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FLUORIDE IN DRINKING WATER: A STUDY ON KNOWLEDGE AND PERCEPTION AMONG RESIDENTS OF SUNGAI BULOH PRISON QUARTERS IN SELANGOR

Khairumi Kasim[1], Shaharuddin Mohd Sham[1*], Zaenal Abidin[2]

[1] Department of Environmental and Occupational Health, Faculty of Medicine and Health Sciences, University Putra Malaysia, Selangor.
[2] Department of Public Health, Bhakti Husada Mulia School of Health, Madiun, East Java

Corresponding author: Shaharuddin Mohd Sham; shaha@upm.edu.my. Department of Environmental and Occupational Health, Faculty of Medicine and Health Sciences, University Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia.

ABSTRACT

Objective: This cross-sectional study aims to determine the relationship between socio-demographical data, knowledge level, and perception level of fluoride in drinking water among residents at Sungai Buloh Prison Quarters Selangor.

Method: A cross-sectional study was conducted among residents at Sungai Buloh Prison Quarters Selangor, by purposive and simple random sampling. A total of 255 respondents participated in this study, and they were required to answer the online questionnaire that consisted of three sections. Then, the data were analysed by using IBM SPSS Statistics 26.

Result: The highest frequency (percentage) of residents at Sungai Buloh Prison Quarters were residents around age 18-64 years old 247(96.9%), male 167(65.5%), tertiary education 155(60.8%) and one to five years lived at study area 82(32.2%). Out of 255 respondents, 247(96.9%) had poor knowledge, and 83(32.5%) had a medium perception towards fluoride in drinking water. Furthermore, chi-square analysis found no association between knowledge level and sociodemographic factors and no association between perception level and sociodemographic factors among residents at Sungai Buloh Prison Quarters Selangor (P-Value > 0.05).

Conclusion: The residents at Sungai Buloh Prison Quarters can further improve their current knowledge and perception level towards fluoride in drinking water by the government's support in providing better education and more awareness specific on fluoride in drinking water.

Keywords: *Fluoride; drinking water; perception; knowledge; health effect*

1. Introduction

Fluoride is a chemical derived from the negatively charged fluorine ion (PubChem, 2022). When negatively charged fluorine ions react with positively charged ions such as sodium ions, they will produce fluoride compounds (American Dental Association, 2021). Fluorine is essential for bone preservation and strengthening, as well as avoiding tooth decay (Unde et al., 2018). But, if fluorine is taken too excessively, it may have the opposite effect, which may cause tooth decay, osteoporosis, and damage to the kidney, bone, nerve, and muscle (Dey & Giri, 2016).

Fluoride may enter the body via a variety of routes, including drinking water, breathing, and food consumption. However, the most important route of human fluoride exposure is via drinking water (Dobaradaran et al., 2009). In Malaysia, fluoridation of water started the fluoridation of water in 1972 to reduce dental caries. On average, 75.7 percent of our country's population is between 20.7 million and receives fluoridated water (Scott, 2017). Fluoride was added into the public water supplies with an average concentration of 1 ppm (part per million), but groundwater may contain much higher fluoride levels (Main, 2015).

In Malaysia, water fluoridation was gazette as a national policy in 1972. This strong collaboration with the government and stakeholders was dramatically improving the piped water supplies in Malaysia, and in 2013, resulted in more than 80% Malaysian population receiving water fluoridation and without noticing the number of Malaysian tooth decay problems was significantly reduced by the time (Water Fluoridation and Oral Health in Malaysia: A Review of Literature, 2021). Malaysia's local government also followed this health's recommendation in 1972 by adding fluoride into public drinking water systems because fluoride may reduce tooth decay cases in this country (Oral Health Division Ministry of Health Malaysia, 2006). In 1957, Johor became the first state to introduce fluoride into their drinking water supplies in Malaysia, followed by other towns in the same state.

Furthermore, scientific research regarding fluoridation of drinking water was conducted in Johor from 1964 until 1976, which had also proved that the addition of fluoride lowered the level of dental caries cases by 60 per cent. Therefore, it is best to add fluoride within the recommended level (Oral Health Division Ministry of Health Malaysia, 2006).

