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Knowledge and Opinion of Dental Students Regarding Community Water Fluoridation

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Abstract

The purpose of this study is to determine the knowledge and opinion of dental students currently enrolled in Michigan dental schools regarding community water fluoridation. A link to the online survey was distributed via email to all dental students attending the dental schools. The survey was open from October 2014 until January 2015. Descriptive statistics, chi-squared test and logistic regression models were used to analyze the data, and association between predictor and key outcome variables. A total of 293 survey were completed online for a return rate of 29 percent. An overwhelming number of students favored community water fluoridation (95.8%). A majority of the dental students were knowledgeable about the optimal levels of fluoridation (71.6%) and adverse effects of community water fluoridation (81.7%). A majority of Michigan dental students are in favor of community water fluoridation.

Keywords: *Community Water Fluoridation; Dental Students; Knowledge; Opinion*

Abbreviations

CDC: US Centers for Disease Control and Prevention; CWF: Community Water Fluoridation; CI: Confidence Interval; LCL: Lower Confidence Level; UCL: Upper Confidence Level

Introduction

Community water fluoridation is considered one of the ten greatest public health achievements of the past century [1]. Fluoride has been shown to play an important role in the prevention of dental caries and has been the most widely used and effective tool to prevent caries [2]. Community water fluoridation is the process of adjusting fluoride levels in municipal water to optimal levels to aid in the prevention of dental caries. The CDC considers community water fluoridation to be not only safe and effective, but also cost effective in preventing dental caries. Several professional healthcare organization including the World Health Organization have supported community water fluoridation as an effective intervention to decrease prevalence of dental caries. According to the CDC, as of 2014, 211 million people or 74.4% use public water systems that contain enough fluoride to prevent dental caries [3]. The percentage of people receiving fluoridated water though their water systems has doubled in the US in the last 50 years. Systematic reviews have reiterated the effectiveness and cost-effective ness of community water fluoridation [4-6]. It has been instrumental in reducing dental caries rates by 25% in children and adults in spite of the availability of fluoride in different products [6]. It has been estimated that community water fluoridation saves between $4 to $27 based on the size of the communities [7].

There has been considerable scientific attention paid to the safety and effectiveness of fluorides over the past few decades. Most of these assessments have been focused on the risks and benefits of fluoride exposure, especially the concerns with the prevalence and severity of dental fluorosis [8-15]. Although beneficial, fluoride also has an adverse effect of dental fluorosis when ingested at higher levels than those recommended for the prevention of dental caries. Fluorosis characterized by hypo-mineralization of tooth enamel caused by ingestion of excessive fluoride during enamel formation. Studies show that dental fluorosis prevalence has narrowed between communities that fluoridate and those that do not [15,16]. In its mild form, fluorosis is clinically observed as a white opaque area on teeth surface. At this level, the affects concern mainly esthetics but more severe cases can affect teeth function. Among individuals aged 6 - 49 years in the United States, about 40 percent were affected by fluorosis; with only less than one percent affected by severe fluorosis [17]. Over the years, objection to implementing community water fluoridation have been gaining attention. The main objections, include concerns about its effectiveness when other fluoride modalities are available as well as the increases in the prevalence of dental fluorosis among children [17-19]. The fear of long term unknow adverse effects also adds to these concerns [20]. A recent study has shown that in spite of the large body of scientific evidence regarding the safety of community water fluoridation, about 13 percent of respondents disagreed [21]. The study also noted that, respondents who had knowledge about community water fluoridation were more likely to agree that it was safe [21]. Similar studies in other countries have shown support for community water fluoridation as well [22-26].

Community water fluoridation is usually a controversial topic in the communities where it being implemented. Misplaced concerns regarding CWF, especially arising out of misinformation and unproven data is a major public health issues because of the number of communities that are fluoridating or trying to retain fluoride in their public water systems. Every year there are several communities in the United States that are revisiting their decision to fluoridate their pubic water through public referendum based on misinformation. Dentists as oral health leaders in the community have a crucial role to play in educating of the public. Research studies looking at the opinions of dentists have shown that a majority of the dentists support CWF [27,28]. There have not been any recent studies conducted in the United States that have looked at the opinions and knowledge of dentists regarding CWF and their ability to effectively advocate or educate their patients about CWF. A recent study conducted in Australia showed that 47 percent of the respondents who obtained their information from a dentist or general medical practitioner were more likely to be strongly supportive of water fluoridation compared to other sources of information like newspapers (40 percent), television or the radio (36 percent) or the Internet (33 percent) or who did not receive any information about water fluoridation (22 percent) [19]. An older study conducted in the United States however did not shown any increased likelihood of patients supporting CWF based on their interacting with their dentists [29]. Dentists' lack of knowledge and expertise has limited their ability to effectively advocate for CWF in their communities [27]. Regardless of the shortcomings, dentist can still play a very important and critical role in educating the public and advocating for policy changes effectively. A critical step towards having well informed dentists is to train dental students in the importance of prevention and evidence based approaches to preventing dental diseases. It is also important to make sure that graduating dental students get a clear message about the role they can play as leaders, experts, and public health advocates in advocating for CWF in their communities. This study aims to examine the knowledge and opinion of dental school students regarding CWF.

