



UNIVERSITI PUTRA MALAYSIA

***KNOWLEDGE AND PERCEPTION OF FLUORIDATED DRINKING
WATER AMONG PUBLIC IN KULAIJAYA, JOHOR.***

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**KNOWLEDGE AND PERCEPTION OF FLUORIDATED DRINKING WATER
AMONG PUBLIC IN KULAIJAYA, JOHOR.**

**BY
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ABSTRACT

KNOWLEDGE AND PERCEPTION OF FLUORIDATED DRINKING WATER AMONG PUBLIC IN KULAIJAYA, JOHOR.

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Introduction: Fluoride is an ionized form of fluorine element which is naturally can be found in natural water bodies and fluoride is also being added into the drinking water supply to prevent and control tooth decay problems, especially among younger children. **Objectives:** The purpose of this study is to determine the level of knowledge and perception about fluoride in drinking water and to determine the association of the knowledge and perception level with the socio-demographic characteristics among the public in Kulaijaya, Johor. **Methodology:** A cross-sectional study was conducted among 243 respondents among the public who lived in Kulaijaya, Johor by convenience sampling method. They were required to answer an online questionnaire that consisted of three (3) sections which were the socio-demographic characteristics, knowledge of fluoride in drinking water, and perception of fluoride in drinking water. **Results and Discussion:** Most of the respondents were from age 18 to 64 years old, 185 respondents (76.1%), 133 (54.7%) of them were female, tertiary education level contributed the majority which was 153 (63%) of the respondents and respondents who lived for more than 10 years were counted as many as 153 (63%). The majority of the respondents had a poor knowledge level which is 164 (67.5%) and a high perception level of fluoride in drinking water which is 83 (34.2%). There was an association between the educational level and the knowledge level ($\chi^2=32.19$, $p\text{-value} = 0.000$) while, there was no association showed between the socio-demographic factors (age, gender, educational level, and residential duration) and the public's perception level of fluoride in drinking water. **Conclusion:** The local government is encouraged to collaborate with other agencies to implement more fluoride programs to be introduced 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

ABSTRAK

PENGETAHUAN DAN PERSEPSI MENGENAI AIR MINUMAN BERFLUORIDA DALAM KALANGAN ORANG AWAM DI KULAIJAYA, JOHOR.

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Pengenalan: Fluorida adalah bentuk unsur fluorin terion yang boleh didapati secara semula jadi dalam sumber air semula jadi dan fluorida juga ditambah ke dalam bekalan air minuman untuk mencegah dan mengawal masalah kerosakan gigi terutamanya dalam kalangan kanak-kanak. **Objektif:** Tujuan kajian ini adalah untuk mengetahui tahap pengetahuan dan persepsi tentang fluorida dalam air minuman dan untuk menentukan perkaitan tahap pengetahuan dan persepsi dengan ciri sosio-demografi dalam kalangan masyarakat di Kulaijaya, Johor. **Metodologi:** Kajian keratan rentas telah dijalankan di kalangan 243 responden dalam kalangan orang awam yang tinggal di Kulaijaya, Johor dengan kaedah persampelan mudah. Mereka dikehendaki menjawab soal selidik dalam talian yang terdiri daripada tiga (3) bahagian iaitu ciri sosiodemografi, pengetahuan tentang fluorida dalam air minuman, dan persepsi fluorida dalam air minuman. **Keputusan dan Perbincangan:** Kebanyakan responden berumur 18 hingga 64 tahun, 185 responden (76.1%), 133 (54.7%) adalah perempuan, tahap pendidikan tinggi menyumbang majoriti iaitu 153 (63%) responden dan responden yang tinggal selama lebih daripada 10 tahun dikira sebanyak 153 (63%). Majoriti responden mempunyai tahap pengetahuan yang lemah iaitu 164 (67.5%) dan tahap persepsi fluorida yang tinggi dalam air minuman iaitu 83 (34.2%). Terdapat perkaitan antara tahap pendidikan dan tahap pengetahuan ($\chi^2=32.19$, nilai $p = 0.000$) manakala, tidak terdapat perkaitan yang ditunjukkan antara faktor sosio-demografi (umur, jantina, tahap pendidikan dan tempoh kediaman) dan tahap persepsi masyarakat mengenai fluoride dalam air minuman. **Kesimpulan:** Kerajaan tempatan digalakkan untuk bekerjasama dengan agensi lain untuk melaksanakan lebih banyak program fluorida yang akan diperkenalkan kepada orang ramai bagi meningkatkan kesedaran tentang fluoridasi air kerana tahap pengetahuan mempunyai signifikan positif dengan pendedahan pendidikan ($p=0.000$).

Kata kunci: Fluorida, Pengetahuan, Persepsi, Air Minuman

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LIST OF ABBREVIATIONS

WHO	World Health Organization
US EPA	United States Environmental Protection Agency
NSDWQ	National Standard Drinking Water Quality
CDC	Centers for Disease Control and Prevention
TSH	Thyroid-stimulation hormone
T3	Triiodothyronine
T4	Thyroxine
SPADNS	Sodium-2-(parasulfophenyl largo)-1,8-dihydroxy- 3,6-naphtnalene disulfonate

CHAPTER 1

INTRODUCTION

This chapter will discuss the background of the study, the problem statement, the research questions, objectives and hypotheses, conceptual framework, definitions, and limitations.

1.1 BACKGROUND OF STUDY

Generally, 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 widely 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).

Since the early 20th century, scientists conducted research and introduced that fluoride is an essential mineral present in drinking water. It was proven that fluoride is

to help lessen tooth decay cases among young school children. In 1945, the population from Grand Rapids in Michigan became the first population to drink fluoridated water. Follow-up research had been run by scientists, stated that fluoride does effectively reduce oral health problems especially among growing children (Colgate, 2021). In Malaysia, community water fluoridation was first implemented in 1972, which was 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 researches. 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 (Dey & Giri, 2018). According to National Standard for Drinking Water Quality in Malaysia, the standard level for fluoride in drinking water is within 0.4-0.6 mg/L (Engineering Services Division, Ministry of Health, 2010) while, the fluoride concentration standard enforced by World Health Organization (WHO) is 1.5 mg/L.

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

1.2 PROBLEM STATEMENT

It is very well known that fluoride does bring beneficial effects to the human body based on many previous scientific researches. There are many sources of fluoride that may help the majority of people to get an adequate intake of fluoride. For instance, foods, tea beverages, fluoridated dental products, and drinking water. Fluoride is highly proven in reducing tooth decay among growing children and helps prevent tooth loss among adults as long as they are exposed to the optimal level of fluoride. The optimal concentration of fluoride in drinking water that has been implemented by the local government is 0.4-0.6 mg/L (Engineering Services Division, Ministry of Health, 2010) in the National Standard for Drinking Water Quality in Malaysia.

However, it is also proven that less-than-optimal fluoride exposure may cause problems to the human body especially increasing cases of tooth decay, and may lead to bone fractures due to weak bone density. Furthermore, more-than-optimal fluoride exposure can lead to deleterious health effects such as enamel fluorosis, skeletal fluorosis, disruption to the thyroid gland, learning problems among growing children, and worsen the diabetic patients' conditions due to disruption to insulin secretion.

Although there are many scientific researches that had been conducted by scientists regarding the usage of fluoride's goodness and adverse effects, the message or the information from the research's papers are maybe still not being able to reach most of the public communities especially for those who are not exposed to many education exposures. If they are not informed well about fluoride usage, it may lead to misunderstandings and misconceptions about fluoride. According to Bahari et al. (2018), claimed that many Malaysians are still not aware of the fluoride in drinking water at optimal concentration. Scherzer et al. (2010) stated that the level of knowledge of fluoride's purpose and benefits in drinking water among the rural Latina population is low, which is in about 17 percent only.

1.3 STUDY JUSTIFICATION

This study may provide valid, reliable, and recent data regarding the level of knowledge and people's beliefs about the usage of fluoride from drinking water consumption. From this study, the finding will be able to provide the baseline for knowledge and perception on fluoride presence in drinking water consumption among residents in Kulaijaya. By identifying and understanding the knowledge and the perception of fluoride in drinking water, further interventional study can be done by using the data obtained from this study. Besides, this study can raise the level of awareness among the public community about fluoride not only of its' benefits but also including the

health effects that may result from unsafe fluoride intake. As far as I know, there is not much research based on this type of study has been conducted in Malaysia based on readings on references.

1.4 STUDY QUESTION

These proposed researches are based on the following research question:

- i. What is the socio-demographic characteristics of the community?
- ii. What does the public know of fluoridation drinking water?
- iii. What does the public perceive of fluoridation of drinking water?
- iv. Is there any association between the socio-demographic characteristics and knowledge level of fluoride in drinking water?
- v. Is there any association between the socio-demographic characteristics and perceptions of fluoride in drinking water?

1.5 STUDY VARIABLES

- i. Independent variables: Socio-demographics characteristics among public community
- ii. Dependent variables: Knowledge level and perception about fluoridated water consumption

1.6 STUDY OBJECTIVES

General Objective:

- i. To evaluate the knowledge level and perception of fluoridated drinking water among the public.

Specific Objectives:

- i. To determine the sociodemographic characteristics of the public.
- ii. To determine the knowledge level of fluoridated drinking water among the public.
- iii. To determine the perception level of fluoridated drinking water among the public.
- iv. To determine the association between the sociodemographic characteristics and knowledge level of fluoride in drinking water.
- v. To determine the association between the sociodemographic characteristics and their perception of fluoride in drinking water.

1.7 STUDY HYPOTHESIS

- i. There is association between the sociodemographic characteristics and knowledge level of fluoride in drinking water among the public.

- ii. There is association between the sociodemographic characteristics and their perception of fluoride in drinking water among the public.

1.8 CONCEPTUAL FRAMEWORK

Conceptual framework, an analytical tool used to better understand a situation or process. The conceptual framework outlines the relationship between independent variable and dependent variable. It also connects both variables with the scope of study in the research.