Most of the drinking water came from natural sources that either surface water or groundwater. Most commonly, the water itself may contain minerals and other inorganic compounds, and some of it may be beneficial for consumers. Some of it needs to filter before being consumed as drinking water. Even so, the natural sources themselves may vary in terms of the concentration of fluorides associated with their places. The fluoride concentration in seawater, river and other ground sources may differ due to natural exposure or industrial discharges (World Health Organizations, 2018).

In Selangor is an extensively utilised surface water source as drinking water in Malaysia, derived from Sungai Langat and Sungai Selangor. (Ab Razak et al., 2015). Since the majority area in Selangor are urban area. There are various types of drinking water consumed by the communities which are boiling water, filter water, reverse osmosis, and bottled water. Thus, with this variety of drinking water the contain of fluoride may be disturbance by the process to make the drinking water and will influence the level of fluoride in drinking water that have been recommended by the NSDWQ.

Drinking water is a significant source of human consumption daily, especially for those living in easily accessed areas. But there are various types of drinking water they can access, like boiling water, filter water, and bottled water. The main concern is people consuming drinking water directly on tap water, boiling water because the level of fluoride remains the same even after cooking. Usually, people who drink drinking water directly from tap water are from low-income families that live in urban areas.

Therefore, for some reason, the level of fluoride directly from tap water is not suitable for human consumption because it can cause danger for humans due to some contamination that happens in the distribution system before the water is distributed to the consumer.

Moreover, according to WHO (2018), millions of people suffer from long-term health problems related to fluoride in drinking water. Therefore, the data provided to address the concentration of fluoride level in drinking water and health effects must be up to date or not it will be neglected and unrecognized. Thus, adults play a vital role in knowledge and perception of fluoride in drinking water because their actions can significantly impact children.

2. Materials and Method

This was a qualitative study with a cross-sectional design and was conducted to determine the knowledge and perception of fluoride in drinking water among residents of Sungai Buloh Prison Quarters Selangor. The sampling method used was simple random sampling, where any residents in Sungai Buloh Prison Quarters have the probability of becoming the respondents.

2.1 Sample Size

The sample size was based on a specific objective was the prevalence or one proportion sample size. From a prevalence pilot study, it is observed that a cross-sectional questionnaire survey of a national sample of 517 Australian adults (response rate = 34.7 percent) aged 18-92 years a do cross-sectional questionnaire survey of a national sample of risk perception and water fluoridation support and opposition in Australia (Armfield & Akers, 2010) Therefore, this study's required minimum sample size was 254 after considering a 15% non-response rate, missing data, or un-availability of participants.

2.2 Questionnaire

The study instruments in this research were a questionnaire. The questionnaire consists of open-ended and close-ended questions with three sections which are: Section A: Sociodemographic Characteristics, Section B: Knowledge of Fluoride in Drinking Water and Section C: Perception of Fluoride in Drinking water with using a multi languages which are Malay and English. 21 questions were structured based on similar published literature on knowledge and perception towards the addition of fluoride to drinking water. This online questionnaire was adapted based on the study from Environmental Health Directorate (2012), Wilger et al., (2004), Quinonez & locker (2009), Sabti et al., (2018) and Whyman et al., (2016).

This questionnaire was graded using a percentage score of 50 percent, 51 percent -75 percent, or 76 percent -100 percent for poor, moderate, or good knowledge, respectively (Vanaja et al., 2016). Meanwhile, the perception score was also based on the percentage score obtained by each respondent, which was 10-20 percent, 21-35 percent, 36-60 percent, 61-85 percent, and 86-99 percent for very low, low, medium, high, and very high perception (Jusoh et al., 2015).

2.3 Quality Assurance and Quality Control

On the different population, a reliability test was performed to see if the questionnaire could be understood and to avoid using novel phrases. A reliability test was carried out prior to data collection. Internal consistency was calculated using Cronbach's alpha. Cronbach's alpha values between 0.6 and 1.0 are deemed acceptable. The actual result is 0.7734, indicating that the questionnaire was reliable and acceptable. The study population that took part in the pre-testing represented 10% of the study sample size with similar characteristics. As a result, 25 respondents were chosen to participate in the pre-testing to ensure the reliability of the study's data.

3. Results

This study was conducted among residents at Sungai Buloh Prison quarters. The response rate was 100%, where 255 recruited for the study.

