Knowledge and Perception of Fluoridated Drinking Water Among Public in Kulaijaya, Johor

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ABSTRACT

Fluoride is an ionized form of the fluorine element which is can be found naturally in water bodies and fluoride is also being added into the drinking water supply to prevent and control tooth decay problems, especially among younger children. The purpose of this study is to determine the level of knowledge and perception about fluoride in drinking water among respondents. A cross-sectional study was conducted among 243 respondents who lived in Kulaijaya, Johor by convenience sampling method. They were required to answer an online questionnaire that consisted of three (3) sections, namelysocio-demographic characteristics, knowledge of fluoride in drinking water, and perception of fluoride in drinking water. Most (185 – 76.1%) of respondents were 18 to 64 years old and133 (54.7%) of them were female. Majority of them (153 – 63%)achieved tertiary education level and most (153 – 63%) lived for more than 10 years in the same location. The majority of respondents had poor knowledge level (164 - 67.5%) and a high perception level of fluoride in drinking water (83 - 34.2%). There was an association between educational level and knowledge level (x2=32.19, p-value = 0.000) while, there was no association found between socio-demographic factors (age, gender, educational level, and residential duration) and the public's perception level of fluoride in drinking water.The local government is encouraged to collaborate with other agencies to implement more fluoridation programs to the public to raise awareness of water fluoridation as knowledge level have positive significance with the education exposure (p=0.000).

Keywords: Fluoride, Knowledge, Perception, Drinking Water.

INTRODUCTION

Fluoride is an ionized form of fluorine element. Fluoride is produced from the reaction between the negatively-charged fluorine with the positively-charged ion such as sodium (How Fluoride Fights Cavities - American Dental Association, 2021). Fluoride can be found commonly in natural water bodies, which are in both salt water and fresh water such as the ocean and the lakes. A high concentration of fluoride in natural water bodies is usually linked with the natural volcanic activities that occur in certain regions (Kitalika *et al.*, 2018.

In Malaysia, community water fluoridation was first implemented in 1972, and the addition of fluoride in community drinking water has significantly reduced the dental carries problems among the local population (Oral Health Division Ministry of Health Malaysia, 2006).

Still, several health risks may result from fluoride consumption based on previous scientific research. Unsafe levels of fluoride consumption can cause deleterious health effects to humans such as dental and skeletal fluorosis, insulin secretion problem, neural

problem, and thyroid gland problems (San *et al.*, 2016). Fluoride exposure during the early years of tooth development may disrupt enamel mineralization, resulting in greater gaps in the degree of crystallinity, disproportionate protein retention, and higher porosity (Aoba and Fejerskov, 2002). Another study found that a high dose of fluoride exposure had detrimental effects on children's learning and development qualities (Shivaprakash, Ohri and Noorani, no date). The higher the fluoride consumption, the lower the level of intelligence among youngsters, emphasizing that fluoride concentration is strongly linked to intelligence in developing children (Duan *et al.*, 2018).

According to National Standard for Drinking Water Quality of Malaysia, the standard level for fluoride in drinking water is 0.4-0.6 mg/L (Engineering Services Division, Ministry of Health, 2010) while, the fluoride concentration standard enforced by the World Health Organization (WHO) is 1.5 mg/L.

Although there are many scientific research that had been conducted by scientists regarding the usage of fluoride's goodness and adverse effects, the message or the information from the research papers may not be able to reach most of the public, especially for those who are not exposed to academia. If they are not informed about fluoride usage, it may lead to misunderstandings and misconceptions about fluoride. Falsifying information and unverified concerns about water fluoridation are serious public health concerns, as fluoridation is frequently based on the results of community consultations with medical practitioners (Melbye and Armfield, 2013). Bahari *et al.* (2018), stated that many Malaysians were still not aware of fluoride in drinking water at optimal concentration. Besides, there is not much research based on this type of study that has been conducted in Malaysia based on readings on references.

The purpose of this study was to assess knowledge and perception about fluoridated water consumption among the public for identifying and understanding the purpose, benefits, and also disadvantages of fluoride in drinking water.