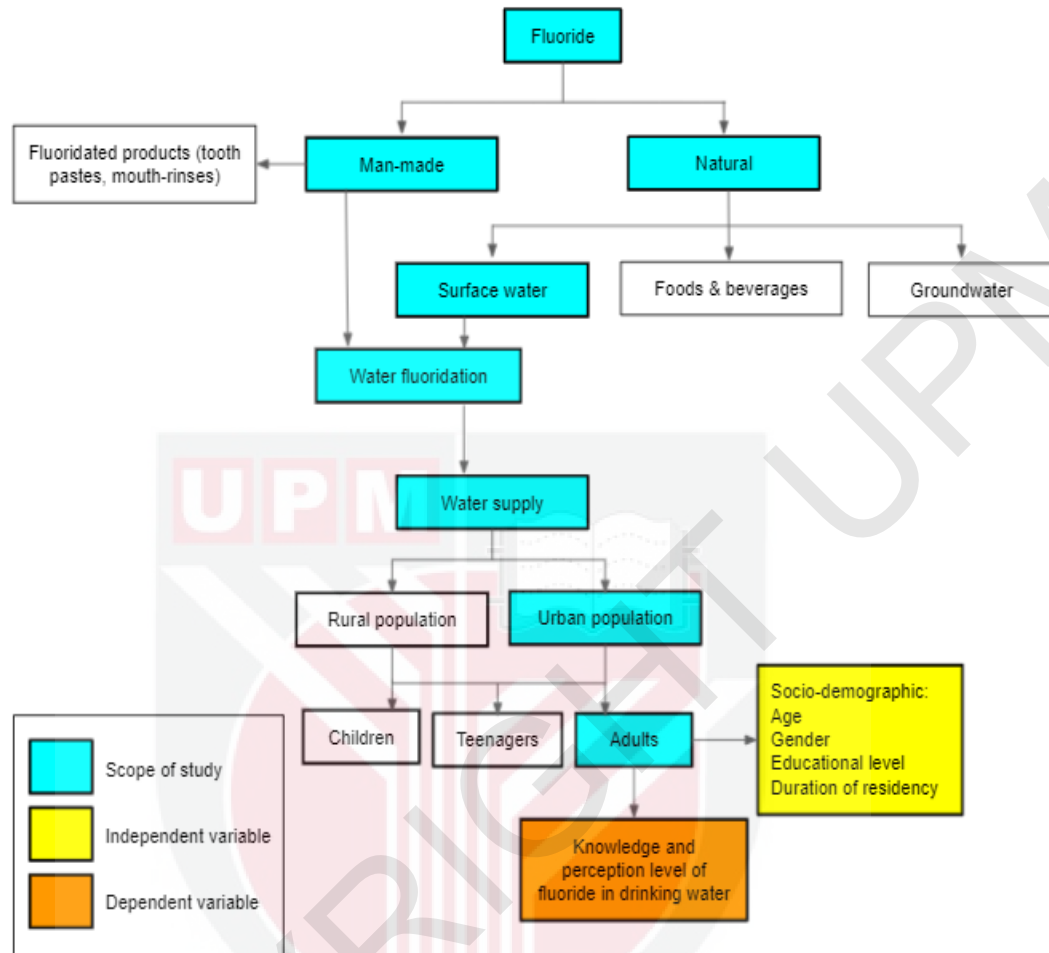


Figure 1.1: Conceptual Framework

1.9 DEFINITIONS

i. Fluoride in drinking water

Conceptual definition: Fluoride is added to the raw drinking water supply since the 1930s (Colgate, 2021). Fluoride is a naturally occurring ion that can be present in salty and mineral deposits. Fluoride at some concentrations has been shown to help prevent cavities and protect teeth from decay (BD Editors, 2018).

Operational definition: According to National Standard for Drinking Water Quality in Malaysia, the standard level for fluoride in drinking water is within 0.4-0.6 mg/L (Engineering Services Division, Ministry of Health, 2010). Fluoride in piped water can be measured via an instrument called HACH Spectrophotometer DR1900 by using the SPADNS method (US EPA, n. d.).

ii. Socio-demographic characteristics

Conceptual definition: Socio-demographic describes the characteristics of the population (The importance of socio-demographics in online surveys, 2013). The variables or the characteristics for socio-demographic consist of age, gender, level of education, migration background information, religions, marital status, number of households, occupation, and income (Survey Guidelines: Socio-Demographic Variables, 2021).

Operational definition: Sociodemographic characteristics can be obtained by distributing the questionnaires, conducting interviews, and also through observation as tools to collect data from sampled population (Formplus Blog, 2021).

1.10 LIMITATIONS

The limitation of this study does not determine the baseline of the public's knowledge or awareness level and the perception of fluoride in other sources such as natural settings, foods, tea beverages, industrial processes, and fluoridated dental products. Instead, this study only determines the baseline of the public's knowledge level and perceptions of fluoride in drinking water. Chemical Safety and Health Unit (2019) stated that fluoride can be released to the environment from volcanic eruptions' emission, emission from the production and phosphate fertilizers and phosphate ores application, as well as, emission from coal-burning activities that are highly concentrated with fluoride. Other than that, tea drinks contain fluoride at a safe concentration and it can be harmful to oral health and bone strength if it is consumed in high dosage (Das et al. 2017) and according to Hester (2019), wrote that tea plants are fluoride hyper- accumulators. This is because the tea leaves may absorb more fluoride in larger concentrations once it gets colder and the fluoride will be emitted when infusing the tea.

1.11 CONCLUSION

In this introduction chapter, the researcher has raised the relevant subject on the background of the study, the problem statement, importance of research, research questions, research variables, research objectives, research hypotheses, conceptual framework, and definitions.

CHAPTER 2

LITERATURE REVIEW

2.1 OVERVIEW OF FLUORIDE

Fluoride is the ionic form for fluorine element and can be found widely in natural settings such as in soil, air, water, and plants (Glossary: Fluoride, 2021). Fluoride is a naturally occurring mineral on the planet. It can be found in rocks, soil, water bodies, and foods in nature (Colgate, 2021). Fluoride is a chemical that is made up of the negative-charged fluorine ion. When a negatively charged fluorine ion combines with a positively charged ion like sodium ion, a fluoride molecule is formed (How Fluoride Fights Cavities - American Dental Association, 2021). Fluorine element is one of the most abundant elements that can be found in the earth's crust and it is highly concentrated in volcanic regions plus, it is usually present in the form of fluoride ions (Paula Silva Linhares et al., 2020).

The most common fluoride source that can be easily be found is in oral health care products such as toothpaste and mouth rinses as fluoride is generally effective in preventing tooth decay problems (Questions on water fluoridation, 2021). Sodium fluoride is the type of fluoride added into the toothpaste as it can help inhibit the growth of cavities and protect the enamel layer on teeth (Cherney, 2019).

In addition to this, fluoride is also highly may be found in tea drinks. According to Tokaloğlu et al. (2004), a large amount of fluoride emitted during infusing the tea and makes the fluoride from the tea is easily absorbed by the gastrointestinal tract, as the fluoride is highly soluble and the bioavailability of fluoride from the tea is nearly close to one hundred percent as similar with fluoride from drinking water. Fluoride is initially accumulated in the leaves of the tea plants that are absorbed from the soil and air (Fluoride in Drinking Water, 2006).

2.2 FLUORIDE IN DRINKING WATER

Fluoride is widely used in many things and give highly effective effects on them especially fluoride is added in drinking water to reduce the risk of getting dental carries especially among developing children (Dey & Giri, 2016). Community water fluoridation is not only providing benefits to growing children, but it is also may help reduce the chances of tooth decay problems among adults by 50 to 60 percent of reduction due to the life-long usage of fluoride (Questions: 12. Fluoride in Water? Contributed by: Dr. Khairiyah Abd Muttalib | Malaysian Dental Association, 2021).

In the 1930s, researchers observed that persons who drank fluoridated drinking water had a decreased risk of developing cavities on their teeth than people who drank unfluoridated drinking water. Researchers conducted follow-up research and discovered

that when fluoride is introduced to the public drinking water system, it is effective in combating tooth decay cases. The American Dental Association, the World Health Organization, and the American Medical Association have all officially said that fluoride should be added to the general populace's drinking water sources due to its effectiveness in preventing tooth fluorosis (Colgate, 2021). The World Health Organization (WHO) has been emphasizing the importance of fluoride use for better public oral health since the late 1960s, claiming that fluoride effectively decreases and prevents dental fluorosis. (Peterson & Ogawa, 2016).

Around 1972, Malaysia's local government followed this health organization's proposal by adding fluoride to community water networks, in the terms of minimizing dental decay cases in the country (Oral Health Division Ministry of Health Malaysia, 2006). In 1957, the state of Johor became the first in Malaysia to put fluoride into its water system, followed mostly by localities in a similar state. From 1964 to 1976, a scientific study on fluoridation of drinking water was completed in Johor, which confirmed that the fluoride addition reduced the number of tooth decay occurrences by 60%, and that it is optimum when fluoride is supplied within the prescribed level (Oral Health Division Ministry of Health Malaysia, 2006).

2.3 IMPLICATIONS OF UNSAFE FLUORIDE EXPOSURE

Previous scientific studies have been conducted by researchers have shown that exposure to fluoride may bring benefits to human health but, fluoride also may lead to opposite implications to public health if a population is exposed to a high level of fluoride or low level of fluoride. World Health Organization (WHO) recommends optimal dose for fluoride is 1.5 mg/L and the National Standard for Drinking Water Quality in Malaysia (NSDWQ), recommends optimal dose for fluoride in drinking water is within 0.4-0.6 mg/L (Engineering Services Division, Ministry of Health, 2010).

Humans may develop tooth decay and possibly osteoporosis due to fluoride deficiency (JOHNSON.LARRY, 2020). Osteoporosis is a disease where the bones structure becomes weak and less in density that may cause fractures even after a minor fall (MSD Manuals, 2021). One main cause of the increasing case of tooth decay is the lack of fluoride intake because the acids released from plaque eliminate the essential minerals on the enamel layer of the tooth. When the enamel layer has been worn away, larger cavities may be developed on teeth as the bacteria has reached the inner layer of the teeth (Aubrey Baudean DDS, 2020).