3.1 Sociodemographic Data

Most of the respondents were aged between 18 years old until 64 years old, 247 (96.9%) respondents, of which most of the age population lived there. Meanwhile, more than 64 years old recorded 8 (3.1%) respondents. The result shows that males contributed to the majority, which is 167 (65.5%) respondents were male. Meanwhile, 88 (34.5%) of the respondents represent lesser female than male respondents. Most respondents are in tertiary education, with 155 (60.8%). Next, only 10 (3.9%) is from primary education.

Meanwhile, 86 (33.7%) respondents for secondary education and lastly did not receive any formal education, which is 4 (1.6%) respondents. Most respondents lived in the study area for about one to five years, with 82 (32.2%). Next, about 71 (27.8%) lived less than a year. Meanwhile, for more than ten years, about 54 (21.2%) lived in the study area for about six until ten years 48 (18.8%).

3.2 Knowledge level

Table 2 shows the knowledge items where most of the respondents (n = 178, 69.8%) know about fluoride and 172 (67.5%) respondents have heard and read about fluoride. The main source of respondents had heard and read about fluoride are from electronic media (n = 66, 25.8%). Some respondents had heard or read about fluoride from educational institutions (n = 31, 12.2%), printing media (n = 21, 8.2%) and from friends (n = 20, 7.8%). Majority respondents know about the addition of fluoride in drinking water (n = 114, 44.7%) and the purpose of fluoride in drinking water (n = 115, 45.1%). Respondents believe that using fluoride in drinking water can prevent dental caries and preserve oral health (n = 159, 62.4%), and it can strengthen the bone (n = 45, 17.6%). Only 76 respondents or 29.8% know the optimal level of fluoride in drinking water implemented by the National Standard Drinking Water Quality (NSDWQ). There are 44.3% (n = 113) respondents know the health effect of lack of fluoride in drinking water, and 46.7% (n = 119) know the health effect excessive of fluoride in drinking water. For the health effect excessive of fluoride, 28 (11%) respondents believe it can lead to dental fluorosis. The remaining 10 (3.9%) respondents believe it can lead to skeletal fluorosis, 4 (1.6%) respondents know it can lead to insulin secretion problem and 5 (2%) respondents know it can lead to neural development problem and thyroid gland problem. Only 18 (7.1%) respondents know the health effect from lack of fluoride in drinking water can cause tooth decay, and 7 (2.7%) respondents know it can cause weak bone structure.

Table 1: Sociodemographic background of respondents (N = 255)

Sociodemographic variables		Frequency	Percentage (%)
Age	18-64	247	96.9
	> 64	8	3.1
Gender	Male	167	65.5
	Female	88	34.5
Education level			
Primary level		10	3.9
Secondary level		86	33.7
Tertiary level		155	60.8
Duration lived in study area	Less than a year	71	27.8
	1 to 5 years	82	32.2
	6 to 10 years	48	18.8
	More than 10 years	54	21.2

Table 2: Knowledge of fluoride in drinking water (N = 255)

Knowledge items	Correct (Yes) n (%)
Know about fluoride	
Yes	178 (69.8%)
No/Not sure	77 (30.2%)
Heard or read about fluoride	
Yes	172 (67.5%)
No/Not sure	83 (32.5%)
Source information relate to fluoride	
Print media	21 (8.3%)
Electronic media	66 (25.9%)
Educational institution	31 (12.2%)
Friends	20 (7.8%)
Know about fluoride addition in drinking water	
Yes	114 (44.7%)
No/Not sure	141 (55.3%)
Know the purpose of fluoride in drinking water	
Yes	115 (45.1%)
No/Not sure	140 (54.9%)
Purpose addition of fluoride	
Prevent dental caries	159 (62.4)
Preserve oral health	159 (62.4)
Strengthen bone	45 (17.6)
Know the optimal level of fluoride in drinking water	
Yes	76 (29.8%)
No/Not sure	179 (70.2%)
Know the health effect of fluoride deficiencies	
Yes	113 (44.3%)
No/Not sure	142 (55.7%)
Know the health effect related to excessive fluoride	
Yes	119 (46.7%)
No/Not sure	136 (53.3%)
Health effects due to excessive fluoride	
Dental fluorosis	28 (11%)
Skeletal fluorosis	10 (3.9%)
Insulin secretion problem	4 (1.6%)
Neural development problem	5 (2.0%)
Thyroid gland problem	5 (2.0%)
Health effects due to fluoride deficiencies	
Weak bones structure	7 (2.7%)
Tooth decay	18 (7.1%)

Results shows majority of respondents in this study has poor knowledge about fluoride (n = 247, 96.9%). Only 8 respondents (3.1%) have moderate knowledge.

