed from the water. Faucet-mounted or pitcher filters only remove impurities, while under-the-sink filters, such as reverse osmosis and distillation filters, remove 65% to 95% and 100% of the fluoride, respectively. Bottled, filtered, and tap water are all generally safe in the United States. The Environmental Protection Agency regulations for tap water are actually stricter than the Food and Drug Administration...
regulations for bottled water. A study\(^3\) of drinking water in Cincinnati, Ohio, found that bacterial counts in bottled water were often higher than those in tap water and fluoride concentration was inconsistent.

Oral health is an emerging national priority. Healthy People 2010 objective 21 deals with dental health; its first goal is to “Reduce the proportion of children and adolescents who have dental caries experience in their primary or permanent teeth.”\(^{6(p21-13)}\) The benefits of water fluoridation are well-known,\(^2\) and Healthy People 2010 specifically emphasized the importance of water fluoridation with the goal of “[increasing] the proportion of the U.S. population served by community water systems with optimally fluoridated water.”\(^{6(p21-28)}\) If many children are consuming water that does not contain fluoride, the effect on their dental health could be substantial. Our clinical observations suggested that many low-income Latino families were consuming bottled or filtered water. We found no prevalence data in the medical literature regarding the types of water use among children of immigrant populations. We designed a study with the following objectives: (1) to describe the consumption of bottled, filtered, and tap water and fluoride use among ambulatory pediatric patients; (2) to analyze differences between ethnic and socioeconomic groups; and (3) to describe how often physicians discuss what type of water their patients consume.

**METHODS**

**PARTICIPANTS**

We surveyed a convenience sample of parents of children cared for in an urban public health center in Salt Lake City, Utah. Of the families served by the clinic, approximately 80% speak Spanish at home, 75% of the children receive Medicaid or State Children’s Health Insurance Program benefits, and nearly 25% of the children are uninsured. Most parents are immigrants from Mexico. Families were considered to be Latino if they completed the survey in Spanish or had a family member who was born in Mexico or Central or South America.

**SURVEY**

The investigators created a 15-question written survey in Spanish and English, consisting of questions designed to delineate water preference and children, water filter use, bottled water use, fluoride use, and demographics. Several parents pilot tested the Spanish and English versions, and several modifications were made based on their recommendations.

The following are examples of the questions on the survey. (1) Do you drink tap water at home (always, sometimes, or never)? (2) Do you give tap water at home to your children (always, sometimes, or never)? (3) If your children drink tap water at home, is it filtered (always, sometimes, or never)? What type of filter do you use (water pitcher, faucet mounted, under sink [reverse osmosis or distillation], or I don’t know)? (4) Do your children drink bottled water at home (always, sometimes, or never)? (5) If you do not drink tap water at home, why not (I don’t know how it tastes, I think tap water will make me sick, I was told not to drink the water, or other)? The full survey is available from the corresponding author.

During a 2-week period, the front desk staff of the clinic distributed the surveys as parents checked in and collected them as parents left the clinic. Clinic staff provided assistance for parents who required it. The University of Utah institutional review board deemed the study to be exempt.

**OUTCOME MEASURES**

The main outcome measure was the prevalence of tap, filtered, and bottled water use among the respondents. Secondary outcomes included supplemental fluoride use and the percentage of patients who reported that their physician had discussed their child’s water use with them.

**STATISTICAL ANALYSES**

The Pearson \(\chi^2\) test was used to compare categorical variables. The Cochran linear trend or trend \(\chi^2\) test was used for ordinal data. We chose a significance value of \(P<.05\). We calculated odds ratios and 93% confidence intervals using standard logistic regression formulas.

**RESULTS**

During the 2-week study period, 296 patients visited the clinic, and 216 parents (73.0%) completed the survey; 80.5% were Latino. Of the parents, 53.1% had been born in Mexico and 36.0% had been born in the United States. Of the population, 40.8% had an annual income level of $14,999 or less (Table 1).