If a person consumes too much fluoride, which is mostly contained in drinking water, the person may get fluorosis, which affects the teeth and bones. Dental fluorosis develops faster than skeletal fluorosis, which requires a high dose of fluoride plus long-

term fluoride exposure. Change in color and chipping of the teeth are clinical signs of dental fluorosis, and it can also cause harm to the tooth enamel in more serious forms. Children aged 8 and younger are the most vulnerable to dental fluorosis since their permanent teeth are still growing (CDC, 2021). According to the National Research Council (2006) stated that overexposure to fluoride may causes enamel fluorosis, where it is a condition of the dental hard tissues that enamel covering the teeth is not able to crystallize adequately and causes visible markings and surface pitting on teeth. 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).

High amounts of fluoride exposure for a long time can cause skeletal fluorosis (World Health Organization, 2018). Stiffness and pain in the joints are common in the early stages of skeletal fluorosis. If the seriousness of skeletal fluorosis worsens, the bone structure may change, and ligaments may calcify, posing a risk of muscular issues. When there is a persistent buildup of fluoride in the skeletal tissues over a long period of time, several symptoms can emerge (WHO, 2018). Skeletal fluorosis is a chronic musculoskeletal disease induced by high fluoride consumption in high-fluoridated areas, either by water or, on limited occasions, from food. Fluoride can accumulate which can induce bone tissue inflammation. It also has an effect on the balance of bone mineral metabolism (KA, 2011).

In multi-generation rats, high fluoride consumption (100-200 ppm) can affect the thyroid gland, histopathology of brain areas, the acetylcholine esterase cycle, and cognitive performance and memorization (Basha et al., 2011). This is because fluoride has opposing effects when it is reacted with iodine on the thyroid gland. Fluoride may cause hypothyroidism by increasing the quantity of thyroid-stimulating hormone (TSH) and decreasing the level of T3 and T4 hormones (McLaren, 1976, as cited in, Dey & Giri, 2016). The deficiency of the T3 and T4 hormones can cause problems with weight, metabolism, muscle development, the strength of bones, and women's period cycle. (Hormone.org, 2018). For people with mild to moderate hypothyroidism, iodine changed the fluoride levels in the urine and the level of thyroid-stimulating hormone (TSH). As a result, it was shown that people who are low in iodine have greater fluoride concentration in their urine and a greater TSH level (Malin et al., 2018). Eighteen percent of Canadian adults with mild to moderate iodine deficit had higher fluoride concentration in their urine and were more likely to develop thyroid problems as a result of inactive thyroid gland function (Malin et al., 2018).

Fluoride might be a contributing factor in the global rise in diabetes incidence. Despite the fact that fluoride is a poor endocrine disrupter, it has the potential to have major impacts on diabetes individuals. Additionally, due to excessive fluoride ions inhibiting glycolysis, blood glucose levels will rise (Qin et al., 2006). People with the condition may have a larger effect than healthy people because they drink more fluoridated water and deposit more fluoride in their bodies. Diabetic patients tend to have

higher risks to get fluoride exposure adverse effects than any normal healthy person because they consume more water than other people (Pain, 2015).

Furthermore, excessive fluoride exposure, particularly if fluoride levels above 1 mg/L, can cause nervous system damage (Choi et al., 2012). When compared to grown brains, fluoride has a stronger impact on cognitive functions in growing brains. Another study found that a high dose of fluoride exposure had detrimental effects on children's learning and development qualities (Shivaprakash et al., 2011). The higher the fluoride consumption, the lower the level of level of intelligence among youngsters, emphasizing that fluoride concentration is strongly linked to intelligence in developing children (Duan et al., 2018). According to Xiang et al. (2003), claimed that the children who consumed water with higher level of fluoride in Wamiao has significantly lower intelligence or IQ levels, compared with the children who consumed lower level of fluoride from drinking water in Xinhuai after undergoing the combined Raven's Test. Decreasing of intelligence among 12 years old children is statistically significant different with the increase of fluoride in drinking water (Saxena et al., 2012). According to Priyanka Razdan et al. (2017) in their study stated that children who were exposed to high fluoride scored the lowest mark in the IQ test, followed by children who exposed to medium level of fluoride and children who exposed to less exposure of fluoride scores the most in the test.

2.4 KNOWLEDGE AND PERCEPTION OF FLUORIDE IN DRINKING WATER

According to Sajjan et al. (2021) in their study of knowledge, attitude, and practices of rural people about fluorides and fluorosis that was conducted in Bangalore, India, stated that 71 percent of participants knew the presence of fluoride in drinking water that may give effects to dental health but the participants did not aware about the exact function of fluoride. Only a small group of participants (22%) were aware of the safe level of fluoride in drinking water and 27 percent of them knew that fluoride may help strengthen the teeth from decaying. The results are mostly because of a lack of education exposures among the study population in the area.

Kroon et al. (2012) mentioned that people in New South Wales, Australia, who have low socio-economic backgrounds, lack formal educational exposures, and have poor oral hygiene practices are the groups who have doubts about water fluoridation in the community. According to Griffin et al. (2008) recorded that most people in Europe are going against the fluoridation of water because of their distrust of the local authorities' service. Thus, scientific researches need to exhibit more purpose and the advantages of fluoride in drinking water to the public, in order to gain the public's trust and assurance to the local authorities and findings from trusted scientific sources. It is very important for the public to have a good level of knowledge and have a good perception of fluoride addition in public drinking water supply for avoiding any misconceptions and oppositions on this matter. This is because, if people have a lack of knowledge level and bad perception of water fluoridation, oppositions and controversy may be developed among

the public and the anti-fluoridation groups in Australia, which may cause the water fluoridation abolished from the jurisdiction that implemented this intervention (Armfield, 2007). 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 & Armfield, 2013). Thus, the public health needs to take initiative by increasing the interventions that are related with the oral-health with the public to raise the knowledge of fluoride in drinking water. The community water fluoridation knowledge program proven to be successful as the rate of the tooth decay cases reduced among young children (*Oral Health | Healthy People 2020*, n.d.; Sivaneswaran et al., 2010).

If people have a good level of knowledge and show good support to the addition of fluoride in drinking water, the public may gain the benefits of fluoride in drinking water. Water fluoridation is necessary for the public's health as it may give significant reduction of tooth decays occurs due to water fluoridation in fluoridated areas in Israel (Blumer et al., 2018). According to Hendaus et al. (2019), they stated that eighty-six percent of parents were using bottled water as the main source of drinking water as most of them were ignorant of the benefits of fluoride that they and their children can consume from drinking tap water. The parents were not allowing their children to consume water from the tap due to the taste, smell, doubts of unknown toxins and they concerned about any disease that may develop from tap water consumption by their children. Besides, the topic of fluoride benefits where it can be provided from tap water was not discussed fluently by

the local medical practitioners, also contributed to the lack of parents' knowledge about adequacy of fluoride intake from piped water by their children which it may prevent them from getting tooth decay. Meanwhile, there was a study conducted by Leavy et al. (2012), showed that 60 percent of the school children consume water from the tap water as was claimed by the parents. The parents stated that drinking water from bottled water or filtered water were not healthier alternatives for drinking water supplies. Thus, they preferred for their children to drink water from the tap water over other choices as they aware of the benefits of fluoride in tap drinking water.

CHAPTER 3

METHODOLOGY

3.1 STUDY DESIGN

The study design of this research is a cross-sectional study where it will determine the level of knowledge and the perception of drinking water fluoridation among the public community in Kulaijaya, Johor.

3.2 STUDY LOCATION

Kulaijaya is a district located in the southern part of Johor. Kulaijaya is chosen as the study location because the large population of the urban and rural community which may has various socio-demographic backgrounds, education level, and knowledge level.

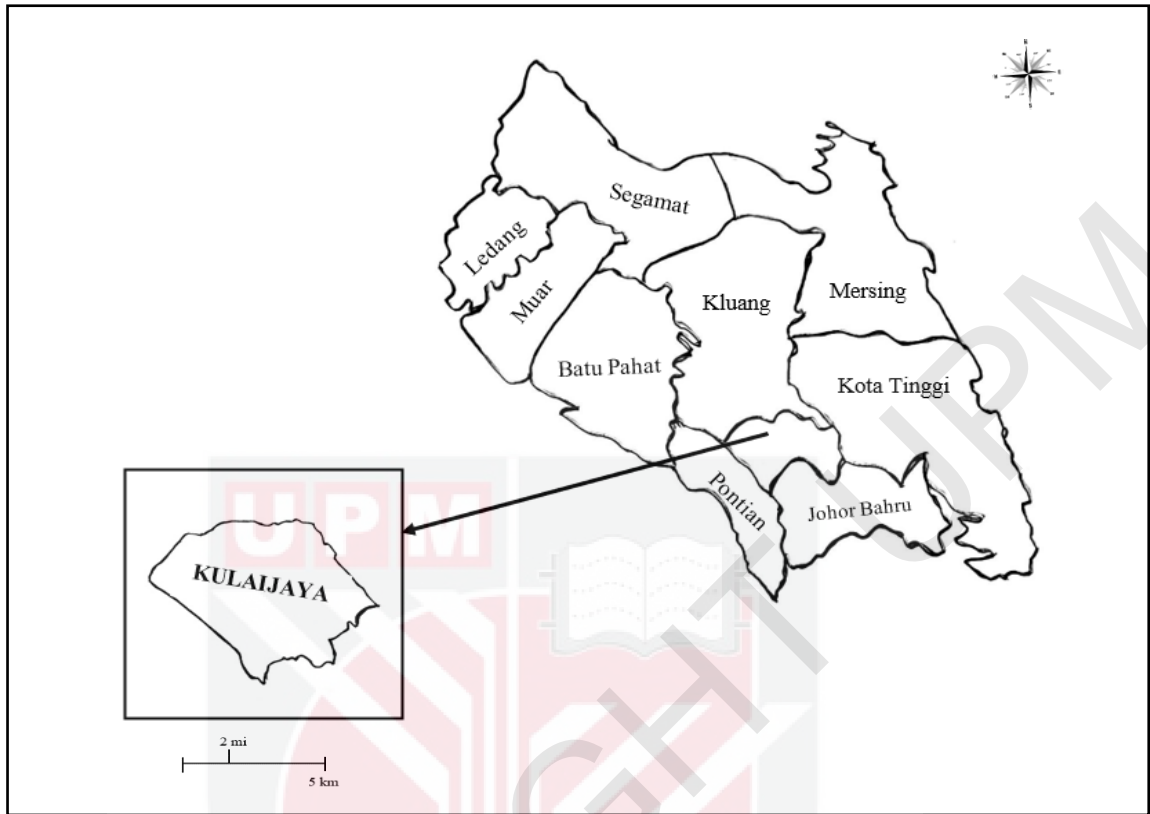


Figure 3.1: The map of study location, Kulaijaya, Johor.

