

STATUS OF WATER FLUORIDATION- AN UPDATE FROM THE ASIAN COUNTRIES

Dr.Fawaz Pullishery *, Dr. Ganesh Shenoy Panchmal **, Dr. Sabin Siddique ***,
Dr.Shanavas Palliyal ****

Abstract

Fluoridation of public supplies has been responsible for dramatically improving the oral health of public. The use of optimum levels of fluoride in water is the most cost-effective and the only realistic way of reducing the burden of dental caries. The primary mechanism by which fluoride prevents dental caries is by enhancing the remineralization of incipient "white spot" lesions. By bathing teeth throughout the day with fluoridated water, drinks, and foods, the demineralization of teeth by acids is lessened and remineralization is increased. Many countries of Asia do not have the convenience of a central water supply to which a measured quantity of fluoride can be added in amounts required for optimal effects in reducing caries and preserving teeth. Some of the Asian countries have implemented the fluoridation of water supply and others have either stopped it or never undertaken such actions.

Key words : Water fluoridation, Asia, Dental caries

The influence of water fluoridation on dentition has been known for many decades. The wide spread availability of, first, water fluoridation and later, of fluoride from several dental and food products has been the reason attributed to the continued decrease of caries, especially in the western world. Through decades of research and more than seventy years of practical experience, fluoridation of public supplies has been responsible for dramatically improving the public's oral health. Despite these impressive results the practice of fluoridating community water supplies continues to generate controversy on a unprecedented scale. Opposition still surfaces in some communities when a decision is made to add fluoride to the water supply.

Fluoridation of drinking water began 70 years ago in the United States, and it continues in 60% of public water supplies in the country today.

Much of Australia, Canada, Ireland, and New Zealand have fluoridated water, but most developed non-English speaking countries have rejected this practice as non-beneficial and possibly harmful. Current fluoridating agents, sodium hexafluorosilicate and hexafluorosilicic acid, which replaced sodium fluoride by 1980, differ from the calcium fluoride which is found normally in water, which was the basis for claims of tooth decay prevention in early epidemiologic studies. Studies reported in the past 15 years support only possible slight benefits from water fluoridation for the deciduous teeth of 5-year-old children, although topical fluoride treatments may be effective.¹ Most recently published estimates of population coverage include: USA (64%), Canada (43%), Panama (18%), Republic of Ireland (73%), Australia (61%), New Zealand (61%), Israel (75%), Malaysia (70%), United Kingdom (10%), Singapore (100%), Brazil (41%), Argentina (21%), Chile (40%), Spain (10%), Columbia (80%). Hong Kong is also fluoridated with 100% population coverage. Recently there have been major extensions announced in the USA (particularly California) and Brazil.

Water fluoridation is described as the controlled addition of fluoride to the water supply with the aim of reducing the prevalence of dental caries. Fluoride can also occur naturally in some water

* Senior Lecturer, Department of Public Health Dentistry
Educare Institute of dental sciences, Kerala

** Senior Professor & HOD, Department of Public Health
Dentistry, Yenepoya Dental College, Mangalore

*** Senior Lecturer, Department of Public Health
Dentistry, Yenepoya Dental College, Mangalore

**** Assistant Professor, Department of Dentistry,
Wayanad Institute of Medical Sciences

Correspondence address: drfawazp@gmail.com

supplies. Current estimates are that 370 million people in 27 countries are currently supplied with artificially fluoridated water and 50 million around the world are drinking water which is not artificially fluoridated but fluoride is present naturally. The estimated worldwide total of people supplied with artificially fluoridated water as on April 2011 is 369,656,000 in 27 countries including the United Kingdom, USA, Canada, Brazil, Chile, Fiji, Malaysia, Paraguay, Peru, Panama, Guyana, Guatemala, Irish Republic, Spain, Poland, Serbia, Australia, Singapore, Vietnam, Brunei, China, Hong Kong, Papua New Guinea, Republic of Korea (South Korea), Israel and Libya. In these 27 countries with artificially fluoridated water there are an estimated 18,061,000 people drinking water in which fluoride is present naturally at or around the optimum level. That brings the world wide total consuming optimally fluoride containing water to around 387,717,000. However it should be stressed that in many instances, the naturally occurring fluoride levels is in excess of the optimum—for example in China, India, Argentina, Tanzania, Zambia and Zimbabwe.² This paper will discuss the current status of water fluoridation in some of the countries in Asia.