3.3 Perception level

Table 3 shows that most respondents use filter water as the primary source of drinking water (n = 134, 52.5%), consume tap water from the drinking water supply (n = 60, 23.5%), and consume drinking water from store-bought bottled water (n = 58, 22.7%). They choose their source of drinking water because of the taste, smell, and color of the drinking water (n = 32, 12.5%), to guarantee the safety of drinking water consumption (n = 10, 3.9%), and it can save money and time (n = 27, 10.6%).

Table 3: Distribution perception of fluoride in drinking water (N = 255)

Perception items	Correct (Yes) n (%)
Use filter water	134 (52.5%)
Consume tap water from the drinking water supply	60 (23.5%)
Consume drinking water from store-bought bottled water	58 (22.7%)
The taste, smell, and color of the drinking water	32(12.5%)
To guarantee the safety of drinking water consumption	10 (3.9%)
Save money and time	27 (10.6%)
Addition of fluoride in public drinking water supply safe	
Yes	103 (40.4)
No	152 (59.6)
Addition of fluoride in the public drinking water supply is effective	
Yes	96 (37.6)
No	159 (62.4)
Addition of fluoride can help prevent tooth decay	
Yes	124 (48.6)
No	131 (51.4)
Addition of fluoride in drinking water	
Yes	111 (43.5)
No	144 (56.5)

Only 103 (40.4%) respondents believe the addition of fluoride in drinking water is safe, and 96 (37.6%) of them stated the effectiveness of fluoride in the drinking water supply. Respondents believed that fluoride could help prevent tooth decay (n = 124, 48.6%) and into the addition of fluoride in drinking water (n = 111, 43.5%).

Most respondents from Sungai Buloh Prison Quarters have a medium-level perception of fluoride in drinking water (n = 83, 32.5%). There are 81 (31.8%) respondents have a low level of perception, and 73 (28.6%) respondents, have a very low level of perception. Meanwhile, the remaining 18 (7.1%) respondents have a high-level perception of fluoride in drinking water.

3.4 Association knowledge level and sociodemographic factors

Chi-square was conducted to determine the association between level of knowledge and sociodemographic factor. Based on Table S1 in supplementary materials., none of the sociodemographic factors and level of knowledge is significant. The p-value of each item is $p > 0.05$.

3.5 Association perception level and sociodemographic factors

Table S2 in the supplementary materials shows no association between level of perception and sociodemographic factor. None of the sociodemographic factors and level of knowledge is significant. The p-value of each item is $p > 0.05$.

4. Discussion

4.1 Sociodemographic

In total, 255 respondents who participated in the survey show that most of them aged between 18 to 64 years old, male, have tertiary education level, and lived in Sungai Buloh Prison Quarters one until five years. The majority of respondents (96.9%) were between the ages of 18 and 64, with 247 (96.9%) being over the age of 64, while 8 (3.1%) were over the age of 64.The age group of the Malaysian population was based on data from the Department of Statistics Malaysia in 2021, which shows that 22.7 million (69.6 percent) of Malaysians were dominated by the age group of 18-64 years old, with only 2.4 million belonging to the elderly age group more than 64 years old (7.4%).

Male respondents made up the majority of those who took part in this survey, with 167 (65.5%) compared to 88 (34.5%) female respondents. A study conducted by Sham et al., (2018) a total of 67 participants, all of whom were 14 years old consist with 36 responders (53.7 percent) were male, while 31 were female (46.7 percent). In addition to this, the result of this study also aligns with Sadasivam et al., (2021) males made up 58.88 percent of the participants, while females made up 41.12 percent.

Furthermore, the majority of them had more than 12 years of education, which is consistent with this study, which found that the majority of respondents in this survey were in or graduated from tertiary education level by 155 (60.8 percent) among the rest of the respondents' educational level categories. According to this study, higher education graduates of Sungai Buloh Prison Quarters in Selangor have a higher overall knowledge and perception of fluorides.