3.3 STUDY DURATION

The estimated duration to carry out this study is for three months in order to reach 243 respondents where is to start in August 2021 until December 2021 among the public community in Kulaijaya.

3.4 SAMPLING

3.4.1 STUDY POPULATION

The study population in this study is the public community of Kulaijaya, Johor. The gender involves males and females. The age involves 18 years and above.

3.4.2 INCLUSION CRITERIA

The inclusion criteria for this study include the public who aged 18 years old and above and lived in Kulaijaya, Johor.

3.4.3 EXCLUSION CRITERIA

Foreigners and mentally disabled people.

3.4.4 SAMPLING FRAMES

The sampling frame in this study would be all of the community in Kulaijaya as the survey intends to get a survey from the public community in Kulaijaya.

3.4.5 SAMPLING UNIT

The public community of Kulaijaya that fulfills the inclusion criteria is the sampling unit of this study.

3.4.6 SAMPLING METHOD

Convenience sampling only requires one location population and is convenient to access with the participants to participate in this study.

3.4.7 SAMPLE SIZE ESTIMATION

The sample size for this research is estimated by considering the study design and the specific objectives of this research in the first place. The sample size calculations are shown in Table 1.

- IV. Specific objective: To determine the knowledge level of fluoridated water consumption among the public community.

Formula: One proportion formula

Sample size obtained: 217 respondents

- II. Specific objective: To determine the association between the socio-demographic characteristics and knowledge level fluoride in drinking water among public community.

Formula: Two proportion formula

Sample size obtained: 56 respondents

III. Specific objective: To determine the perception level of fluoridated water consumption among public community.

Formula: One proportion formula

Sample size obtained: 221 respondents

IV. Specific objective: To determine the association between the socio-demographic characteristics and their perception of fluoride in drinking water. Formula: Two proportion formula

Sample size obtained: 200 respondents

Therefore, the highest respondent number obtained is 221 respondents. Then it is added with 10% (22 respondents) of additional respondents as a backup for any circumstances. The total sample size for this research would be 243 respondents.

The percentage added for sample size is based on a study by Pirooska Bisits Bullen in 2013.

Specific Objective	Calculation	Reference	Total sample size
To determine the knowledge level fluoridated water consumption among public community.	Formula One Proportion: $n = \frac{Z^2_{1-\alpha/2} P(1 - P)}{d^2}$ n= sample size Z= Z value (e.g if CI=95%, value of Z=1.96) P= Expected prevalence/proportion P= 0.17 d= desired precision (if 5%, d= 0.05)	The reference for knowledge of fluoride, P = 17% (poor knowledge about fluoride's purpose and benefits) by (Scherzer et al., 2010).	= 217

To determine the association between the socio-demographic characteristics and knowledge level fluoride in drinking water among the publiccommunity	Formula Two Proportion: $\delta = P_2 - P_1 , P = \frac{P_1 + rP_2}{r+1} \text{ and } Q = 1 - P$ $m = \frac{m'}{4} \left[1 + \sqrt{1 + \frac{2(r+1)}{rm'\delta}} \right]^2 \quad (*)$ where $m' = \frac{[z_{\alpha}\sqrt{(r+1)PQ} + z_{\beta}\sqrt{(rPQ_1 + P_2Q_2)}]^2}{r\delta^2}$ $N = (r+1)m$ Note: (*) is corrected with continuity. r = ratio of exposed to unexposed P1= Unexposed with outcome (received less than high school education) P1 = 36% P2 = Exposed with outcome (received more than high school education) P2 = 76%	The reference for knowledge level of fluoride, were correctly identified the purpose of fluoride. People who received more than high school education answered correctly (76%) than people who received less than high school education (36%) by (Knowledge of the Purpose of Community Water Fluoridation – United States, 1990, 2021)	= 56
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To determine the perception of fluoridated water consumption among public community.	Formula One Proportion: $n = \frac{Z^2_{1-\alpha/2} P(1 - P)}{d^2}$ n= sample size Z= Z value (e.g if CI=95%, value of Z=1.96) P= Expected prevalence/proportion Population size = 517 P = 50% d= desired precision (if 5%, d= 0.05)	The reference for perception of fluoridated water consumption shows that the survey of national the sample of 517 adults in Australia. (Armfield & Akers, 2010).	= 221
To determine the association between the socio-demographic characteristics and their perception of fluoride in drinking water.	Formula Two Proportion: $s = P_2 - P_1 , \quad p = \frac{P_1 + rP_2}{r+1} \text{ and } Q = 1 - p$ $m = \frac{nr}{4} \left[1 + \sqrt{1 + \frac{2(r+1)}{nr\delta^2}} \right]^2 \quad (*)$ where $m = \frac{\left[z_{\alpha} \sqrt{(r+1)P_1Q_1} + z_{\beta} \sqrt{(rP_2Q_2 + P_1Q_2)} \right]^2}{r\delta^2}$ $N = (r+1)m$ Note: (*) is corrected with continuity. r = ratio of exposed to unexposed P1= Unexposed with outcome (High school graduate) P1 = 47.32% P2 = Exposed with outcome	The reference for perception of fluoride in drinking water shows that the agreement with safety of community water fluoridation	= 200

	(College graduate) $P2 = 67.89\%$	(CWF) was agreed by 67.89% of college graduate respondents than 47.32% of high school graduate respondents (Mork & Griffin, 2015).	
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Table 3.1: Sample size calculation

3.5 INSTRUMENTATION AND DATA COLLECTION

3.5.1 QUESTIONNAIRE

The research instrument is a closed-ended questionnaire prepared in both English and Malay Language that consist of three (3) sections which are explained as follow; Section A: Socio-demographic characteristics; Section B: Knowledge of Fluoride in drinking water; and Section C: Perceptions of Fluoride in drinking water.

The questionnaire will be disseminated through multiple social media platforms such as WhatsApp, Instagram, LinkedIn, and Facebook to reach respective respondents and to prevent any direct contact with them due to pandemics.

The first section which is Section A is a section where the respondents need to fill in their sociodemographic information such as their gender, age, education level, and the years they live in the study location. The second section which is Section B is a section where the respondents need to answer multiple-choice questions regarding the knowledge of fluoride in drinking water to test the respondent's knowledge level about the subject.

The third section which is Section C is a section where the respondents need to answer questions regarding their perception of fluoride in drinking water. The questions applied in this part are multiple-choice questions regarding extracting the information from the respondents' think or perceive of the addition of fluoride in drinking water and the reason behind it.

The questions applied in the questionnaire are based on previous researches. The questionnaires about knowledge and beliefs of fluoridated water consumption are adapted from the past scientific research (Community Water Fluoridation: attitudes and opinion from the New Zealand Oral Health Survey) by (Whyman, Mahoney and Børsting, 2015); (Water consumption beliefs and practices in a rural Latino community: implications for fluoridation) by (Scherzer, Baker, Pollick and Weintraub, 2010); and (Public Opinions on Community Water Fluoridation) by (Quiñonez and Locker, 2009).

The adapted questionnaire is also being modified to make it suitable for the local population and for the respective specific objectives.

3.5.2 SCORING OF KNOWLEDGE LEVEL AND PERCEPTION LEVEL

The questionnaire consists of closed-ended questions and the respondents need to answer ‘yes’, ‘no’ or ‘not sure’ for the provided questions. For correct answers, 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 level among study population by previous studies (Quality of Kelantan drinking water and knowledge, attitude and practice among the population of Pasir Mas, Malaysia) by (Ab Razak et al., 2016); (Knowledge, attitude and practice (KAP) survey of osteoporosis among students of a tertiary institution in Malaysia) by (Khan et al., 2014); 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, 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).

3.6 QUALITY CONTROL

3.6.1 RELIABILITY OF QUESTIONNAIRE

The questionnaire will undergo pre-testing to 10% of a sample size before the actual data collection will be carried out. The internal consistency will be analyzed using Cronbach's alpha coefficient to test the reliability (Ab Razak et al., 2016; Cronbach's Alpha: Simple Definition, Use and Interpretation, 2021; Abuhaloob, 2014). Based on the

pre-test survey that has been conducted, the result undergoes a reliability test which was the Cronbach's alpha coefficient test. A Cronbach's alpha value of 0.77 was obtained which indicates a reliable value for internal reliability.

3.7 DATA ANALYSIS

The type of data that will be collected in this research is qualitative data. The data of knowledge and perception of fluoride in drinking water among adults' public community are collected qualitatively because it is nominal and categorical data. The data obtained from data collection for every objective will be analyzed using IBM SPSS version 25.0 software with different types of statistical analysis:

1. Descriptive analysis

The data from specific objectives of determining the sociodemographic characteristics among the adults' public community will be analyzed by using descriptive analysis. The primary data which is sociodemographic information will be presented in a table in appendices that contain the number of participants, age, gender, educational level, and the duration of living in the particular study location. The data will be presented in a table with frequency, and percentage.

The data from specific objectives of determining the knowledge level and perception of fluoride in drinking water among the adults' public community will also be analyzed using descriptive analysis. The data will be presented in percentage form.

2. Chi-square analysis/Fisher's Exact Test

Chi-square analysis will be used for determining the association between the socio-demographic characteristics and the knowledge level of fluoride in drinking water among the public community. Besides, Chi-square analysis also will be used for determining the association between the socio-demographic characteristics and the perception of fluoride in drinking water among the public community. Chi-square analysis or Fisher Exact Test will be used as the data are in categorical and numerical form.