Status of Water fluoridation in Asia

Traditionally, the burden of dental caries has been low in Asia, but during recent years the prevalence rates have grown markedly among children, adults, and older people. Much of the disease still remains untreated, or teeth are being extracted because of caries. This is particularly the case in low and middle income countries and among poor and disadvantaged population groups. Unfortunately, many countries in Asia have not been able to implement national health programs that use fluoride. The Phan-Ng meeting disclosed important barriers and opportunities to incorporating the use of fluoride. Prevention by the use of fluoride is most cost-effective and the only realistic way of reducing this public health burden. Taking account of the scientific evidence and the 2007 WHO World Health Assembly Resolution

60.17 participants of the meeting confirmed that universal access to fluoride for dental health is a part of the basic human right to health. The statement is strongly supported by the International Association for Dental Research, the World Dental Federation FDI, and the World Health Organization, co-sponsors of the meeting.³ Many countries do not have the convenience of a central water supply to which a measured quantity of fluoride can be added in amounts required for optimal effects in reducing caries and preserving teeth.

China

According to the 3rd National Survey of Oral Health conducted in 2005, China is a country where endemic fluorosis is reported due to water and non-water sources of fluoride in some areas and a considerable dental caries burden in others.^{4,5,6} Guangzhou, the capital city of Guangdong province, had an 18-year experience of water fluoridation. Guangzhou was supplied by tap water mainly from Pearl River and the annual average fluoride concentration was 0.2-0.3ppm before water fluoridation. The water fluoridation project was first implemented in Fangcun District of Guangzhou in July 1965. In November 1965, the project was expanded to the whole urban area of the city with average fluoride concentration of 0.8ppm. Guangzhou Bureau of Health informed Guangzhou Tap Water Company to stop water fluoridation because the caries prevention effect was challenged by the high dental fluorosis in September of 1983. In Guangzhou, the water fluoridation was interrupted during 1976-1978 due to shortage of sodium silico-fluoride. It was resumed only in the Fangcun district of the city and later it was halted in 1983. According to a study conducted the fluoridation reduced the number of cavities, but increased dental fluorosis. As of 2002, there was no water fluoridation in China.⁷ Two major problems were found for the project. First, behindhand equipment and techniques at that time caused inaccurate and fluctuated fluoride concentrations. The actual fluoride concentration

was frequently much higher or lower than the concentration set. Second, the supporters and objectors had different diagnostic criteria and research results on dental fluorosis. Some feasibility studies of water fluoridation had been conducted in China but did not come into reality.⁸

Status in Hong Kong

Fluoridation of drinking water was introduced by the Hong Kong Government in 1961 following international recognition of its effectiveness and safety as a caries preventive measure. Since the introduction of water fluoridation, the prevalence and severity of dental caries has declined in Hong Kong. The Department of Health (formerly Medical and Health Department) had conducted a number of oral health surveys to monitor the oral health conditions of children during the period. Comparing the results of a pre-fluoridation survey done in 1960 and a post fluoridation survey done in 1987, dental caries of children aged 6-11 years, both in the permanent and deciduous dentition, had been greatly reduced. In 1987, after 26 years of water fluoridation, there was a sharp reduction in mean DMFT value in permanent teeth (0.62) and mean DMFT value in primary teeth (2.23) when compared with 1960. The latest Department of Health survey was done in 2001. The result of this territory wide oral health survey showed that the mean DMFT value for Hong Kong's 12-year old students was at a low level of 0.8.

In Hong Kong, water is totally fluoridated at an average level of 0.49 mg/L. Fluoridation is carried out by means of dry feeder using sodium silicofluoride or solution feeder using sodium fluoride. According to statistics on fluoridation of water supplies in Hong Kong 2009/10, the distribution of fluoridated water is estimated to serve a total of 6.968 million people. The cost per person receiving fluoridated water is HK \$ 1.390 per annum.⁹

India

India has endemic zones of high fluoride content in many states; most affected states being Andhra Pradesh, Gujarat, Rajasthan. Out of a total of 609 districts, 220 districts are known to have high fluoride levels in ground water. It has been estimated that about 65 million people (6% of the country's population) are at risk of fluoride toxicity.¹⁰

Water fluoridation extends its benefit to all the residents of the community, so that all social classes benefit without the need for active participation on the part of individuals. However, the following limitations have prevented this effective tool from being used in India.¹¹

The crucial requirement for community water fluoridation is a well established, centralized piped water supply. It is not technically feasible for most of India since only 30% of the population have central piped water supply.¹²

It is also argued that India already has a high concentration of fluoride in drinking water and does not need any community water fluoridation. However, only 6% of the population lives in high fluoride areas or known endemic fluoride belts. About 3% of the population lives in optimal fluoride areas and rest about 90% of population consumes water deficient in fluoride. These results were confirmed by National Oral Health Survey 2002-03 findings, which found that 26.6% of households use water with fluoride levels of 1.5 ppm or more and no more than 6.6% subjects had fluorosis (if questionable fluorosis was excluded).¹³