However, a recent study conducted by Muralidharan and Paul (2018) discovered no significant improvement in fluoride knowledge among fresh graduates and preclinical batch of tertiary education. Following that, the duration of residency revealed that the majority of respondents, 82 (32.2 percent), had been Sungai Buloh Prison Quarters residents for more than one to five years. This will almost certainly result in a slight overestimation of overall fluoride knowledge and perception among different communities or newcomers. In the current study, residents who lived in the study area for a longer period of time scored higher on all levels of knowledge and perception of overall fluorides, with a poor level of knowledge and perception being the most common.

4.2 Knowledge level

In this study, the percentage of residents who showed poor knowledge of fluoride in drinking water was high compared to moderate knowledge. In contrast to this, the majority, 79%, had knowledge of the presence of fluoride in drinking water, 73% were not aware that fluoride

in permissible concentration strengthens the tooth against decay, and 68% of people were not aware of the presence of fluoride in the foods they consumed (Knowledge, Attitude, and Practice of Parents about Dental Fluorosis in their Children, 2018).

In this study, most residents know about fluoride in drinking water from their read or heard. In addition, most of them received information from electronic media, educational institutional, Print media, and friends. According to Lowry et al. (2021), one-third of respondents (283/761, 37%) had read or heard about fluoridation in the previous 12 months from local newspapers, followed by dental practises, and a significant minority believed that their water supply was already fluoridated.. Correspondingly to Shearer & Mitchell (2021), electronic media access to information has become quick, cheap, and simple to implement. Electronic media devices such as personal computers, smartphones, digital radio, and television can read digital content.

One of the most popular forms of electronic media is presenting information on hypermedia websites via the global Internet network. Therefore, the percentage of respondents who had heard or read fluoride from electronic media sources is the highest of other information sources. In addition, in 2013, 80 per cent of the population received water fluoridation as a result of strong collaboration among stakeholders and the extensive network of piped water supplies. Still, in 2018 due to the end of water fluoridation in Pahang, the coverage fell to 74.1 percent because lack of funding, weak legislation, the use of reverse osmosis water filtration systems, the difficulty of maintaining an optimal level of fluoride in the water, a lack of local data on the impact of Water

Fluoridation cessation on oral health and cost-effectiveness were some of the significant challenges in Water Fluoridation (Faizah et al., 2020). Thus, in this study, only some people know about the purpose and addition of fluoride in drinking water due to the significant challenges of water fluoridation in Malaysia. MS et al., (2017) have shown that consuming high fluoride levels from unregulated or untested sources can cause dental fluorosis, characterized by brownish mottling of the teeth in its most severe form. Some participants in both groups, dentists and medical practitioners, believed that fluoride could have adverse effects on general human health, cause allergies in some people, have a negative impact on human bones, cause cancer in humans, cause neurological side effects, and be environmentally expensive (Sabti et al., 2019).

Furthermore, the World Health Organization (WHO) supports and recommends community water fluoridation because it is cost-effective in preventing tooth decay for both families and the health care system (Griffin et al. 2001). Despite having limited knowledge about the status of water fluoridation in Kuwait, approximately 77 percent of both dentists and medical practitioners believed that water supplies in Kuwait should be fluoridated (Sabti et al., 2019). Despite the fact that numerous scientific studies have been conducted to demonstrate the effectiveness of fluoride in preventing oral and skeletal-related diseases through its addition to the drinking water system, there are still many opposing opinions and beliefs that do not support water fluoridation. According to

Seymour et al. (2015), there has been an increase in anti-fluoridators who choose to remove fluoride from their drinking water. According to the previous study, Fluorida County needed to reverse its decision to discontinue fluoridation entirely and fluoridate them again in 2013 due to public opposition to fluoridation in 2011. (Pinellas County Utilities, 2017). Furthermore, the Fluoride Action Network (FAN) is one of many organisations actively opposing the addition of fluoride to drinking water (Fluoride Action Network, 2021). Thus, it is critical to conduct this type of research because there are numerous rumours about fluoride use, and anti-fluoride groups may be able to disprove the rumours by clarifying the situation with scientific knowledge and source references.