Specific Objectives	Statistical Analysis
To determine the sociodemographic characteristics of the public community.	Descriptive analysis
To determine the knowledge level of fluoridated water consumption among public community.	Descriptive analysis
To determine the association between the sociodemographic characteristics and knowledge level of fluoride in drinking water among public community.	Chi-square analysis/ Fisher Exact Test
To determine the perception of fluoridated water consumption among	Descriptive analysis

public community.	
To determine the association between the socio-demographic characteristics and their perception of fluoride in drinking water.	Chi-square analysis/Fisher Exact Test

Table 3.2: Specific objectives and Statistical analysis

3.8 STUDY ETHICAL CONSIDERATION

Research ethics is about rules, principles, rationality, morality, and what should or should not be done in the scope of research. It is compulsory for this research to obtain ethical approval from the Ethics Committee for Research Involving Human Subject UPM (JKEUPM). Ethical approval from the Ethics Committee for Research Involving Human Subjects of Universiti Putra Malaysia was obtained before conducting data collection. The respondents in this study will be voluntarily and they will be briefed regarding the study before participate in the survey. Respondents will obtain respondent consent form before proceed the survey to confirm the respondents' agreement and to inform the respondents about the confidentiality of the given information.

CHAPTER 4

RESULTS

4.1 STUDY BACKGROUND

The study was conducted from August until December 2021. From the calculation of the sample size, 243 respondents shall be recruited from the study through convenience sampling.

4.2 SOCIO-DEMOGRAPHIC CHARACTERISTICS DISTRIBUTION AMONG RESPONDENTS

Table 4.1 shows the socio-demographic distribution among the Kulaijaya community. Descriptive analysis was used to obtain the collected data in terms of frequency and percentage to show the distribution of socio-demographic characteristics regarding their age, gender, educational level, and residential duration among the public.

Table 4.1: The socio-demographic characteristics distribution among respondents.

Socio-demographic characteristics (N=243)		Frequency, 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)

AGE

Most of the participated respondents aged between 18 to 64 years old that was as many as 185 respondents (76.1%) while, 58 (23.9%) respondents aged more than 64 years old participated in this survey.

GENDER

The results show that female respondents had the majority participation in this survey which was 133 (54.7%). Meanwhile, 110 (45.3%) were male respondents.

EDUCATIONAL LEVEL

In this part, the educational level of the respondents was divided into four categories which were primary education, secondary education, tertiary education, and not received any formal education. Tertiary education level contributed the majority which was 153 (63%) of the respondents, followed by 83 (34.2%) of the respondents who had secondary education level, and those who had primary education level contributed 4 (1.6%) of the respondents. Meanwhile, those who never received any formal education only 3 (1.2%) of the respondents.

RESIDENTIAL DURATION

The residential duration was also divided into four categories which were less than 1 year, 1-5 years, 6-10 years, and more than 10 years. The survey participants who lived for more than 10 years were counted as many as 153 (63%), representing the majority of the respondents. The respondents who lived there in a range of 6-10 years were as many as 39 (16%), 33 (13.6%) of the respondents were those who lived there for 1-5 years, and the respondents 18 (7.4%) were those who lived there for less than a year.

4.3 KNOWLEDGE LEVEL OF FLUORIDATED DRINKING WATER CONSUMPTION AMONG PUBLIC DISTRIBUTION.

Figure 4.1 shows the knowledge level of fluoridated drinking water consumption distribution among the Kulaijaya community. Descriptive analysis was used to obtain the collected data in terms of frequency and percentage to show the distribution of the public's knowledge level regarding this matter. Table 4.2 shows the knowledge items used for determining the knowledge level among residents in Kulaijaya.

Figure 4.1: The knowledge level of fluoridated drinking water consumption among public distribution.

Knowledge Level of Fluoride in Drinking Water

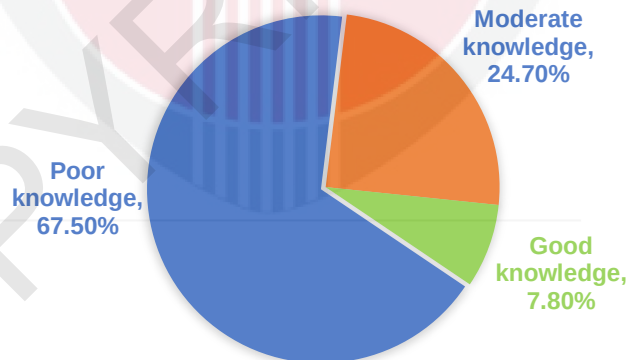


Table 4.2: The knowledge items for determining the knowledge level among residents in Kulaijaya, Johor.

Knowledge Items		n (%)
1. Do you know what fluoride is?	Yes	173 (71.2)
	No/Not sure	70 (28.8)
2. Have you heard or read about fluoride before?	Yes	205 (84.4)
	No/Not sure	38 (15.6)
3. 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)
4. Do you know there is an addition of fluoride in your drinking water?	Yes	117 (48.1)
	No/Not sure	126 (51.9)
5. Do you know the purpose of the addition of fluoride in drinking water?	Yes	128 (52.7)
	No/Not sure	115 (47.3)
6. What is/are the purpose(s) of the	Prevent dental caries	138 (56.8)
	Preserve oral health	111 (45.7)

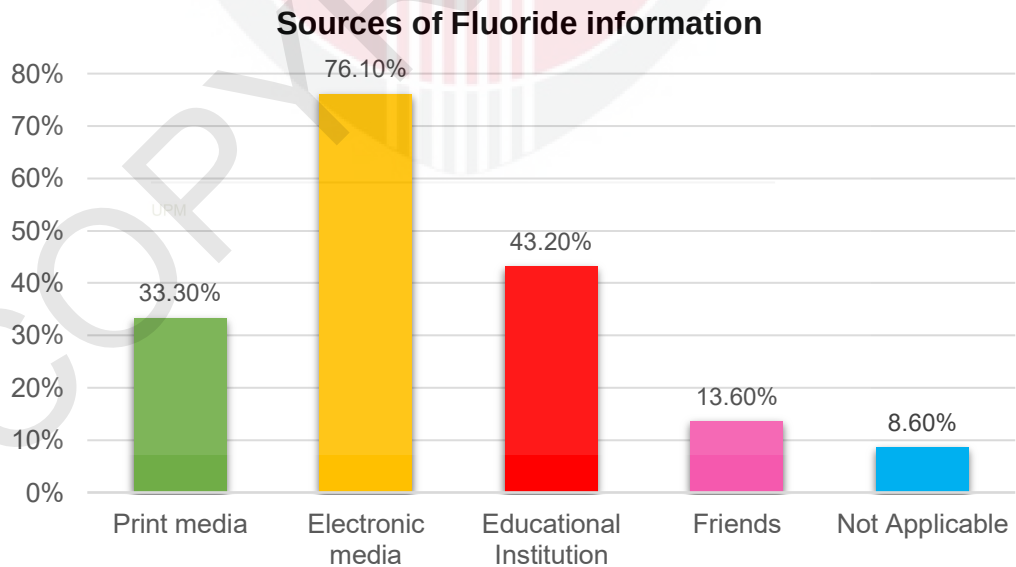
addition of fluoride in	Strengthen bones	42 (17.3)
drinking water?	Not sure	66 (27.2)
7. Do you know the		
optimal level of		
fluoride addition in	Yes	37 (15.2)
drinking water that is	No/Not sure	206 (84.8)
implemented by the		
National Standard		
Drinking Water		
Quality (NSDWQ)?		
8. Lack of fluoride	Yes	129 (53.1)
exposure can cause	No/Not sure	114 (46.9)
diseases		
9. Excessive exposure to	Yes	158 (65.0)
fluoride can cause	No/Not sure	85 (35.0)
diseases		
10. What health effects	Dental fluorosis	150 (61.7)
may be caused by	Skeletal fluorosis	79 (32.5)
excessive levels of	Insulin secretion problem	30 (12.3)
		31 (12.8)

fluoride in drinking	Neural development	
water?	problem	34 (14.0)
	Thyroid gland problem	72 (29.6)
	Not sure	

11. What are the health

effects that may be	Weak bones structure	75 (30.9)
caused by lack of	Tooth decay	146 (60.1)
fluoride exposure in	Not sure	77 (31.7)
drinking water?		

Figure 4.2: Sources of Fluoride information



KNOWLEDGE ITEMS DATA

Based on Figure 4.2, shows that 71.2% of the respondents knew about fluoride is, and 84.4% of the respondents have heard or read about fluoride. Electronic media, educational institution, 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. Based on Table 4.2, the respondents 117 (48.1%) were aware about there is addition of fluoride in the drinking water, and 128 (52.7%) of the respondents knew the purpose of addition of fluoride in the drinking water.

The respondents 138 (56.8%) agreed the addition of fluoride can prevent dental carries, 111 (45.7%) of the respondents know that fluoride can preserve oral health and 42 (17.3%) of them agreed that fluoride can strengthen the bones. Only 37 (15.2%) of the respondents' survey knew the optimum level of fluoride addition in drinking water that is implemented by National Standard Drinking Water Quality (NSDWQ). They 29 (53.1%) also know that lack of fluoride exposure can cause diseases, and 158 (65%) of them knew that excessive exposure to fluoride can also cause diseases.

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 of the respondents agreed that excessive exposure to fluoride can cause dental fluorosis.

Meanwhile, the respondents answered the health impacts that may be caused by

lack of fluoride exposure such as weak bones structure with 75 (30.9%), and tooth decay with 146 (60.1%) representing the majority of the respondents.

KNOWLEDGE LEVEL

Based on the Figure 4.1, most of the respondents have poor knowledge level which is 67.5%, then, 24.7% of the respondents scored at moderate knowledge level and only 7.8% of the respondents have good knowledge level about fluoride in drinking water.

4.4 THE ASSOCIATION BETWEEN THE SOCIO-DEMOGRAPHIC CHARACTERISTICS AND THE KNOWLEDGE LEVEL OF FLUORIDE IN DRINKING WATER

Based on the result shown in table 4.3, the educational level shows an association between the socio-demographic characteristics (educational level) and the knowledge level among the residents in Kulaijaya, Johor ($\chi^2=32.19$, p-value = 0.000). Meanwhile, the other socio-demographic data such as age, gender, and residential duration show no association with the knowledge level.

Table 4.3: The association between the socio-demographic characteristics and knowledge level of fluoride in drinking water among the public.