Materials and Methods

This cross-sectional study was reviewed and approved by the Institutional Review Board at the university. All students enrolled in the four-year DDS program in the two Michigan dental school (approximately 908) were eligible to participate in this study. Participation in this study was voluntary. As an incentive for participation, students could enter a raffle for a $100 gift card (one per school) upon completion of the survey. An online survey tool was developed to assess the knowledge and opinion of dental students regarding CWF. The questionnaire consisted of 10 questions related to demographics, source of information regarding CWF, students' knowledge and opinion about CWF. The questions on knowledge enquired about the optimal levels of fluoride in drinking water to prevent caries and adverse effects. The opinion question solicited information on the students support for CWF and who they felt should have the authority to decide on CWF in communities. The question on source of information was formatted as a multiple answer, allowing the respondents to

Variables	(n)	(%)	95% CI	
			LCL (%)	UCL (%)
Gender				
Female	144	54.5	48.3	60.7
Male	120	45.5	39.3	51.7
Dental School				
School 1	121	45.8	39.7	52.1
School 2	143	54.2	47.9	60.3
Year				
Dental Student Year 1	73	27.7	22.3	33.5
Dental Student Year 2	85	32.2	26.6	38.2
Dental Student Year 3	72	27.3	22.0	33.1
Dental Student Year 4	34	12.9	9.1	17.5
Residency				
Michigan	165	62.5	56.4	68.4
Out of state	99	37.5	31.6	43.6
Grew Up in CWF Area				
Do not know	16	6.1	3.5	9.7
No	35	13.3	9.4	18.0
Yes	213	80.7	75.4	85.3
Apart from fluorosis, do you think CWF has other adverse effects?				
Yes	34	12.9	9.1	17.5
No	230	87.1	82.5	90.9
Current recommended level of fluoride for CWF systems				
< 0.7 ppm	62	23.5	18.5	29.1
0.7 - 1.2 ppm	189	71.6	65.7	77.0
1.2 - 2.0 ppm	9	3.4	1.6	6.4
> 2.0 ppm	1	0.4	0.0	2.1
No recommended level	3	1.1	0.2	3.3
Knowledge†				
Yes	169	64.0	57.9	69.8
No	95	36.0	30.2	42.1
Correct Response for Optimal Fluoride for CWF†				
Yes	189	71.6	65.7	77.0
No	75	28.4	23.0	34.3

Table 1: *Descriptive statistics for demographic and knowledge variables (N = 264).*