Of the 216 parents, 65 (30.1%) said they never drank tap water and 89 (41.2%) said that they never gave it to their children. Of the children who drank no tap water, 59.6% always drank bottled water and 33.6% drank only water that had been filtered. Of the water filters, 10.2% were either reverse osmosis or distillation filters that remove most or all of the fluoride. Approximately 40% of

**Table 1. Demographic Characteristics of the 216 Study Participants**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>No. (%) of Participants*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethnicity</td>
<td></td>
</tr>
<tr>
<td>Latino</td>
<td>173 (80.5)</td>
</tr>
<tr>
<td>Non-Latino</td>
<td>42 (19.5)</td>
</tr>
<tr>
<td>Country/region of origin</td>
<td></td>
</tr>
<tr>
<td>United States</td>
<td>76 (36.0)</td>
</tr>
<tr>
<td>Mexico</td>
<td>112 (53.1)</td>
</tr>
<tr>
<td>South America</td>
<td>13 (6.2)</td>
</tr>
<tr>
<td>Central America</td>
<td>6 (2.8)</td>
</tr>
<tr>
<td>Other†</td>
<td>4 (1.9)</td>
</tr>
<tr>
<td>Annual income, $</td>
<td></td>
</tr>
<tr>
<td>0-14,999</td>
<td>87 (40.8)</td>
</tr>
<tr>
<td>15,000-29,999</td>
<td>38 (17.8)</td>
</tr>
<tr>
<td>30,000-59,999</td>
<td>12 (5.6)</td>
</tr>
<tr>
<td>≥60,000</td>
<td>7 (3.3)</td>
</tr>
<tr>
<td>Chose not to answer</td>
<td>11 (5.2)</td>
</tr>
<tr>
<td>Respondent did not answer</td>
<td>35 (16.4)</td>
</tr>
<tr>
<td>Left answer blank</td>
<td>23 (10.8)</td>
</tr>
</tbody>
</table>

*Percentages are based on the total for each category, and may not total 100 because of rounding. Denominators vary because of missing data.

†England, Iraq, the Pacific Islands, and the Philippines.
the 89 parents who never gave their children tap water did not give fluoride supplements. The most common reasons for avoiding tap water were taste, fears of illness, and being told by someone to avoid tap water.

Comparisons between Latino and non-Latino parents with respect to drinking and providing tap water to their children are shown in Table 2. Compared with non-Latino parents, Latino parents were less likely to drink tap water and to give it to their children. More Latinos than non-Latinos believed that tap water was likely to make them sick. Latino and non-Latino children who were never given tap water did not differ in whether they drank bottled or filtered water. There was little difference in the types of water filters used by Latino and non-Latino parents. There was little difference in water use between recent and long-term immigrants. Among the families who did give tap water to their children, there was no observable trend in the age that it was introduced for either Latino or non-Latino families. Latinos and non-Latinos did not differ in supplemental fluoride use.

The type of water preferred and consumed was not associated with annual income level. Of the 88 lowest-income families (≤$14 999 per year), 32.9% reported always giving bottled water to their children and 32.0% always filtered their children’s tap water. In the highest-income group (> $60 000 per year), 14.3% always gave bottled water and 57.1% always used filters (P = .50 for both). However, there were few families whose annual income was greater than $60 000.

Of the parents, 82.5% reported that their child’s physician had never discussed water use with them. There was little difference in the frequency of discussing water use associated with annual household income or ethnicity. Of the parents, 19.9% indicated that there was no fluoride in their water, while 18.5% said they did not know if there was fluoride in their tap water. Neither of these groups gave their children supplemental fluoride.

We found that nonconsumption of tap water was high among our study group. Of the study population, 41.2% never gave their children tap water and 30.1% never drank it themselves. Immigrant Latinos were even less likely to consume tap water or to give it to their children than non-Latinos. The primary factor influencing this behavior in immigrant Latinos seems to be a fear that tap water is a potential cause of illness. Ironically, regulations for the safety of tap water are more stringent than those for bottled water. Our results are consistent with national literature showing that many adults consume bottled or filtered water rather than tap water. Our data suggest that this trend is even more common among children, particularly those from predominately immigrant Latino families and families least able to afford the expense of bottled water or water filters.