RESEARCH METHODS

This was a cross-sectional study conducted among the public living in Kulaijaya, Johor by convenience sampling method. Kulaijaya is a district located in the southern part of Johor with a latitude and longitude of 1.6583° N, 103.6060°E. Kulaijaya is chosen as the study location because the large population which has various socio-demographic and educational backgrounds, and knowledge level. A total of 243 respondents participated in this study. Those aged 18 years old and above, and lived in Kulaijaya, Johor were invited to participate in this survey. Participation was voluntary. Residents who were mentally unstable and foreigners were not allowed to participate in this study.

Data Collection

A pre-test was conducted 10% of the sample size before the actual study to ensure that respondents understand the questions provided and to check the internal reliability of the questionnaire. The pre-test yielded a Cronbach's Alpha score of 0.77, indicating a reliable value for internal reliability.

The research instrument was a close-ended questionnaire that was distributed to the respondents via various online platforms such as Instagram, Facebook, and WhatsApp. It consisted of three (3) sections which were socio-demographic characteristics, knowledge of fluoride in drinking water, and perception of fluoride in drinking water. The questionnaire was prepared in two different languages, English and Malay.

The questionnaire consisted of closed-ended questions and the respondents need to answer 'yes', 'no' or 'not sure' for the provided questions. Correct or 'yes' answers, will be scored as 1, while if the respondents answered the wrong answers, or 'no/not sure' answer, the scoring will be 0. This scoring system is generally used for evaluating the knowledge and perception level among the study population by previous studies (Ab Razak *et al.*, 2016) and (Likert scale and yes/no calculation of one score, 2012).

The knowledge levels are scored as a poor level of knowledge if respondents obtained less than 50 percent of the knowledge scores, while having moderate level of knowledge if respondents obtained 51 to 75 percent of the knowledge scores and 75 to 100 percent of knowledge scores will be categorized as a good level of knowledge among the study respondents (Vanaja *et al.*, 2016).

Meanwhile, the perception levels are scored as a very low perception level if the respondents scored in a range of 10-20 percent of perception scores, low perception level if the respondents obtained 21 to 35 percent of the perception scores, medium perception level if the respondents get 36 to 60 percent of the perception scores, high perception level if the respondents obtained 61 to 85 percent of the perception scores and very high perception level if the respondents scored 86 to 99 percent of the perception scores (Jazimin Jusoh *et al.*, 2015)

Statistical Analysis

IBM SPSS (Statistical Package for Social Science) version 25 was used to analyse the data collected. Statistical analysis used in this study was descriptive analysis to determine the distribution of the socio-demographic characteristics, the knowledge and perception level of fluoridated drinking water consumption among the respondents. Chi-square was used to determine the association between the socio-demographic characteristics and the level of knowledge and perception regarding the fluoride in drinking water.

RESULTS AND DISCUSSION

Socio-demographic Characteristics Distribution of the Respondents

This study involved 243 respondents, aged 18 years old and above, and living in Kulaijaya, Johor. The results in Table 1 showed the distribution of socio-demographic among the public respondents. There were higher percentages of respondents aged 18 to 64 years old when compared to age more than 64 years old. Female respondents had higher percentages than male respondents. Tertiary education level was higher compared to the secondary, primary education levels and respondents who never received any formal education had the lowest percentages of participants. Most (153 – 63%) participants lived more than 10 years in the area. Other categories are those who lived in the range of 6-10 years (39 - 16%), 1 – 5 years (33 - 13.6%) and the least number which was 18 (7.4%) were those who lived there for less than a year.

Table 1
The Distribution of Socio-demographic Characteristics among the Public in Kulaijaya, Johor. (N = 243)

Socio-demographic characteristics (N=243)		n (%)
Age	18 – 64 years old	185 (76.1)
	More than 64 years old	58 (23.9)
Gender	Male	110 (45.3%)
	Female	133 (54.7)
Educational Level	Primary education	4 (1.6)
	Secondary education	83 (34.2)
	Tertiary education	153 (63.0)
	Not received any formal education	3 (1.2)
Residential Duration	Less than 1 year	18 (7.4)
	1 -5 years	33 (13.6)
	6-10 years	39 (16.0)
	More than 10 years	153 (63.0)

Source: Processed Data

The age group of the population in Malaysia was based on the data from the Department of Statistics Malaysia in 2021 shows that 22.7 million (69.6%) of Malaysians dominated by the age group of 18-64 years old than the elderly age group (more than 64 years old) by only 2.4 million (7.4%).