Socio-demographic characteristics		Knowledge Level (%) N = 243			X ²	p-value (p<0.05)
		Poor (N=164)	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	3 (1.83)	0 (0)	0 (0)		

	any formal					
	education					
Residential	Less than 1	11 (6.71)	6 (10.0)	1 (5.26)	10.03	0.126 ^b
Duration	year					
	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	108	29 (48.33)	16 (84.21)		
	10 years	(65.85)				

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

4.5 PERCEPTION LEVEL OF FLUORIDATED DRINKING WATER CONSUMPTION AMONG PUBLIC COMMUNITY DISTRIBUTION.

Figure 4.3 shows the perception level of fluoridated drinking water consumption distribution among the Kulaijaya community. Descriptive analysis was used to obtain the collected data in terms of frequency and percentage to show the distribution of the public's knowledge level regarding this matter. Table 4.4 shows the perception items used for determining the perception level among residents in Kulaijaya.

Figure 4.3: The perception level of fluoridated drinking water consumption among public.

Perception Level of Fluoride in Drinking Water

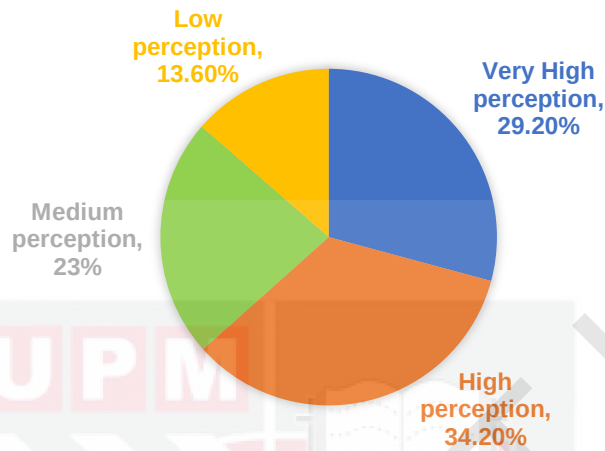


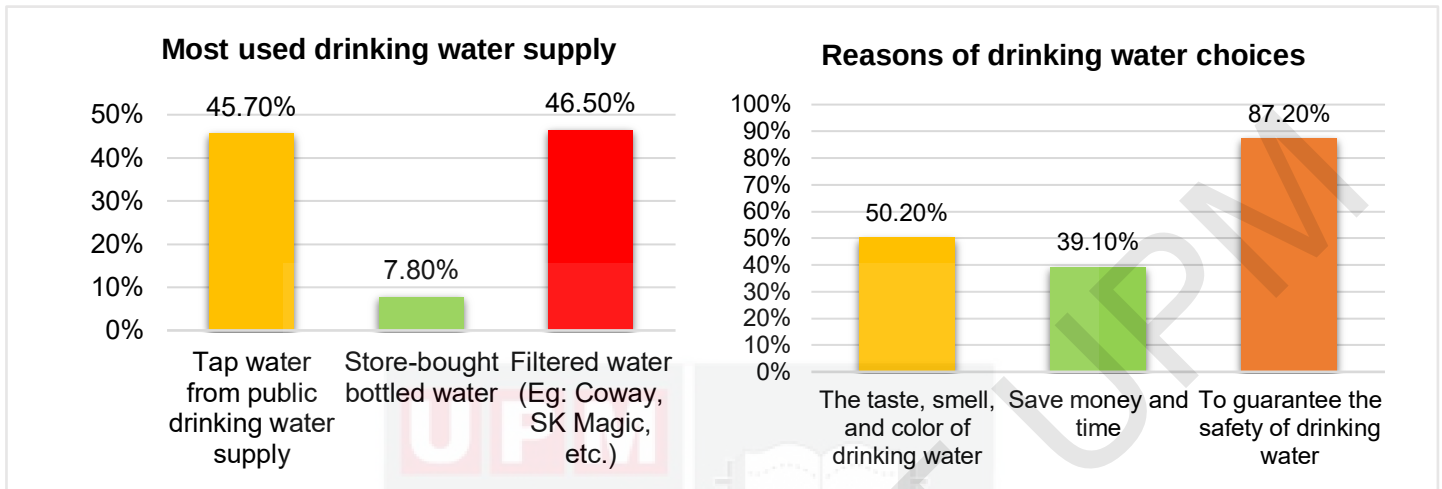
Table 4.4: The perception items for determining the perception level among residents in Kulaijaya, Johor.

Perception Items		n (%)
1. 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 (E.g.: Coway, SK Magic, etc.)	113 (46.5)
2. 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)
		212 (87.2)

To guarantee the safety of the
drinking water consumption

3. 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)
4. 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)
5. 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)
6. Are you into the addition of fluoride in drinking water?	Yes	159 (65.4)
	No/Not sure	84 (34.6)

Figure 4.4: Most used drinking water supply and the reasons of drinking water choices.



PERCEPTION ITEMS DATA

Based on Figure 4.4, show that most of the respondents 46.5% use filtered water as the main source of drinking water, 45.7% of them use tap water as the main drinking water supply and 7.8% use store-bought bottled water as the main drinking water source. Most of them, 87.2% agreed that to guarantee the safety of the drinking water consumption, 50.2% of them agreed that the reason for choosing their main drinking water source is for the taste, smell, and color of the drinking water, and only 39.1% agreed for it can save the money and time.

Based on Table 4.4, the respondents 141 (58%) think that the addition of fluoride to the public drinking water supply is safe, 135 (55.6%) of the respondents also think that the addition of fluoride to public drinking water supply is effective, 168 (69.1%) of the

respondents think that the addition of fluoride to public drinking water supply can help prevent tooth decay and 159 (65.4%) support the addition of fluoride in the drinking water.

PERCEPTION LEVEL

Based on Figure 4.3, most of the respondents have high perception level which is 34.2%, then, 29.2% of the respondents scored at a very high perception level, 23% of them scored medium perception, 13.6% of the respondents have low perception level and none of them have very low perception level about fluoride in drinking water.

4.6 THE ASSOCIATION BETWEEN THE SOCIO-DEMOGRAPHIC CHARACTERISTICS AND THE PERCEPTION LEVEL OF FLUORIDE IN DRINKING WATER

The association between the socio-demographic characteristics and perception level of fluoride in drinking water among the public community in Kulaijaya, Johor using the Chi-square and Fisher Exact Test. Based on the result shown in table 4.5, none of the socio-demographic data such as age, gender, educational level, and residential duration show association with the perception level.

Table 4.5: The association between the socio-demographic characteristics and perception level of fluoride in drinking water among public.

Socio-demographic characteristics		Perception Level (%)				X ²	p-value
		Very Low (N=0)	Low (N=33)	Medium (N=56)	High (N=83)	Very High (N=71)	(p<0.05)
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	Primary education	1 (3.03)	2 (3.57)	0 (0)	1 (1.41)	14.03	0.057 ^b
	Secondary education	16 (48.48)	20 (35.71)	30 (36.14)	17 (23.94)		
	Tertiary education	16 (48.48)	32 (57.14)	52 (62.65)	53 (74.65)		
	Not received any formal education	0 (0)	2 (3.57)	1 (1.20)	0 (0)		

Residential	Less than 1		4 (12.12)	3 (5.36)	4 (4.82)	7 (9.86)	7.15	0.606 ^b
Duration	year							
	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)		
	More than		20 (60.60)	36 (64.29)	52 (62.65)	45 (63.38)		
	10 years							

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

CHAPTER 5

DISCUSSION

SOCIO-DEMOGRAPHIC CHARACTERISTICS

In total, 243 respondents who participated in the survey show that the majority of them aged between 18 to 64 years old, female, have tertiary education level, and lived in Kulaijaya, Johor for more than 10 years. Most of the respondents were aged between 18 to 64 years old, that is as many as 185 respondents (76.1%) while 58 (23.9%) respondents who were aged more than 64 years old participated in this survey. 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 have the majority of the participation in this survey which was 133 (54.7%) compared to 110 (45.3%) male respondents. There was a study conducted by Scherzer et al. (2010) among rural Latino communities that were dominated by Latina women 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 education level which is similar to this study that

shows most of the respondents in this survey were in or graduated from tertiary education level by 63% among the rest of other respondents' educational level categories.

The respondents with higher education have the majority of participations in this study. People with higher educational level, usually will have a better understanding and perception of fluorides as a result of their educational status. However, a recent study by Muralidharan and Paul (2018) discovered that there was no significant gain in fluoride awareness among fresh graduates and preclinical group of higher education. The period of occupancy revealed that the majority of respondents had lived in Kulaijaya for more than ten years. This will almost certainly lead to an underestimation of total fluoride knowledge and perception across diverse communities or immigrants.

KNOWLEDGE OF FLUORIDE IN DRINKING WATER

Generally, the percentage of respondents who showed poor knowledge level of fluoride in drinking water was highest compared to moderate knowledge and good knowledge level. In contrast to this, the majority, 79 percent knew about the presence of fluoride in drinking water, 73 percent were not aware that fluoride can protects the tooth from decaying as long as the fluoride concentration at the permissible level, and 68 percent of them did not have the knowledge of fluoride which they can get from the foods they eat (Kakti, 2018).

From the results of this study, most of respondents knew about fluoride in drinking water from their readings or the sources that they heard. They received the information

were mostly from electronic media, educational institutions, printed media and friends. Lowry et al. (2021), stated that 37 percent of the survey participants read or heard about fluoridation in the past twelve months from printed media, which is local newspapers, followed by dental practices, and a significant minority thought that their water supply was already fluoridated. According to Shearer & Mitchell (2021), electronic media is the most convenient, quickest, and cheapest way for many people to access to a lot of information and also to spread many news. Smartphone, television channels, digital radio, and personal computer are the well-known and most used electronic media devices by majority of people. Presenting information on hypermedia websites via the global Internet network is one of the most popular forms of electronic media. Hence, the percentage of respondents who had heard or read fluoride from electronic media sources is the highest of other information sources. Dentists were mentioned as another source of knowledge by the participants. According to the findings of the study, populations that do not pay the visit the dentist may miss out many information on critical fluoride exposure from community drinking water supply, and they may experience higher rates of dental decay (Barker et al., 2016).

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 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 small number of populations, 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 medias such as commercials on televisions and social medias. Other than that, the community water fluoridation program that was once has been implemented in Johor from the year of 1964 until 1976 (Oral Health Division Ministry of Health Malaysia, 2006). Hence, many people nowadays are not aware or lack of information about fluoride addition in drinking water.