4.3 Perception level

The residents of Sungai Buloh Prison Quarters primarily used a filtered water system as their

primary drinking water source, followed by tap water. Only a few of them drink bottled water purchased from a store. This is because they believe it is safe for them to consume drinking water from their preferred drinking water source. A study was conducted in Mexico, where the majority of the population chose to drink water from readily available bottled water and filtered water systems. The unpleasant taste, cloudy appearance of the water, and foul odour of the water led them to believe that the municipal drinking water supply in their country was unsafe to use as a drinking water supply to be consumed.

Furthermore, due to corroded pipes, an air conditioning system, poor infrastructure, and possibly agricultural contamination, the Latina population claimed that using a filtered water system at their home was necessary due to their water supply appearing unclean and unsafe to drink. As a result, consumers will be sceptical of the municipal drinking water supply provided by the municipality (Scherzer et al., 2010). According to Azlan et al. (2011), in their study conducted in Malaysia's Peninsular, tap water was first treated at the drinking water treatment plant before being released to the public for consumer use to ensure the parameters of the drinking water were within the permissible limit based on the Malaysian Drinking Water Standards implemented by the Ministry of Health (MOH). As a result, the drinking water was safe to drink without any treatment. However, the water can become contaminated due to old and corroded plumbing pipes, causing the drinking water to lack the physical properties (taste, smell, and colour) that it should have before reaching consumers. As a result, Malaysians were willing to spend hundreds of ringgits on a filtered water system for their home in order to ensure the safety of their drinking water consumption (Mat Salleh, 2007).

Most Malaysians placed less emphasis on other important parameters in ensuring water quality, such as fluoride concentration in drinking water, and more emphasis on physical properties such as taste, smell, and clarity of the water (Bahari et al., 2018; Mat Salleh, 2007). However, the majority of respondents in this study have a medium perception of fluoride in drinking water. This is because they agreed and supported the addition of fluoride to drinking water as a health benefit, such as effective prevention and treatment of developing dental caries, particularly in younger children. According to Gussy et al. (2008), fluoride exposure may have a protective effect and reduce the risk of dental caries from fluorides in drinking water as well as fluoridated oral products such as fluoridated toothpaste.

Furthermore, according to the study's findings, 74 percent of parents agreed that fluoride could help prevent tooth decay in their children. Fluoride was proven to be one of the most significant achievements in public health in the twentieth century because it was effective in preventing and controlling dental caries problems, particularly among young schoolchildren (The Story of Fluoridation | National Institute of Dental and Craniofacial Research, 2018). Despite the fact that numerous scientific studies had been conducted to demonstrate fluoride's effectiveness in combating dental caries, there were still some negative aspects or perceptions about drinking water fluoridation. The Fluoride Action Network (FAN) is he most well-known organisation actively opposing the addition of fluoride to the public drinking water supply. Their goal, according to them, is to educate the public about the fluoride toxicity effect that most people and governments overlook, which is more than just treating tooth decay problems (Fluoride Action Network | About FAN, n.d.).

In agreement with Connett (2004), he identified the reasons for disagreement on drinking water fluoridation. One of the reasons was that fluoride intake was difficult to control once fluoride was added to drinking water because different people drank different amounts of water. People with chronic illnesses, such as diabetes patients, athletes, and common labourers, for example, drank more water than the average person, potentially exposing them to an excessive amount of fluoride. Furthermore, he stated that fluoride was not the only source of fluoride, but that fluoride can be found in a variety of places that may cause an excessive dosage of fluoride intake daily, such as tea drinks and

toothpaste. Fluoride is abundant in tea beverages, particularly brewed black tea, which contains approximately 3 to 4 ppm of fluoride (Izuora et al., 2011). According to the study conducted by Lung et al., black tea has the highest amount of fluoride infused than other types of tea (2008). A person who consumes a lot of tea 63 drinks in a day may be more likely to develop dental or skeletal fluorosis (Tokalolu et al., 2004).

4.4 Association between knowledge and perception level towards sociodemographic factors

According to the findings of this study, the sociodemographic characteristics of age, gender, educational level, and residential duration had no significant association with knowledge level. Knowledge is an important factor in determining one's behaviour. One of the degrees of knowledge is application; if someone reaches this level, his knowledge will be used or applied in accordance with well-established principles (Efendi & Makhfduli, 2009).