Female respondents were the majority of participants (133-54.7%) compared to 110 (45.3%) male respondents. A study conducted by Scherzer *et al.* (2010), among rural Latino communities dominated by Latina women who have children by 65% than the Latina men's participation. In addition to this, the result of this study also aligns with the study that was conducted by (Blumer *et al.*, 2018) in Israel

where the majority of the respondents were 85% female and 15% were male. Besides, most of them received more than 12 years of educational level which is similar to this study that shows most of the respondents (63%) were graduated from tertiary education level compared to the rest of the educational level categories.

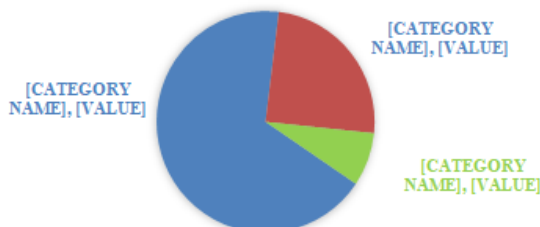**Knowledge of Fluoride in Drinking Water**
The result for the knowledge level is presented in Figure 1. Descriptive analysis was used to obtain the collected data in terms of frequency and percentage to show the public's knowledge level distribution regarding this matter. Table 2 shows the knowledge items used for determining the knowledge level among residents in Kulaijaya.

Based on the findings, most respondents have a poor knowledge level (67.5%), followed by 24.7% with moderate knowledge level and only 7.8% have good knowledge level about fluoride in drinking water.

Figure 2 shows that 71.2% of the respondents knew what fluoride is, and 84.4% have heard or read about fluoride. Electronic media, educational institutions, print media, friends, and not were the options provided as the source of fluoride knowledge. The respondents answered 76.1%, 43.2%, 33.3%, 13.6% and 8.6%, respectively.

From the results of this study, most respondents received information from electronic media, educational institutions, printed media, and friends. According to Shearer & Mitchell (2021), electronic media is the most convenient, quickest, and cheapest way for many people to access a lot of information and also to spread much news. Smartphones, television channels, digital radio, and personal computers are the well-known and most used electronic media devices by a majority of people. Presenting information on hypermedia websites via the global Internet network is one of the most popular forms of electronic

Source: Processed Data

Figure 1
Knowledge Level of Fluoride in Drinking Water
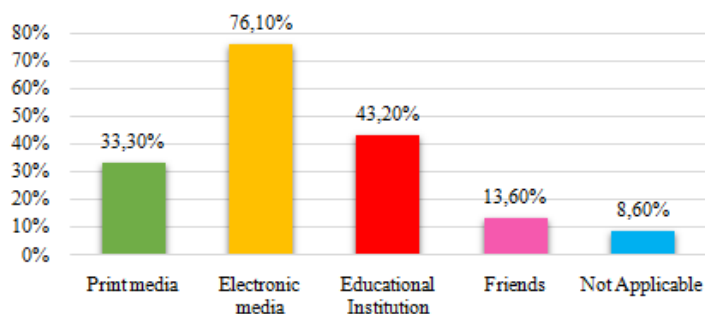
Source: Processed Data

Figure 2
Sources of Fluoride Information

media. Hence, the percentage of respondents who had heard or read about fluoride from electronic media sources is the highest of other information sources.

Based on Table 2, 117 (48.1%) respondents were aware about the addition of fluoride in drinking water, and 128 (52.7%) knew the purpose of the addition of fluoride in drinking water. In addition, 138 (56.8%) respondents agreed that the addition of fluoride can prevent dental carries, 111 (45.7%) knew that fluoride can preserve oral health and 42 (17.3%) agreed that fluoride can strengthen the bones. Only 37 (15.2%) respondents knew the optimum level of fluoride addition in drinking water that stated by the National Standard Drinking Water Quality (NSDWQ). Other than that, only 29 (53.1%) knew that lack of fluoride exposure can cause diseases, while 158 (65%) of them that excessive exposure to fluoride can also cause diseases.