† Computed variables

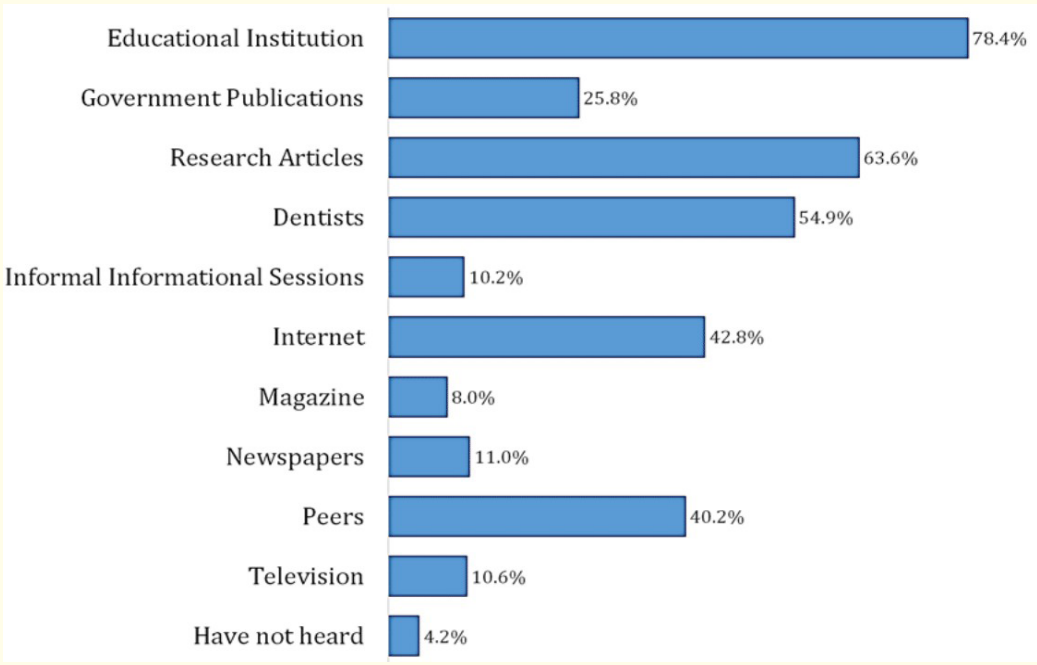

Figure 1: *Source of information regarding benefits and risks of CWF.*

Variable	Knowledge		
	Yes (%)	No (%)	P value
Gender	n = 264		
Female	60.4	39.6	0.18
Male	68.3	31.7	
School	n = 264		
School 1	57.8	42.2	0.06
School 2	69.2	30.8	
Dental Student Year 1	n = 264		
Yes	46.6	53.4	<0.001*
No	70.7	29.3	
Dental Student Year 2	n = 264		
Yes	64.7	35.3	0.89
No	63.7	36.3	
Dental Student Year 3	n = 264		
Yes	73.6	26.4	0.05*
No	60.4	37.6	
Dental Student Year 4	n = 264		
Yes	79.4	20.6	0.05*
No	61.7	38.3	
Residency	n = 264		
Michigan	58.2	41.8	0.01*
Out of State	73.7	26.3	
Grew up in CWF area	n = 248		
Yes	63.8	36.2	0.91
No	62.9	37.1	
Opinion on CWF	n = 256		
Favor	66.0	34.0	0.23
Oppose	33.3	66.7	

Table 2: *Bivariate analysis results for knowledge and demographic and opinion variables.*

** P ≤ 0.05*

In the logistic regression model, students from dental school 1 were less likely than students dental school 2 (OR = 0.52, p = 0.02) to be knowledgeable. Also, students from the first year of dental school (OR = 0.22, p = 0.004) were less likely to be knowledgeable about CWF compared to senior year dental students. Students who were from out of state (OR = 2.24, p = 0.008) and were in favor of CWF (OR = 9.59, p = 0.04) were also more likely to be knowledgeable about CWF compered to others. The results from the logistic regression model are summarized in table 3.

Variable		Odds Ratio	95% CI		P value
			Lower	Upper	
Gender	Male	1.18	0.68	2.06	0.56
	Female	-			
School	School 1	0.52	0.29	0.92	0.02*
	School 2	-			
Year	Dental Student Year 1	0.22	0.08	0.61	0.004*
	Dental Student Year 2	0.48	0.18	1.31	0.15
	Dental Student Year 3	0.79	0.28	2.25	0.65
	Dental Student Year 4	-			
Residency	Out of State	2.24	1.23	4.08	0.008*
	Michigan	-			
Grew up in CWF area	Yes	0.99	0.28	3.46	0.98
	No	1.12	0.26	4.76	0.88
	Do not know	-			
Opinion on CWF	Favor	9.59	1.08	84.95	0.04*
	Oppose	1.62	0.50	52.68	0.79
	Indifferent	-			

Table 3: *Multinomial logistic regression model results for knowledge and demographic and opinion variables.*

** P ≤ 0.05*

When asked about their support for CWF, 69.9 percent and 29.9 percent of dental students overwhelmingly indicated that they strongly favor and favor CWF respectively. Only about 1.1 percent stated that they strongly opposed/opposed CWF. When asked about who should have the authority to make the final call on whether communities should fluoridate, most of the student indicated that health professional should be able to make the call rather than the communities. The results for the opinion questions are summarized in table 4.

Variables	(n)	(%)	95% CI	
			LCL (%)	UCL (%)
What is your opinion on CWF?				
Strongly Favor	174	65.9	59.8	71.6
Favor	79	29.9	24.5	35.8
Indifferent	8	3.0	1.3	5.9
Oppose	2	0.8	0.1	2.7
Strongly Oppose	1	0.4	0.0	2.1
Opinion on CWF†				
Favor	253	95.8	92.7	97.9
Oppose	3	1.1	0.2	3.3
Indifferent	8	3.0	1.3	5.9
Who should have final say in approving CWF in a community?				
Communities	54	20.5	15.8	25.8
Health Professionals	128	48.5	42.3	54.7
Local Government (City/County)	34	12.9	9.1	17.5
State Government / Federal Government	39	14.8	10.7	19.6
Do not have an opinion	9	3.4	1.6	6.4