Water fluoridation is widely acknowledged to reduce childhood caries. Children who drink little or no tap water may not be receiving the benefits of water fluoridation, because some types of bottled and filtered water lack fluoride.

### Table 2. Water Use Results and Comparison Between Latinos and Non-Latinos

<table>
<thead>
<tr>
<th>Response</th>
<th>Latinos (n = 173)*</th>
<th>Non-Latinos (n = 43)*</th>
<th>Odds Ratio (95% Confidence Interval)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adults never drink tap water†</td>
<td>58 (33.5)</td>
<td>5 (11.6)</td>
<td>0.26 (0.10-0.67)</td>
</tr>
<tr>
<td>Children never drink tap water†</td>
<td>76 (43.9)</td>
<td>9 (20.9)</td>
<td>0.32 (0.15-0.70)</td>
</tr>
<tr>
<td>Children drink only bottled water</td>
<td>55 (31.8)</td>
<td>8 (18.6)</td>
<td>2.11 (0.93-4.76)</td>
</tr>
<tr>
<td>Children drink only filtered water</td>
<td>54 (31.2)</td>
<td>10 (23.3)</td>
<td>1.72 (0.78-3.76)</td>
</tr>
<tr>
<td>Avoid tap water because it causes illness†</td>
<td>73 (42.2)</td>
<td>5 (11.6)</td>
<td>5.63 (2.17-14.54)</td>
</tr>
<tr>
<td>Avoid tap water because someone told them not to drink it</td>
<td>14 (8.1)</td>
<td>2 (4.7)</td>
<td>1.81 (0.44-7.37)</td>
</tr>
<tr>
<td>Avoid tap water because of taste</td>
<td>53 (30.6)</td>
<td>11 (25.6)</td>
<td>1.29 (0.61-2.72)</td>
</tr>
</tbody>
</table>

*Data are given as number (percentage) of each group.
†The difference between the 2 groups is statistically significant (P < .05).

The type of water patients consume may impact fluoride intake and, hence, their oral health. We found a high prevalence of not drinking tap water among low-income and Latino children born to immigrant parents. This finding has important potential implications regarding oral health. Latino and African American children have higher rates of untreated dental caries compared with white children (43% and 36% vs 26%), and children in poverty have less access to dental care, especially dental sealants. If, in addition, they are less likely to be exposed to the preventive aspects of fluoridation, the public health implications are significant.

We found that while there was little difference in the type of water ingested because of taste or being told to drink a certain type of water, there was a statistically significant difference in avoidance of water because of safety concerns. Immigrant Latinos were more likely to avoid tap water for fear of illness than non-Latinos. The concern of Latinos is logical because many have immigrated to the United States from places with poor water quality. There is evidence to suggest that those who sell water filters exploit the anxiety that Latino families may have regarding tap water safety. Our findings did not support this evidence. If these concerns remain, immigrant Latinos could boil water prior to its use in infants; although it is an unnecessary step in most cases, it is low cost and does not remove fluoride. Directing anticipatory guidance about the safety and benefits of tap water in the United States to Latinos could improve children’s dental health outcomes.

We learned that, of our lowest-income families, 32.9% always give bottled water to their children and 32.0% always filter their children’s tap water. Using national statistics, we project that these families are spending up to 10 000 times more per year on water for their children than they would if they were to consume tap water. Because these expenditures may be due to unfounded health concerns, physicians may be able to educate patients about...
the safety of tap water, with resultant health and economic benefits for the families.