Table 2
The Knowledge Items for Determining the Knowledge Level Among the Residents in Kulaijaya, Johor. (N = 243)

Knowledge Items		n (%)
Do you know what fluoride is?	Yes	173 (71.2)
	No/Not sure	70 (28.8)
Have you heard or read about fluoride before?	Yes	205 (84.4)
	No/Not sure	38 (15.6)
Where did you hear or read about fluoride?	Print media	81 (33.3)
	Electronic media	185 (76.1)
	Educational Institution	105 (43.2)
	Friends	33 (13.6)
	Not applicable	21 (8.6)
Do you know there is an addition of fluoride in your drinking water?	Yes	117 (48.1)
	No/Not sure	126 (1.9)
Do you know the purpose of the addition of fluoride in drinking water?	Yes	128 (52.7)
	No/Not sure	115 (7.3)
What is/are the purpose(s) of the addition of fluoride in drinking water?	Prevent dental caries	138 (56.8)
	Preserve oral health	111 (45.7)
	Strengthen bones	42 (17.3)
	Not sure	66 (27.2)
Do you know the optimal level of fluoride addition in drinking water that is implemented by the National Standard Drinking Water Quality (NSDWQ)?	Yes	37 (15.2)
	No/Not sure	206 (84.8)
Lack of fluoride exposure can cause diseases	Yes	129 (53.1)
	No/Not sure	114 (46.9)
Excessive exposure to fluoride can cause diseases	Yes	158 (65.0)
	No/Not sure	85 (35.0)
What health effects may be caused by excessive levels of fluoride in drinking water?	Dental fluorosis	150 (61.7)
	Skeletal fluorosis	79 (32.5)
	Insulin secretion problem	30 (12.3)
	Neural development problem	31 (12.8)
	Thyroid gland problem	34 (14.0)
	Not sure	72 (29.6)
What are the health effects that may be caused by lack of fluoride exposure in drinking water?	Weak bones structure	75 (30.9)
	Tooth decay	146 (60.1)
	Not sure	77 (31.7)

Source: Processed Data

The health effects may be caused by excessive levels of fluoride in drinking water such as dental fluorosis, skeletal fluorosis, thyroid gland problem, neural development problem, and insulin secretion problem. The respondents answered the survey, 150 (61.7%), 79 (32.5%), 34 (14%), 31 (12.8%) and 30 (12.3%) respectively. Most respondents agreed that excessive exposure to fluoride can cause dental fluorosis. Meanwhile, 75 (30.9%) respondents answered the health impacts that may be caused by lack of fluoride exposure such as weak bones structure, with the majority (146-60.1%) chose tooth decay.

The percentage of respondents who showed poor knowledge level of fluoride in drinking water was highest compared to moderate knowledge and good knowledge level, respectively. In contrast, a study mentioned that the majority (79%) of respondents knew about the presence of fluoride in drinking water, 73% were not aware that fluoride can protect the tooth from decaying as long as the fluoride concentration at the permissible level, and 68% did not have the knowledge of fluoride which they can get from the foods they ate (Kakti, 2018).

Karim *et al*. (2020), stated that 80 % of the population received water fluoridation as a result of strong collaboration among stakeholders and the extensive network of piped water supplies in 2013, but due to the end of water fluoridation in Pahang in 2018, the coverage decreased to 74.1 % 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, insufficiency of local data on the impact of water fluoridation cessation on oral health and cost-effectiveness were the biggest obstacles in water fluoridation. Therefore, only a few of people know about the purpose and addition of fluoride in drinking water due to the significant challenges of water fluoridation in Pahang. In this study, only a small number of the respondents (19-7.8%) were aware of fluoride in drinking water due to the lack of knowledge exposure about the drinking water fluoridation to the local community. Based on the observations, the local health authority and local media companies are less emphasizing about the fluoride's basic introduction to the public via various kinds of mass media such as commercials on televisions and social media.