The sociodemographic characteristics of age, gender, educational level, and residential duration were found to have no significant association with perception level in this study. Perhaps this is because the perception items were not specific enough to describe the respondents' personal opinion regarding the fluoridation of the drinking water supply, as determining perception and knowledge involved extracting the public's subjective rather than objective aspects or views about fluoride in drinking water. Aside from that, it is possible that the respondents were unaware of the fluoride addition to the public's drinking water system, which prevented them from clarifying or voicing their opinions on the subject through this research..

5. Conclusion

In conclusion, the population at Sungai Buloh Prison Quarters has access to fluoride in drinking water. Still, they have low knowledge and moderate perception of fluoride in drinking water due to limited access to sources of information that are more specific on fluoride. They only know fluoride from toothpaste advertisements and ingredients lists. Although there is low knowledge, it can be improved further by a good propagation of policies and measures by the government that can also help the residents enhance the perception of fluoride in drinking water. The program's availability and easy access are required to assure its cost-effectiveness, safety, and advantages, improve oral health, and increase the population's quality of life. The findings from this study should inspire government authorities to promote existing fluoride in drinking water even more.

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Supplementary

Table S1 Association between knowledge and sociodemographic factors of fluoride in drinking water

Table S2 Association between the level of perception and sociodemographic factors of fluoride in drinking water

Table S1: Association between knowledge and sociodemographic factors of fluoride indrinking water (N=255)

Sociodemographic Characteristic		**Low** Frequency (%)	**Moderate** Frequency (%)	**Good** Frequency (%)	Expected count	p value
Age (years)	18 – 64	239 (96.8)	8 (100)	0	0.268	1.0 [b]
	> 64	8 (3.2)	0	0		
					0.268	1.0 [b]
Gender	Male	160 (64.8)	7 (87.5)	0	1.770	0.269 [b]
	Female	87 (35.2)	1 (12.5)	0	1.770	0.269 [b]
Education level	Primary education	10 (4)	0	0	0.914	0.820[b]
	Secondary education	84 (34)	2 (25)	0	0.914	0.820 [b]
	Tertiary education	149 (96.1)	6 (75)	0	0.914	0.820 [b]
	No formal education	4 (1.6)	0	0	0.914	0.820 [b]
Duration lived at study area	Less than a year	70 (28.3)	1(1.4)	0	4.110	0.258 [b]
	1 – 5 years	78 (31.6)	4(50)	0	4.110	0.258 [b]
	6 – 10 years	48 (19.4)	0	0	4.110	0.258 [b]
	More than 10 years	51 (20.6)	3(37.5)	0	4.110	0.258 [b]

b = Fisher Exact Test, * p-value is significant at p< 0.05

Table S2: Association between the level of perception and sociodemographic factors of fluoride in drinking water

Sociodemographic Characteristic		**Very low** Frequency (%)	**Low** Frequency (%)	**Medium** Frequency (%)	**High** Frequency (%)	Expected count	p value
Age (years)	18 – 64	71 (97.3)	79(97.5)	80(96.4)	17(6.9)	0.566	0.779 [b]
	>64	2(2.7)	2(2.5)	3(3.6)	1(5.6)	0.566	0.779 [b]
Gender	Male	54(74)	56 (69.1)	48(57.9)	9(50)	6.866	0.076 [b]
	Female	19(26)	25 (30.9)	35(42.2)	9(50)	6.866	0.076 [b]
Education level	Primary education	4(5.5)	4(4.9)	2(2.4)	0	13.279	0.164 [b]
	Secondary education	23 (31.5)	31 (38.3)	22(26.5)	10 (55.6)	13.279	0.164 [b]
	Tertiary education	45 (61.6)	43 (53.1)	59(71.1)	8(44.4)	13.279	0.164 [b]
	No formal education	1(1.4)	3 (3.7)	0	0	. 13.279	0.164 [b]
Duration lived in the study area	Less than a	18 (24.7)	26 (32.1)	22(26.5)	5(27.8)	2.876	0.969 [b]
	1 – 5 years	23 (31.5)	28 (34.6)	25(30.1)	6(33.3)	2.876	0.969 [b]
	6 – 10 years	14 (19.2)	13 (16)	18(21.7)	3(16.7)	2.876	0.969 [b]
	More than 10 years	18 (24.7)	14 (17.3)	18(21.7)	4(22.2)	2.876	0.969 [b]

b = Fisher Exact Test, * p-value is significant at $p < 0.05$