A study was conducted by MS et al. (2017) have revealed that taking high amount of fluoride from non-regulated or uncertified sources can cause dental fluorosis, which was 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, 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 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 et al. 2001). Although knowledge about the status of water fluoridation in Kuwait was limited, approximately 77 percent of both dentists and medical practitioners believed that water supplies in Kuwait should be fluoridated (Sabti et al., 2019). Ministry of Health (MOH) implemented and monitored the safe level of fluoride addition in drinking water throughout Malaysia based on the National Standard Drinking Water Quality (NSDWQ) (Oral Health Division Ministry of Health Malaysia, 2006). The public needs to convince of the local government in providing fluoridation at safe level into drinking water supply in order to preserve the oral health by preventing and controlling dental caries problems in this country.

There were 138 (56.8%) and 111 (45.7%) respondents, respectively, think 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 its importance in bone building. The term was only known by 42 (17.3 percent) of the respondents. Another outcome in our study was that 146 (60.1 percent) of respondents said teeth decay is known to occur if there is a deficiency of fluoride exposure, compared to 75 (30.9 percent) 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, n. d.).

PERCEPTION OF FLUORIDE IN DRINKING WATER

The public in Kulaijaya mostly used a filtered water system as their main drinking water source, followed by using tap water as their drinking water supply and only a few of them use bottled water that they bought from stores. This is because they think that it is safe for them to consume the drinking water by using their preferable drinking water supply. In contrast, according to a past research, 48 percent of the people in Western Newfoundland, Canada, utilized a water filter at their homes (Ochoo, 2017). This is because they believe it is safer for them all to drink the water from their preferred drinking water source. Cury et al. (2019) did a descriptive study focused on the hazards of water fluoridation and the probably toxic dose, PTD for a 20-kilogram child that aged 5 to 6 years old. According to the findings of the study, fluoridated drinking water is safe in terms of acute fluoride toxicity, because a child weighing 20kg would need to consume 143 litres of water to be exposed to 5.0mg F/kg PTD.

A study was conducted in Mexico was also align with this research where the majority of the population who lived there chose to use readily bottled water and filtered water system as their main source to drink water. The unpleasant taste, the cloudiness of water appearance, and also the foul smell of the water made them perceive that the

municipal drinking water supply in their country was unsafe to use as drinking water supply to be consumed. Besides, the Latina population also claimed that using a filtered water system at their home was necessary due to the corroded pipe at their home, air conditioning system, poor infrastructure, and also maybe because of agricultural contamination that made their water supply appear to look unclean and unsafe to drink. Thus, it will make the consumers feel distrust of the local municipal drinking water supply that was provided by the local government (Scherzer et al., 2010).

In contrast, according to Azlan et al. (2011) in their study that was conducted in the Peninsular of Malaysia, the tap water was being treated at the drinking water treatment plant first before it was released to the public for consumers' usage to ensure the parameters of the drinking water were following the permissible limit based on the Malaysian Drinking Water Standards implemented by the Ministry of Health (MOH). Therefore, the drinking water was safe to consume without any treatment. However, the water can be contaminated due to out-of-date and corroded plumbing pipes which will make the drinking water do not meet the physical properties (taste, smell, and color) as it should be before arriving at the consumers. Hence, Malaysians were 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).

Most of the Malaysians were less emphasizing other important parameters in ensuring the quality of water such as the fluoride concentration in the drinking water than the physical properties such as the taste, smell, and clarity of the water (Mat Salleh, 2007;

Bahari et al., 2018). However, the majority of the respondents in this study show 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 effective prevention and treatment from developing dental caries, especially among younger children. Based on the study conducted by Gussy et al. (2008) 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 toothpaste. In addition to this, 74% of parents agreed that fluoride can be helpful in preventing tooth decay among their children based on the findings of the study.

Fluoride had been proven to be one of the most significant achievements in public health in the 20th century as it was effectively helpful in preventing and controlling dental caries problems especially among young school children (The Story of Fluoridation | National Institute of Dental and Craniofacial Research, 2018). Although multiple scientific researches had been conducted to show the effectiveness of fluoride in fighting dental caries, there were still other antagonistic aspects or perceptions regarding drinking water fluoridation. The Fluoride Action Network (FAN) is the most well-known group that is 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.).

In alignment with Connett (2004), he pointed out the reasons to disagree about drinking water fluoridation. One of the reasons was fluoride intake is difficult to control once the fluoride was added into the 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 laborers drank higher volumes of water than average people which may cause them to be exposed to an excessive amount of fluoride. Furthermore, he was also stated that drinking water was not the sole source of fluoride, but fluoride also can be found in various places which may cause an immoderate dosage of fluoride intake daily such as from tea drinks and toothpaste. Fluoride can be found highly in tea beverages especially brewed black tea which has about 3 to 4 ppm of fluoride (Izuora et al., 2011). Black tea has the highest amount of fluoride infused than other types of tea based on the study conducted by Lung et al. (2008). A person who consumed a lot of tea drinks in a day may have a higher chance to develop dental or skeletal fluorosis (Tokaloğlu et al., 2004).

ASSOCIATION BETWEEN SOCIO-DEMOGRAPHIC CHARACTERISTICS AND KNOWLEDGE AND PERCEPTION LEVEL OF FLUORIDE IN DRINKING WATER

Based on the result of this study, it was shown that the socio-demographic characteristics which were the age, gender, and residential duration had no association with the knowledge level. Meanwhile, educational level, which was one of the socio-demographic factors, showed an association with the knowledge level of fluoride in drinking water among the public in Kulaijaya, Johor. Blumer et al. (2018) revealed that

the fathers (84%) and the mothers (88%) that have higher education level were aware of the benefits and in favor of fluoride intake from drinking water by 37%. Besides, he also stated that the mothers' educational levels were related with the knowledge of water fluoridation ($p = 0.027$, Pearson Chi Square). Knowledge is a critical aspect in determining one's behaviour. 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 & Makhfduli, 2009).

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 reject as it shows there was no association between the 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 the 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 rather subjective 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's drinking water system which made them not being able to clarify or voice out their opinions regarding this subject through this research. In contrast, there was a study conducted by Ochoo in 2017, which was the respondents with a higher education level perceived their water supply as more fulfilling (totally satisfied/very satisfied) than those with a lower level of education.

CHAPTER 6

CONCLUSION AND RECOMMENDATION

CONCLUSION

In conclusion, the majority of residents in Kulaijaya, Johor have poor level of knowledge regarding the fluoride addition in drinking water. In contrast to this, most of the residents have high level of perception about the water fluoridation was reported in this study. They have positive-thinking and were in favor of the water fluoridation implementation as they convinced that addition of fluoride was safe and effective in fighting tooth decay crisis among younger children. Education level has significant association on the knowledge level ($p = 0.001$), while the socio-demographic characteristics (age, gender, education level and residential duration) do not influence the perception level of the respondents about this matter.

RECOMMENDATION

The local government are encouraged to provide health promotion programs for Malaysians to be more aware of fluoride presence, which is not only in toothpaste that they use it on daily basis, but also from multiple other sources in environment. In addition to this, the local government can form efficient collaborative programs with other agencies which emphasizing oral health to produce more effective outcome in introducing fluoride to the public. Water fluoridation has been implemented into drinking water supply in Malaysia since 1972, but most of Malaysian still not aware of fluoride in their daily consumption of water. Thus, local government shall increase programs that related to fluoride to the Malaysians population. For instance, by implementing fluoride educational

programs at primary level of education in Malaysia and also fluoride education for the parents to make them more aware of fluoride intake taken by their children. Hence, diseases that caused by the lack of fluoride exposure such as dental decay and by the excessive fluoride exposure cases can be controlled and prevented in this country.

Furthermore, it is recommended for this study to give proper instruction for the respondents to answer this survey to prevent them from randomly choose the answers provided without actually reading the questions properly and to help them to answer more attentively. Lastly, it is also recommended to conduct this same type of study to include the fluoride from multiple sources such as from foods, beverages, and oral healthcare products instead of merely fluoride intake from drinking water. Therefore, we can determine the baseline of knowledge and perception of fluoride presence or intake from various sources.

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APPENDICES



**ETHICS COMMITTEE FOR RESEARCH INVOLVING HUMAN SUBJECTS
(JKEUPM)
UNIVERSITI PUTRA MALAYSIA**

Research title	: Knowledge And Perception of Fluoridated Drinking Water Among Public in Kulaijaya, Johor
Study Site	: Johor
JKEUPM Ref No.	: JKEUPM-2021-676
Researcher	: Noor Farhana Binti Jalil
Supervisor	: Dr Shahrudin Bin Mohd Sham

Documents received and reviewed with reference to the above study:

1. Ethics Application Form, Version 1 dated 05/09/2021
2. Respondent's Information Sheet / Consent (English), Version 1 dated 22/09/2021
3. Respondent's Information Sheet / Consent (Malay), Version 1 dated 22/09/2021
4. Proposal (English), Version 1 dated 30/09/2021
5. Questionnaire / Interviews (English), Version 1 dated 05/09/2021
6. Curriculum Vitae of:
 - a. Dr. Shahrudin bin Mohd Sham

The University Research Ethics Committee, Universiti Putra Malaysia (JKEUPM) operates in accordance to the ICH-GCP Guidelines.

Decision by JKEUPM:

- ☒ Approved
- ☒ Permission MUST BE OBTAINED from the respective hospitals/ institutions before conducting the research
- ☐ Disapproved

Please note that the approval is **VALID UNTIL 30 SEPTEMBER 2022**

Researchers should comply with the following:

- I. Complete a Study Final Report upon study completion (Form 3.2).
- II. Ethical approval is required in the case of amendments/ changes to the study documents/ study sites/ study team.
- III. Applicable for Clinical Trial Studies and Clinical interventional Studies only: Progress Report has to be submitted to JKEUPM at every 6 months from the date of approval (Form 3.1). Report occurrences of all Serious Adverse Events (SAEs), Suspected Unexpected Serious Adverse Reaction (SUSARs) and Protocol Deviation/ Violation at all JKEUPM approved sites to JKEUPM. SAEs are to be reported within 15 calendar days from awareness of event by investigator. Initial report of SUSARs are to be reported as soon as possible but not later than

QUESTIONNAIRE



KNOWLEDGE AND PERCEPTION OF FLUORIDATED DRINKING WATER AMONG PUBLIC IN KULAIJAYA, JOHOR.