A study was conducted by Nurul *et al.* (2017) have revealed that taking high amount of fluoride from non-regulated or uncertified sources can cause dental fluorosis, which is characterised by brownish mottling of the teeth in its most severe form. Some of the respondents from both groups, dentists and medical practitioners, were aware that fluoride could have deleterious effects on general human health, causing 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 water fluoridation and recommends it politically and technically feasible because community water fluoridation is cost-effective in preventing tooth decay for both families and the health care system (Griffin, Jones and Tomar, 2001).

Ministry of Health (MOH) Malaysia implements and monitors the safe level of fluoride addition in drinking water throughout Malaysia based on the National Standard Drinking Water Quality (NSDWQ) (Blumer *et al.*, 2018). The public needs to convince the local government in providing fluoridation at a safe level into the drinking water supply in order to preserve oral health by preventing and controlling dental caries problems in this country.

There were 138 (56.8%) and 111 (45.7%) respondents, respectively, who thought that fluoridated drinking water helps to prevent dental caries and maintain oral health. Caries, according to Fejerskov et al. (2015), is among the most frequent oral cavity disorders, affecting the cementum, dentin, and enamel of the teeth. Unfortunately, the majority of the respondents in this study were ignorant of fluoride's importance in bone building. The term was only known by 42 (17.3%) of the respondents. Another outcome in our study was that 146 (60.1%) of respondents said teeth decay is known to occur if there is a deficiency of fluoride exposure, compared to 75 (30.9%) who said bone structure weakness is another likely effect. This information on

fluoride deficiency is useful because it has been demonstrated that in 2013, a large improvement in Malaysia's piped water supply resulted in more than 80 percent of Malaysians obtaining fluoridated drinking water, which considerably reduced tooth decay concerns over time (Karim *et al.*, 2020).

The Association Between the Socio-demographic Characteristics and Knowledge Level of Fluoride in Drinking Water
Based on the result shown in table 3, the educational level shows an association between the socio-demographic characteristics (educational level) and the knowledge level among the residents in Kulaijaya, Johor (x^2=32.19, p-value = 0.000).

Based on the result of this study, it is shown that the socio-demographic characteristics (age, gender, and residential duration) had no association with knowledge level. Meanwhile, educational level, which was one of the socio-demographic factors, showed an association with knowledge level of fluoride in drinking water. Blumer et al. (2018), revealed that fathers (84%) and mothers (88%) who had higher education level were aware of the benefits and in favour of fluoride intake from drinking water by 37%. Besides, the authors also stated that mothers' educational levels were related to knowledge of water fluoridation (p = 0.027, Pearson Chi Square). Knowledge is a critical aspect in determining one's behaviour.

Table 3
Association Between Socio-demographic Characteristics and Knowledge Level of Fluoride in Drinking Water (N=243)

Socio-demographic characteristics Poor (N=164)		Knowledge Level (%) N = 243			X^2	p-value (p<0.05)
			Moderate (N=60)	Good (N=19)		
Age	18-64 years old	122 (74.39)	50 (83.33)	13 (68.42)	2.61	0.258[b]
	More than 64 years old	42 (25.61)	10 (16.67)	6 (31.58)		
Gender	Male	81 (49.39)	21 (35.0)	8 (42.11)	3.76	0.153
	Female	83 (50.61)	60 (65.0)	11 (57.89)		
Educational Level	Primary education	3 (1.83)	1 (1.67)	0 (0)	32.19	0.000[b*]
	Secondary education	74 (45.12)	9 (15.0)	0 (0)		
	Tertiary education	84 (51.22)	50 (83.0)	19 (100.0)		
	Not received any formal education	3 (1.83)	0 (0)	0 (0)		
Residential Duration	Less than 1 year	11 (6.71)	6 (10.0)	1 (5.26)	10.03	0.126[b]
	1-5 years	20 (12.20)	12 (20)	1 (5.26)		
	6-10 years	25 (15.24)	13 (21.67)	1 (5.26)		
	More than 10 years	108 (65.85)	29 (48.33)	16 (84.21)		