Table 4: *Descriptive statistics for opinion variables (n = 264).*

† Computed variable

Discussion

In this study, we tried to examine the knowledge and opinion of dental students regarding CWF. There are no recent studies looking at the knowledge, attitudes and opinion of dental students or dentists regarding CWF. A study by Petterson, several decades ago is the only study examining the attitudes of graduating dentists regarding water fluoridation [30]. In our study, we found that most of the students were aware of the optimal levels of fluoride and any adverse effects associated with CWF individually, but when we looked at the "Knowledge" variable, students answering both question the question accurately drops to 64 percent. This shows that there are gaps in knowledge that need to be addressed. A recent study involving dentists also found that they lacked knowledge about CWF to effectively advocate for it [27]. About 23 percent of the students choose 0.7ppm as the optimal level. This might have been due to the confusion about the new fluoride level recommendation [15] that was common knowledge, but had not been officially announced at the time of the survey. Further analysis of the data indicated that this response was more likely to be provided by first and second year dental students, who might have been presented with this information in their public health courses which are taught early in dental school curriculum. The data from this study also indicated that first year dental students were less likely to be knowledgeable about CWF, which is understandable as this survey was conducted when they were in their first term of dental school. Students from "School 2" and those with out of state residency were also more likely to answer the questions correctly. In Michigan, about 92% of the population who use community water systems receive fluoridated water [31]. Due to these high levels of fluoridation in the state, there is not much discussion and activity around CWF in the state compared to other states where CWF is a much discussed public health issue. This could explain why out of state students are more engaged and aware about CWF than Michigan resident students. This might also clarify why "School 2" students are more likely to be knowledgeable about CWF as the school has a higher share of out of state students compared to "School 1". A study by Mork., et al. suggested that individuals supported CWF if they were knowledgeable about the benefits and risks of CWF [21], which is simper to the findings in this study where students who favored CWF were more likely to be knowledgeable than those who were indifferent to or opposed CWF. Since dentists play a critical role in the communities when they go through the process of fluoridating their water systems, it is important that they are not only trained to have sound scientific knowledge of fluorides and CWF but also act as public health advocates for CWF and have the skills to discuss the scientific facts in lay man terms, so their patients can understand the information. This can be accomplished by making changes to the dental school curriculum to provide appropriate public health training to predoctoral dental students.

In the study by Petterson, 72 percent of graduating dentist expressed approval for CWF, which is similar to the 95.8 percent favorable opinion in this study. These results are also consistent with the strong support for CWF by dentists in other similar studies [27,28]. As the number of students opposing CWF was very low (n = 3), bivariate and multivariate analysis were not performed as they would not show any significant difference between student characteristics and support for CWF. When asked about the role in decision-making for CFW, dental students believe that health professionals in the community should have the final say in fluoridation of a community water system. This is contrary to the current law and practice of allowing local governments and communities making that decision at the local level. It is undetermined if the students do not know what the current regulation is, or if they do not agree with the current regulation.

The survey also has a relatively low response rate of 29%. Additionally, all the data in this study is self-reported and is subject to response bias. Participants might have misunderstood question leading to inaccurate responses, especially the questions on optimal fluoride levels. This study's findings reflect the practices and opinions of students attending Michigan dental schools and might not be generalized to others. A survey of dental students at all US dental educational institutions might provide a better understating of the factors influencing the support for community water fluoridation among the future dental workforce.

Conclusion

From this study we can conclude that:

1. A majority of Michigan dental students are knowledgeable about CWF.

2. A gap in knowledge exists and needs to be address in the predoctoral program to train these students be better advocates for CWF in the future.
3. An overwhelming majority of the students are in favor of community water fluoridation.

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Conflict of Interest

The authors have no affiliations with or involvement in any organization or entity with any financial or non-financial interest in the subject matter or materials discussed in this manuscript.