Unfortunately, water fluoridation has also been a subject of vigorous opposition. Several arguments are put forth against the use of fluorides in any form for caries prevention, such as fluoride destroys muscle structure, muscle function and depletes muscle energy, destroys bone, teeth, RBCs, blood vessels, linings of stomach and intestine causing GI problems and even infertility. Such opposition has been faced in other parts of

the world following reports of association of fluoride with increased mortality, cancer, Down's syndrome, bone fracture, etc. However these claims have been refuted by epidemiologic research amongst humans.¹⁴

Water fluoridation has also suffered at the hands of medical ethics, it being objected to on the grounds of undesirable side-effects and has been termed as a compulsory medication.¹⁵

Israel

The first step towards initiating a water fluoridation program in Israel was taken in 1962 when Mekorot, the National Water Company, prepared a list of the fluoride levels in supplies across the whole country. This showed fluoride levels north of Beer Sheeba to be very low. Like most other countries Israel does not have separate domestic and industrial or agricultural water supplies. By about 2011, about 65% of the municipalities in Israel had agreed to allow fluoridation and there was active opposition to the fluoridation in the towns where it has been instituted. In 2011 the Health and Welfare Committee of Knesset criticized the Health Ministry for continuation of water fluoridation. Fluoridation in Israel has produced striking reductions in the dental caries experience in children. Proposed new schemes would increase the coverage of the percentage of people who receive fluoridated water.¹⁶

Over 5 million people in Israel drink artificially fluoridated water. When some 150,000 people receiving naturally fluoridated water are also taken into account, it means that around 70% of the total population benefit from the protection afforded against tooth decay by optimally fluoride containing water. Major cities served by fluoridation include Jerusalem, Tel Aviv and Haifa.¹⁷

Malaysia

Water fluoridation is a primary prevention initiative for dental caries in Malaysia. Although water supply is the purview of individual states, water

fluoridation is monitored by the MOH nationally. Water fluoridation was first introduced in Malaysia in 1957 in the State of Johor, followed by Penang in 1959 and Sarawak in 1962.¹⁸

This public health measure for prevention of dental caries was accepted as government policy in 1972. Since 1974, the nationwide water fluoridation programme was implemented incrementally. The percentage of population which received fluoridated public water supplies have increased gradually from 62.4% in 2003 to 75.5% in 2009. However, the extent of fluoridation in individual states varied considerably. In most of the states, more than 70% of their population received fluoridated water except Sabah (4.5%), Kelantan (16.1%), Terengganu (58.1%), and Sarawak (64.8%).¹⁹

Singapore

In 1958, Singapore was the first country in Asia to implement a community water fluoridation program covering 100% of its population. With universal coverage via a municipal water supply (there is only one water utility in Singapore, the Public Utilities Board), Singapore does not have to depend on other communal forms of fluoride delivery. Planning and detailing of water fluoridation was undertaken in the mid 1950s. In 1954 the adoption of community water fluoridation was officially approved by the Government. Fluoridation of the municipal water supply commenced on an experimental basis in May 1956, and in January 1958 the entire municipal water supply of Singapore was fluoridated. When water fluoridation was introduced in Singapore, the people accepted it calmly. There were no reports of any referenda or anti-fluoridation activities.²⁰

Indonesia

The pilot project of water fluoridation underwent for 5 years from 1997 until 2002 at South Kalimantan. Prior to the pilot project, the base line data was executed and it was found that the prevalence of dental caries for children aged 12 year was 91.26% with a mean DMFT of 3.02, whereas level

of fluoride in drinking water originated from various sources of drinking/treated water company. Thus, there was a decrease of DMF-T by 0.18, free of caries of 6.98% and no fluorosis detected during 5 years fluoridation of drinking/treated water.²¹

Brunei

The first water fluoridation plant was installed in the Layong water treatment plant, Tutong district, in 1987. Since then, 3 more water fluoridation plants have been commissioned throughout the country. About 95% of the population receives fluoridated water. Currently, all except Tasek Water Treatment Plant provides fluoridated water but Tasek however is expected to supply fluoridated water to the population by June 1997 and as the sole water authority, they provide potable water to 99.9% of the Brunei population.²²

Cambodia

In the 1990s the National Oral Health Plans listed water fluoridation for Phnom Penh as a priority. Initially this was not feasible due to the poor reticulated water system. Today however, the situation has improved so that most of the Phnom Penh populations now have access to safe piped drinking water. The Ministry of Health is currently investigating the possibility of fluoridating the water supply in Phnom.²³