b = Fisher Exact Test

*p-value is significant if p<0.05
Source: Processed Data

Knowledge has numerous degrees, one of which is application; if someone reaches this level, his knowledge will be utilised or applied in line with well-established principles (Efendi and Makhfduli, 2009).
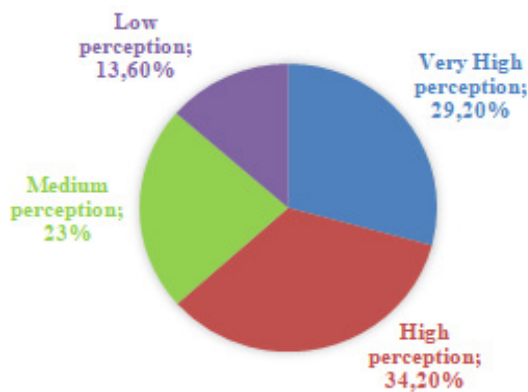
Perception of Fluoride in Drinking Water
The result for the perception level is presented in Figure 3 shows the percentage of public perception level distribution regarding this matter. Table 4 shows the perception items used in the survey.

Based on Figure 3, most of the respondents have high perception level which is 83 (34.2%), followed by 71 (29.2%) scoring at a very high perception level, 56 (23%) scored medium perception, 33 (13.6%) having low perception level and none (0%) having very low perception level about fluoride in drinking water.

Figure 4 shows that most respondents (113 - 46.5%) used filtered water as the main source of drinking water, 111 (45.7%) of them use tap water and only 19 (7.8%) use store-bought bottled water. Most of them (212 - 87.2%) agreed that, to guarantee the safety of the drinking water consumption, while 122 (50.2%) agreed that the reason for choosing their main drinking water source is because of the taste, smell, and colour of the drinking water, and only 95 (39.1%) agreed for it can save money and time (based on Figure 5).

Source: Processed Data

Figure 3
Perception Level of Fluoride in Drinking Water
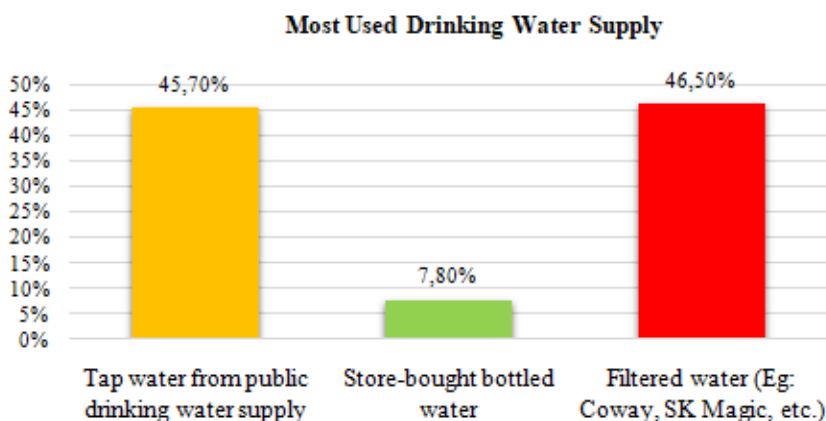
Source: Processed Data

Figure 4
Most Used Drinking Water Supply

Table 4
The Knowledge Items for Determining the Knowledge Level Among the Residents
**in Kulaijaya, Johor. (N = 243)**

Perception Items		n (%)
What is your most commonly used source of drinking water?	Tap water from the public drinking water supply	111 (45.7)
	Store-bought bottled water	19 (7.8)
	Filtered water (Eg: Coway, SK Magic, etc.)	113 (6.5)
State the reason for your choice of the drinking water source	The taste, smell, and color of the drinking water	122 (50.2)
	Save money and time	95 (39.1)
	To guarantee the safety of the drinking water consumption	212 (87.2)
Do you think that the addition of fluoride to the public drinking water supply is safe?	Yes	141 (58.0)
	No/Not sure	102 (42.0)
Do you think that the addition of fluoride to the public drinking water supply is effective?	Yes	135 (55.6)
	No/Not sure	108 (44.4)
Do you think that the addition of fluoride to the public drinking water supply can help prevent tooth decay?	Yes	168 (69.1)
	No/Not sure	75 (30.9)
Are you into the addition of fluoride in drinking water?	Yes	159 (65.4)
	No/Not sure	84 (34.6)