Bibliography

1. "Ten Great Public Health Achievements--United States, 1900-1999". *MMWR. Morbidity and Mortality Weekly Report* 48.12 (1999): 241-243.
2. Pfarrer AM and RL Karlinsey. "Challenges of Implementing New Remineralization Technologies". *Advances in Dental Research* 21.1 (2009): 79-82.
3. CDC. Oral Health: Community Water Fluoridation.
4. McDonagh MS., *et al*. "Systematic Review of Water Fluoridation". *British Medical Journal (Clinical Research Ed.)* 321.7265 (2000): 855-859.
5. Truman Benedict I., *et al*. "Reviews of Evidence on Interventions to Prevent Dental Caries, Oral and Pharyngeal Cancers, and Sports-Related Craniofacial Injuries". *American Journal of Preventive Medicine* 23.1 (2002): 21-54.
6. Griffin SO., *et al*. "Effectiveness of Fluoride in Preventing Caries in Adults". *Journal of Dental Research* 86.5 (2007): 410-415.
7. Griffin SO., *et al*. "An Economic Evaluation of Community Water Fluoridation". *Journal of Public Health Dentistry* 61.2 (2001): 78-86.
8. Ismail AI and RR Bandekar. "Fluoride Supplements and Fluorosis: A Meta-Analysis". *Community Dentistry and Oral Epidemiology* 27.1 (1999): 48-56.
9. Ismail AI and JG Messer. "The Risk of Fluorosis in Students Exposed to a Higher than Optimal Concentration of Fluoride in Well Water". *Journal of Public Health Dentistry* 56.1 (1996): 22-27.
10. Burt Brian A. "Introduction to the Symposium". *Journal of Public Health Dentistry* 55.1 (1995): 37-38.
11. International Association for Dental Research. "International Symposium on Fluorides: Mechanisms of Action and Recommendations for Use". *Journal of Dental Research* 96 (1990): 505-831.
12. US Public Health Service (ed.). Review of Fluoride. Benefits and Risks (1991).
13. Newbrun E. "Effectiveness of Water Fluoridation". *Journal of Public Health Dentistry* 49.5 (1989): 279-289.
14. Council, National Research. Health Effects of Ingested Fluoride. The national Academies Press (1993).

15. Council, National Research. "Fluoride in Drinking Water: A Scientific Review of EPA's Standards". The National Academies Press (2006).

16. Mascarenhas AK. "Risk Factors for Dental Fluorosis: A Review of the Recent Literature". *Pediatric Dentistry* 22.4 (2000): 269-277.

17. Beltran-Aguilar Eugenio D., *et al*. "Prevalence and Severity of Dental Fluorosis in the United States, 1999-2004". *NCHS Data Brief* 53 (2010): 1-8.

18. Cheng KK., *et al*. "Adding Fluoride to Water Supplies". *British Medical Journal (Clinical Research Ed.)* 335.7622 (2007): 699-702.

19. Armfield JM and HF Akers. "Community Water Fluoridation Support and Opposition in Australia". *Community Dental Health* 28.1 (2011): 40-46.

20. Armfield Jason Mathew and Harry Francis Akers. "Risk Perception and Water Fluoridation Support and Opposition in Australia". *Journal of Public Health Dentistry* 70.1 (2010): 58-66.

21. Mork Nathan and Susan Griffin. "Perceived Safety and Benefit of Community Water Fluoridation: 2009 Health Styles Survey". *Journal of Public Health Dentistry* 75.4 (2015): 327-336.

22. Quinonez Carlos R and David Locker. "Public Opinions on Community Water Fluoridation". *Canadian Journal of Public Health* 100.2 (2009): 96-100.

23. Mummery W Kerry., *et al*. "Socio-Economic Differences in Public Opinion Regarding Water Fluoridation in Queensland". *Australian and New Zealand Journal of Public Health* 31.4 (2007): 336-339.

24. Campbell D., *et al*. "Fluoridation--What the Public Know and What They Want". *Australian and New Zealand Journal of Public Health* 25.4 (2001): 346-348.

25. Griffin Marcus., *et al*. "European Citizens' Opinions on Water Fluoridation". *Community Dentistry and Oral Epidemiology* 36.2 (2008): 95-102.

26. Furukawa Sayaka., *et al*. "Associations between Oral Health Behavior and Anxiety about Water Fluoridation and Motivation to Establish Water Fluoridation in Japanese Residents". *Journal of Oral Science* 53.3 (2011): 313-319.

27. Lowry RJ and G Adams. "Attitudes to Water Fluoridation in General Dental Practice in the North East of England". *British Dental Journal* 196.7 (2004): 423-424.

28. Grant SM., *et al*. "New Zealand Dentists' Views on Community Water Fluoridation". *The New Zealand Dental Journal* 109.2 (2013): 69-73.

29. Isman R. "Effects of the Dentist as the Primary Information Source about Fluoridation". *Journal of Public Health Dentistry* 43.4 (1983): 274-283.

30. Petterson EO. "Attitudes Concerning Water Fluoridation among Graduating Swedish Dentists". *Community Dentistry and Oral Epidemiology* 7.2 (1979): 69-74.

31. Michigan Department of Health and Human Services. Michigan State Oral Health Plan (2015).

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