We discovered little difference in the number of exclusive water filter or bottled water users, and in the types of water filters used, across ethnicities. From our point of view, we consider the fact that most filter users use less expensive and fluoride-sparing faucet-mounted and water pitcher filters to be a positive finding. However, 10.2% of our filter users use under-the-sink filters, such as reverse osmosis or distillation filters, that remove between 65% and 100% of fluoride and, therefore, did not receive adequately fluoridated water. The impact of always drinking bottled water on fluoride intake is uncertain because the regulations for bottled water do not require disclosure of fluoride content on the labels. Although it is likely that some bottled water contains some fluoride, physicians and families cannot quantify the fluoride consumption of their patients or children. Appropriately prescribing fluoride thus becomes a much more difficult task for the physician. The additional cost of prescribing fluoride to children who could be drinking tap water is significant; in Salt Lake City, an annual supply of fluoride is $143.88. Furthermore, prescribing too much fluoride, when the true content of fluoride in bottled or filtered water is unknown, can lead to enamel fluorosis. While enamel fluorosis is usually mild to moderate and does not cause health concerns, it can cause long-term cosmetic effects. We believe that bottled water producers should list, in uniform and easy-to-understand terms, the content of fluoride in a serving of water. This would assist families and physicians in ensuring that children receive adequate and appropriate doses of fluoride.

We learned that few physicians (17.5%) seemed to be asking parents whether their children drink bottled, filtered, or tap water. In contrast, a study of academic general pediatricians reported that 70% assessed the type of water consumed by patients prior to prescribing fluoride supplementation. One possible explanation for this discrepancy was that our survey was conducted within a month of initiating fluoridation of our water supply. It is possible that physicians were not in the habit of asking what type of water was consumed because the public water supply had not contained fluoride recently. On the other hand, physicians may not be aware of local water issues. Physicians can check local water reports online (available at: http://www.epa.gov/safewater/crc).

One of the most concerning findings of this study is that about 40% of the study population was at risk for inadequate fluoride intake from water and was not taking supplemental fluoride. This issue could be addressed by physicians discussing water preferences and options with their patients and prescribing fluoride when appropriate. By addressing focused questions about the type of water children are consuming and education about the safety and benefits of tap water during anticipatory guidance, physicians can have a positive effect on the oral health of families and allow them to make educated decisions regarding their water choice.

Finally, asking questions about water use may increase the ability of physicians to give appropriate anticipatory guidance about the introduction of water in an infant's diet. The American Academy of Pediatrics has stated that “Neither breastfed nor formula-fed infants require extra water, even in hot, dry climate areas and even when febrile.” Nevertheless, many families introduce water at a young age to infants. In our study, we did not find any differences between immigrant Latinos and non-Latinos in relation to the timing of water introduction. Discussing water use routinely will give physicians the opportunity for improved education.

**LIMITATIONS**

This study was limited by using a convenience sample in 1 clinical setting. The results may not be generalizable to other settings. Most of our patients were from Mexico and, hence, our survey may have captured Mexican cultural beliefs about water consumption and illness that may not be generalizable to other ethnic or geographic groups. We were not able to capture the number of incomplete surveys or ascertain why some surveys were not completed. Finally, individuals may have perceived that there was a “correct” answer to some or all of the questions.

**IMPLICATIONS**

The results of our study suggest that physicians should routinely ask which type of water their patients use and, if it seems likely that the child is drinking water that does not contain fluoride, prescribe it. Physicians should advocate for including the fluoride content on the labels of bottled water. A patient education campaign about the safety and benefit of tap water may reduce family expenses and improve fluoride intake among children.
script, or in the decision to submit the manuscript for publication.

**Additional Information:** Dr Young provided mentoring support, and Dr Hoff provided statistical support.

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**REFERENCES**


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**Trial Registration Required.** In concert with the International Committee of Medical Journal Editors (ICMJE), *Archives of Pediatrics and Adolescent Medicine* will require, as a condition of consideration for publication, registration of all trials in a public trials registry (such as http://ClinicalTrials.gov). Trials must be registered at or before the onset of patient enrollment. This policy applies to any clinical trial starting enrollment after July 1, 2005. For trials that began enrollment before this date, registration will be required by September 13, 2005, before considering the trial for publication. The trial registration number should be supplied at the time of submission.

For details about this new policy, and for information on how the ICMJE defines a clinical trial, see the editorials by DeAngelis et al in the September 8, 2004 (2004;292:1363-1364) and June 15, 2005 (2005;293:2927-2929) issues of *JAMA.* Also see the Instructions to Authors on our Web site: www.archpediatrics.com.