Source: Processed Data

According to past research, 48 percent of people in Western Newfoundland, Canada, utilized water filters in their homes (Ochoo, Valcour and Sarkar, 2017). This is because they believe it is safer to drink from their preferred drinking water source. A study conducted in Mexico was also align with this research where the majority of the population chose to use readily bottled water and filtered water system as their main source of drink water. The unpleasant taste and smell as well as the cloudiness of the water made them perceive that municipal drinking water supplies in their country was unsafe to use as drinking water. The Latina population also claimed that using a filtered water system in their homes was necessary due to the corroded pipes in their homes, air conditioning system, poor infrastructure, and also from agricultural contamination that made their water supply appear to look tainted and unsafe to drink. Thus, it will make the consumers feel distrust of the local municipal drinking water supply that is provided by the local government (Scherzer *et al.*, 2010).

In contrast, according to Azlan et al. (2011) in their study that was conducted in Peninsular Malaysia, tap water is treated at the water treatment plant first before being supplied to the public for consumption to ensure the parameters of the drinking water are following the permissible limit based on the Drinking Water Standards implemented by the Ministry of Health (MOH) Malaysia. Therefore, the water is safe to consume without any further treatment. However, the water can be contaminated due to out-of-date and corroded plumbing pipes which will make the drinking water not meeting the physical properties (taste, smell, and colour) as it should be before use. Hence, Malaysians are willing to spend hundreds of ringgits for having a filtered water system at their home to ensure the safety of the drinking water consumption (Mat Salleh, 2007).
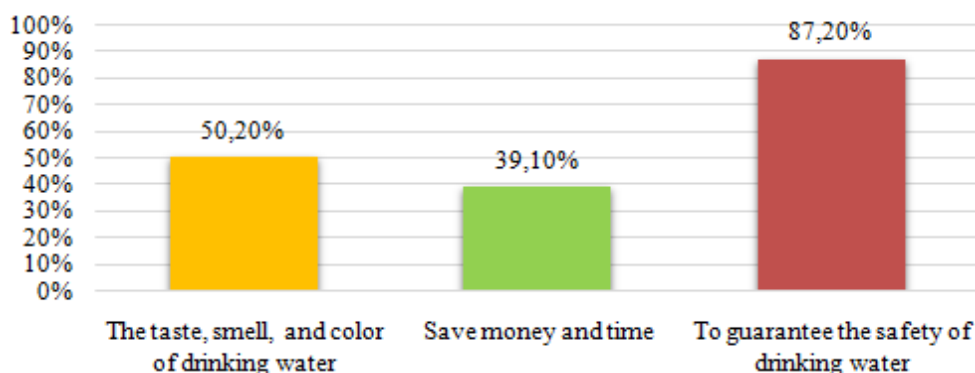
Source: Processed Data

Figure 5
The Reasons for Drinking Water Choices

Most Malaysians were less to emphasize other important parameters in water such as fluoride addition compared to physical properties such as taste, smell, and clarity of the water (Mat Salleh, 2007) (Bahari *et al.*, 2018). However, majority of the respondents in this study shows a high level of perception of fluoride in drinking water. This is because they agreed and supported that the addition of fluoride in drinking water were safe and are effective to prevent dental caries, especially among younger children. Based on the study by (Gussy *et al.*, 2008) the authors stated that exposure to fluoride may give a protective effect and can reduce the chance of getting dental caries from both fluorides in drinking water and fluoridated oral products such as toothpastes. In addition, 74% of parents agreed that fluoride can be helpful in preventing tooth decay among their children based on the findings of the study.

The same cannot be said for The Fluoride Action Network (FAN) which is a well-known group actively going against the idea of adding fluoride into the public drinking water supply. According to them, their aim is to educate the public to be aware of fluoride toxicity effect that most people and government tend to overlook which is more than just treating tooth decay problems (Fluoride Action Network | About FAN, n.d.).