**Pengetahuan dan Persepsi mengenai Fluorida di dalam Pengambilan Air Minuman
Dalam Kalangan Komuniti Awam DiKulaijaya, Johor.**

QUESTIONNAIRE/SOAL SELIDIK

This set of questionnaires will be used as the instrument for obtaining information related to study matter from the respondents for the study purposes. The respondents need to answer all of the questions provided in the questionnaire below. The questionnaire consists of closed-ended questions and has three sections. The three sections which are:

Section A: Socio-demographic Characteristics, Section B: Knowledge of Fluoride in Drinking Water and Section C: Perception of Fluoride in Drinking Water.

Set soal selidik ini akan digunakan sebagai instrumen bagi memperoleh maklumat yang berkaitan dengan kajian daripada para responden untuk tujuan kajian. Responden perlu menjawab ke semua soalan yang disediakan dalam soal selidik di bawah. Soal selidik ini mengandungi soalan tertutup dan mempunyai tiga bahagian. Tiga bahagian yang disediakan dalam soal selidik ini antaranya ialah: **Bahagian A: Ciri-ciri Sosio-demografi, Bahagian B: Pengetahuan mengenai Fluorida di dalam Air Minuman dan Bahagian C: Persepsi mengenai Fluorida di dalam Air Minuman.**

Introduction

Fluoride is an ionized form of the element fluorine that will be beneficial to teeth because it will help to prevent tooth decay. In Malaysia, fluoride added to water to prevent tooth decay among children and been a main concern to public health. All public water supplies intended for human consumption are subjected to drinking water quality standards known as the National Standard Drinking Water Quality (NSDWQ). NSDWQ is a set of guidelines designed to help determine the proper raw water treatment that meets the drinking water quality standards for safe and potable water supply. Therefore, an optimum range is 0.4mg/L - 0.6 mg/L to make sure the public did not receive lack or excess fluoride in drinking water that will lead to health risk such as dental fluorosis, skeletal fluorosis, insulin secretion problem, neural development problem, thyroid gland problem and tooth decay. A variety of sources of exposures to fluoride is through food, water and extreme usage of toothpaste. However, drinking water shows the highest prominence as the exposure to fluoride towards the public since it is a major consumption of fluoride through ingestion.

Pengenalan

Fluorida adalah bentuk terion dari unsur fluorin yang memberi manfaat kepada gigi kerana dapat membantu mencegah kerosakan gigi. Di Malaysia, fluorida ditambahkan ke bekalan air orang awam untuk mencegah kerosakan gigi terutama di kalangan kanak-kanak dan

menjadi tumpuan utama kesihatan awam. Semua sumber bekalan air awam adalah tertakluk kepada standard kualiti air minuman yang dikenali sebagai Kualiti Air Minum Standard Nasional (NSDWQ). NSDWQ adalah satu garis panduan yang dirancang untuk membantu pengguna menentukan rawatan air yang betul dan memenuhi standard kualiti air bagi bekalan air yang selamat. Oleh itu, julat optimum yang ditetapkan oleh NSDWQ ialah 0.4mg / L - 0.6 mg / L untuk memastikan orang ramai tidak kekurangan atau berlebihan menggunakan fluorida dalam air minum yang akan menyebabkan risiko kesihatan seperti fluorosis gigi, fluorosis rangka, masalah rembesan insulin, masalah perkembangan saraf, masalah kelenjar tiroid dan kerosakan gigi. Pelbagai sumber pendedahan kepada fluorida seperti melalui makanan, air dan penggunaan ubat gigi yang berlebihan. Namun begitu, air minum menunjukkan keutamaan tertinggi kerana pendedahan fluorida kepada orang ramai melalui majoriti pengambilan fluorida melalui pencernaan.

Please tick (/) on the blank space provided.

Sila tandakan (/) pada ruangan kosong yang disediakan.

SECTION A: SOCIO-DEMOGRAPHIC CHARACTERISTICS

BAHAGIAN A: CIRI- CIRI SOSIO-DEMOGRAFI

1. Age/Umur:

☐ 18-64 years old / 18-64 tahun

☐ More than 64 years old / Lebih daripada 64 tahun

2. Gender/Jantina:

☐ Male / Lelaki

☐ Female / Wanita

3. Educational level/Tahap pembelajaran:

- ☐ Primary education / Pendidikan rendah
- ☐ Secondary education / Pendidikan menengah
- ☐ Tertiary education / Pendidikan tinggi
- ☐ Did not receive any formal education / Tidak menerima sebarang Pendidikan formal

4. How long have you lived in the study area/Sudah berapa lama anda tinggal dikawasan penyelidikan?

- ☐ Less than a year / Kurang dari setahun
- ☐ 1-5 years / 1-5 tahun
- ☐ 6-10 years / 6-10 tahun
- ☐ More than 10 years / Lebih dari 10 tahun

SECTION B: KNOWLEDGE OF FLUORIDE IN DRINKING WATER

BAHAGIAN B: PENGETAHUAN MENGENAI FLUORIDA DI DALAM AIR MINUMAN

5. Do you know what fluoride is? /Adakah anda tahu apa itu fluorida?

- ☐ Yes / Ya
- ☐ No / Tidak
- ☐ Not sure/Tidak pasti

6. Have you heard or read about fluoride before? /Pernahkah anda mendengar atau membaca tentang fluorida sebelum ini?

☐ Yes / Ya

☐ No / Tidak

☐ Not sure / Tidak pasti

7. Where did you hear or read about fluoride? Please select all that apply./Di manakah anda mendengar atau membaca tentang fluorida? Sila tanda yang berkenaan.

☐ Print media / Media cetak

☐ Electronic media / Media elektronik

☐ Educational institution / Institusi pendidikan

☐ Friends / Rakan-rakan

☐ Not applicable / Tidak berkaitan

8. Do you know there is the addition of fluoride in your drinking water?/Adakah anda tahu terdapat penambahan fluorida di dalam air minuman anda?

☐ Yes / Ya

☐ No / Tidak

☐ Not sure / Tidak pasti

9. Do you know the purpose of the addition of fluoride in drinking water? / Adakah anda tahu tujuan penambahan fluorida di dalam air minuman?

☐ Yes / Ya

☐ No / Tidak

☐ Not sure / Tidak pasti

10. What is/are the purpose(s) of the addition of fluoride in drinking water? / Apakah tujuan penambahan fluorida di dalam air minuman?

☐ Prevent dental caries / Mengelakkan daripada karies gigi

☐ Preserve oral health / Mengekalkan kesihatan oral

☐ Strengthen bones / Menguatkan tulang

☐ Not sure / Tidak pasti

11. Do you know the optimal level of fluoride addition in drinking water that is implemented by the National Standard Drinking Water Quality (NSDWQ)? / Adakah anda tahu tahap optimal penambahan fluorida di dalam air minuman yang dilaksanakan oleh Kualiti Air Minum Standard Nasional (NSDWQ)?

☐ Yes / Ya

☐ No / Tidak

☐ Not sure / Tidak pasti

12. Lack of fluoride exposure can cause diseases/ Kurang pendedahan fluorida boleh menyebabkan penyakit.

☐ Yes / Ya

☐ No / Tidak

☐ Not sure / Tidak pasti

13. Excessive exposure of fluoride can cause diseases/ Pendedahan fluorida yang berlebihan boleh menyebabkan penyakit.

☐ Yes / Ya

☐ No / Tidak

☐ Not sure / Tidak pasti

14. What are the health effects that may be caused by excessive levels of fluoride in drinking water? / Apakah kesan kesihatan yang disebabkan oleh pendedahan fluorida yang berlebihan di dalam air minuman?

☐ Dental fluorosis / Fluorosis gigi

☐ Skeletal fluorosis / Fluorosis tulang

☐ Insulin secretion problem / Masalah pada perembesan insulin

☐ Neural development problem / Masalah pada perkembangan pembelajaran

☐ Thyroid gland problem / Masalah pada kelenjar tiroid

☐ Not sure / Tidak pasti

15. What are the health effects that may be caused by lack of fluoride exposure in drinking water? / Apakah kesan kesihatan yang disebabkan oleh kurang pendedahan fluorida di dalam air minuman?

☐ Weak bones structure / Struktur tulang yang lemah

☐ Tooth decay / Pereputan gigi

☐ Not sure / Tidak pasti

SECTION C: PERCEPTION OF FLUORIDE IN DRINKING WATER

BAHAGIAN C: PERSEPSI MENGENAI FLUORIDA DI DALAM AIR MINUMAN

16. What is your most commonly used source of drinking water? / Apakah sumber bekalan air minuman yang sering digunakan?

☐ Tap water from public drinking water supply / Air paip daripada sistem air minuman awam

☐ Store bought bottled water / Air botol yang dibeli

☐ Filtered water (Eg: Coway, SK Magic, etc.)

17. State the reason for your choice of the drinking water source/ Nyatakan sebab pilihan sumber air minuman anda.

*You can choose more than one answer/ *Anda boleh memilih lebih daripada satu jawapan.

☐ The taste, smell and color of the drinking water / Rasa, bau dan warna air minuman

☐ Save money and time / Jimat kos dan masa

☐ To guarantee the safety of the drinking water consumption / Yakin dengan keselamatan air minuman

18. Do you think that the addition of fluoride to the public drinking water supply is safe? / Adakah anda berpendapat bahawa penambahan fluorida ke dalam bekalan air minuman awam adalah selamat?

☐ Yes / Ya

☐ No / Tidak

☐ Not sure / Tidak pasti

19. Do you think that the addition of fluoride to the public drinking water supply is effective? / Adakah anda berpendapat bahawa penambahan fluorida ke dalam bekalan air minuman awam adalah berkesan?

☐ Yes / Ya

☐ No / Tidak

☐ Not sure / Tidak pasti

20. Do you think that the addition of fluoride to public drinking water supply can help prevent tooth decay? / Adakah anda berpendapat bahawa penambahan fluorida ke dalam bekalan air minuman awam dapat membantu mengelakkan pereputan gigi?

☐ Yes / Ya

☐ No / Tidak

☐ Not sure / Tidak pasti

21. Are you into the addition of fluoride in drinking water? / Adakah anda menyokong penambahan fluorida di dalam air minuman?

☐ Yes / Ya

☐ No / Tidak

☐ Not sure / Tidak pasti