Thailand

Water fluoridation was a pilot project at Bangpakong, Chachoengsao Province in 1991 to evaluate feasibility and effectiveness. The fluoride level was adjusted to 0.7 ppm. Results showed that for children aged 6 to 14 years, dental caries decreased 33.2%. According to National Health Development Plan No. 7, a plan was made to set water fluoridation in Bangkok but it didn't work due to local policy issues. In 1994, the project was set at Nakhonnayok and Prachuap Khiri Khan and was evaluated five years after that. The optimal fluoride level was adjusted to 0.5 ppm. Results showed that dental caries decreased 45.1% and 28.1% in primary teeth and 31.4% and 14.4% in

permanent teeth of 12-year-olds and 15 year olds respectively. The evaluated cost was 12 Baht/person/year. However, water fluoridation in Thailand is no longer conducted.²⁴

Conclusion

Community Water fluoridation has been extensively researched worldwide after its initial project in Grand rapids in the year 1945. Overwhelmingly the conclusion is that the practice is safe, practical, and beneficial to all. The primary mechanism by which fluoride prevents dental caries is by enhancing the remineralization of incipient "white spot" lesions. By bathing teeth throughout the day with fluoridated water, drinks, and foods, the demineralization of teeth by acids is lessened and remineralization is increased. This is a dynamic process, so fluoride needs to be consistently and frequently reintroduced into the oral cavity. Having low concentrations of fluoride constantly present in dental plaque and saliva provides the best protection from caries. The primary and most effective benefit of fluoride is topical on post-erupted teeth. A secondary benefit is systemic and pre-eruptive, strengthening the developing teeth of children under age 8 or 9 years old.

Many Asian countries are facing difficulties in the implementation of water fluoridation as they have lack of centralized water supply. The fall in the incidence of dental caries after the introduction of fluoride into toothpaste formulations, although seen in all social classes, was particularly noticeable in higher social classes; consequently a very marked social-class gradient exists in many other countries. Water fluoridation by public authorities has provoked lot of controversies. Community Water fluoridation is the best and most equitable delivery system for fluoride because all one has to do is drink the water. A more coordinated approach on a community and individual basis seems to be needed regarding water fluoridation to maximize the cost-benefit ratio of prevention.

References

1. Mullen J. History of water fluoridation. *British Dental Journal* 2005; 199(7):1-4.
2. Lowry R. Fluoridation: What the papers say: How does the United Kingdom press treat water fluoridation and does it matter? *British Dental Journal* 2000; 189(1):14-8.
3. Petersen P, Phantumvanit P. Perspectives in the Effective use of Fluoride in Asia. *Journal of Dental Research* 2012; 91(2):119-21.
4. Xiaoqiu Q. The report of third national survey of oral health 2008: People's Medical Publishing House 2008 pp. 62–67.
5. Zhu L, Petersen PE, Wang HY, Bian JY, Zhang BX. Oral health knowledge, attitudes and behaviour of children and adolescents in China. *International Dental Journal* 2003; 53(5):289-98.
6. Petersen PE, Kwan S, Zhu L, Zhang BX, Bian J-Y. Effective use of fluorides in the People's Republic of China--a model for WHO Mega Country initiatives. *Community Dental Health* 2008; 25(4):257-67.
7. 7.Guangzhou Work Group for Water Fluoridation. The dental caries preventive effect of water fluoridation for children. *New Medicine* 1972; 2: 20.
8. Liang S. The water fluoridation in Guangzhou should be evaluated appropriately. *Journal of Dental Prevention& Treatment* 1994; 3:48.
9. Ho T, Wong T, Lo E, editors. Water Fluoridation in Hong Kong. The Workshop on "Effective Use of Fluoride in Asia". 2011 Available : http://www.thaidental.net/fluorideasia/Effective_use_of_fluoridein_asia.pdf.
10. World Health Organization, Geneva . WHO Technical Report Series 846. Fluorides and Oral Health 1994.
11. Tewari A, Kaur N. Fluoride--India does not need water fluoridation--an illusion. *Journal of the Indian Dental Association* 1985; 57(8):285.
12. Tewari A, Sachdev V. Fluoride: is water fluoridation an effective tool for caries prevention? Its feasibility in India. *Journal of the Indian Dental Association* 1985;57(6):203
13. Bali R, Mathur V, Talwar P, Chanana H. National oral health survey and fluoride mapping 2002-2003. New Delhi: Dental Council of India 2004.
14. Whiting P, McDonagh M, Kleijnen J. Association of Down's syndrome and water fluoride level: a systematic review of the evidence. *BMC Public Health* 2001;1(1):6.
15. Anand K, Baridalyne N, Moorthy D, Kapoor S, Sankar R, Pandav C. Ethical issues in public health policy. *National Medical Journal of India* 2002; 15(2):97-100.
16. Kelman A. Fluoridation--the Israel experience. *Community Dental Health* 1996;13(2):42.
17. British Fluoridation Society (BFS): One in a million – the facts about water fluoridation, 3rd ed. [Online] .Available : <http://www.bfsweb.org/onemillion/onemillion2012.html> [2013 Mar 12]

Conflict of Interest: None Declared