(Connett, 2004) pointed out the reasons to disagree on drinking water fluoridation. One of the reasons was fluoride intake is difficult to control once the fluoride was added into drinking water because different people drank different volumes of water. For example, people who have a chronic illness such as diabetes patients, athletes, and common labourers drank higher volumes of water than the average people which may cause them to be exposed to higher amount of fluoride. Furthermore, he also stated that drinking water was not the sole source of fluoride. Fluoride can also be found in various foodstuff which may cause an immoderate dosage of daily fluoride intake such as from tea drinks and toothpastes. Fluoride can be found in high concentrations in tea beverages especially brewed black tea, which has about 3 to 4 ppm of fluoride (Izuora *et al.*, 2011).

The Association Between Socio-demographic characteristics and Perception Level of Fluoride in Drinking Water

Based on the result shown in Table 5, there was no association between socio-demographic characteristics and perception level among the residents in Kulaijaya, Johor.

In this study, we found out that there was no data that shows any of the socio-demographic characteristics (age, gender, educational level and residential duration) has statistically significant results with the level of perception of fluoride in drinking water. Thus, the null hypothesis was failed to be rejected as it shows there was no association between socio-demographic factors and the perception level. All of the variables were independent variables. Maybe this is because the items of the perception were not specific enough

to describe the respondents' personal opinion regarding fluoridation of the drinking water supply since determining the perception was extracting the public's aspects or views about fluoride in drinking water that were subjective rather than objective. Other than that, it also may be possible due to the respondents not being aware enough of the fluoride addition into the public drinking water system which made them not being able to clarify or voice out their opinions regarding the subject through this research. In contrast, there was a study conducted by (Ochoo, Valcour and Sarkar, 2017), where respondents with a higher education level perceived their water supply as more fulfilling (totally satisfied/very satisfied) compared to those with lower level of education.

CONCLUSION

Majority of residents in Kulaijaya, Johor have a poor level of knowledge regarding fluoride addition in drinking water. In contrast to this, most of the residents have a high level of perception about water fluoridation that was reported in this study. They had positive thinking and were in favour of water fluoridation implementation as they were convinced that the addition of fluoride was safe and effective in fighting tooth decay among younger children. Education level has a significant association with knowledge level (p = 0.000). Thus, educational exposure is vital to the public especially among parents to make them more aware of fluoride intake taken by their children. Hence, diseases caused by lack of fluoride

Table 5
Association Between Socio-demographic Characteristics and Perception Level of Fluoride in Drinking Water (N=243)

Socio-demographic characteristics	Perception Level (%) N = 243					X^2	p-value (p<0.05)
	Very Low (N=0)	Low (N=33)	Medium (N=56)	High (N=83)	Very High (N=71)		
Age							
18-64 years old		27 (81.82)	41 (73.21)	64 (77.11)	53 (74.65)	7.88	0.806
More than 64 years old		6 (18.18)	15 (26.79)	19 (22.89)	18 (25.35)		
Gender							
Male		19 (57.58)	23 (41.07)	31 (37.35)	37 (52.11)	14.94	0.119
Female		14 (42.42)	33 (58.93)	52 (62.65)	34 (47.89)		
Educational Level		1 (3.03)	2 (3.57)	0 (0)	1 (1.41)		
Primary education		16 (48.48)	20 (35.71)	30 (36.14)	17 (23.94)		
Secondary education		16 (48.48)	32 (57.14)	52 (62.65)	53 (74.65)	14.03	0.057[b]
Tertiary education		0 (0)	2 (3.57)	1 (1.20)	0 (0)		
Residential Duration							
Less than 1 year		4 (12.12)	3 (5.36)	4 (4.82)	7 (9.86)		
1-5 years		7 (21.21)	7 (12.5)	11 (13.25)	8 (11.27)		
6-10 years		2 (6.06)	10 (17.86)	16 (19.28)	11 (15.49)	7.15	0.606[b]
More than 10 years		20 (60.60)	36 (64.29)	52 (62.65)	45 (63.38)		

b = Fisher Exact Test

*p-value is significant if p<0.05

Source: Processed Data

such as dental caries and by excessive fluoride exposure cases can be controlled and prevented in this country.

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