



UNIVERSITI PUTRA MALAYSIA

***KNOWLEDGE AND PERCEPTION OF FLUORIDE IN DRINKING
WATER AMONG RESIDENTS IN PRECINCT 9, PUTRAJAYA***

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**KNOWLEDGE AND PERCEPTION OF FLORIDE IN DRINKING WATER
AMONG RESIDENTS IN PRECINCT 9, PUTRAJAYA**

BY

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ABSTRACT

KNOWLEDGE AND PERCEPTION OF FLUORIDE IN DRINKING WATER AMONG RESIDENTS IN PRECINCT 9, PUTRAJAYA

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Introduction: Fluoride is commonly found in certain concentrations in the drinking water which is a major dietary source in human daily life due to its variability in the water content. The knowledge and beliefs on the fluoride in drinking water, its purpose and associated health risks aids in equate water fluoridation and effective prevention programs. **Objective:** Therefore, this study aim to determine the level of knowledge and perception of fluoride in drinking water among residents living in Precinct 9, Putrajaya and their association with socio-demographic characteristics. **Methodology:** A self-administered online questionnaire, available in English and Malay language, comprises of 21 questions was modified from a number of previously used questionnaire and validated. The questions examined participant's knowledge and perception of fluoride addition in drinking water regarding the purpose, safety and effectiveness. Descriptive analysis was applied for socio-demographic data and Chi-square was used to compare discrete data. All data obtained were analyzed using SPSS Version 23.0. Participants completed a brief questionnaire about socio-demographic characteristics, evaluation of health benefits and issues, and water consumption choices. **Results and Discussion:** A total of 240 participants completed the questionnaire giving a response rate of 100%. The highest frequency (percentage) of residents were 213 (88.8%), aged 18-64 years old, 141 (58.8%) female, 214 (89.2%) have tertiary education and 125 (51.1%) lived in Precinct 9 for more than 10 years. Of all participants, 137 (57.1%) and 83 (34.6%) have poor knowledge and medium perception regarding fluoride in drinking water respectively. There was a significant association between those with higher education level with knowledge ($p=0.02$) and perception ($p=0.005$) where they were more likely to know about fluoride in drinking water. Water fluoridation was perceived as safe (40.1%) and effective (27.7%). **Conclusion:** Most participants had limited knowledge and negative perception of fluoride beyond a general sense it was beneficial. It appears that in moving forward to receive the water fluoridation support will need to attend to the challenge of anti-fluoride sentiment influence.

Keywords: Knowledge, Perception, Fluoride, Drinking Water, Putrajaya

ABSTRAK

PENGETAHUAN DAN PERSEPSI MENGENAI FLUORIDA DALAM AIR MINUMAN ANTARA PENDUDUK DI PRESINT 9, PUTRAJAYA

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Pendahuluan: Fluorida biasanya ditemui pada kepekatan tertentu dalam air minuman di mana ia merupakan sumber diet utama dalam kehidupan seharian manusia disebabkan variasi fluorida dalam kandungan air. Pengetahuan dan persepsi mengenai fluorida dalam air minuman, tujuan serta hubungan risiko kesihatan membantu menyeimbangkan fluoridasi air dan keberkesanan program pencegahan. **Objektif:** Oleh itu, kajian ini bertujuan untuk menentukan tahap pengetahuan dan persepsi fluorida dalam air minuman antara penduduk di Presint 9, Putrajaya dan perkaitan antara faktor sosio-demografik dengan tahap pengetahuan dan persepsi terhadap fluorida. **Kaedah:** Sebuah borang soal selidik secara atas talian, boleh didapati dalam Bahasa Inggeris atau Melayu, mengandungi 21 soalan yang telah di ubahsuai daripada beberapa borang soal selidik yang telah digunakan dan divalidasi. Soalan-soalan tersebut mengkaji pengetahuan dan persepsi penam bahan fluorida ke dalam air minuman berkenaan tujuan, keselamatan dan keberkesanannya. Analisis diskriptif telah digunakan bagi data berkaitan sosio-demografik dan 'chi square' telah dijalankan bagi membandingkan data diskrit. Kesemua data yang diperolehi telah dianalisa menggunakan SPSS versi 23.0. **Keputusan dan Perbincangan:** Seramai 240 peserta melengkapkan borang soal selidik memberikan kadar maklum balas sebanyak 100%. Frekuensi (peratusan) penduduk adalah 213 (88.8%) berumur 18 hingga 64 tahun, 141 (58.8%) perempuan, 214 (89.2%) mempunyai tahap pengajian ketiga dan 125 (51.1%) tinggal di Presint 9 melebihi 10 tahun. Daripada kesemua peserta, 137 (57.1%) dan 83 (34.6%), masing-masing mempunyai pengetahuan yang lemah dan persepsi yang sederhana berkenaan fluorida dalam air minuman. Terdapat hubungan yang ketara antara mereka yang mempunyai tahap pengajian lebih tinggi dengan pengetahuan ($p=0.002$) dan persepsi ($p=0.005$) di mana mereka lebih mengetahui tentang fluorida dalam air minuman. **Kesimpulan:** Kebanyakan responden mempunyai pengetahuan yang sedikit tentang fluorida walaupun terdapat banyak kelebihan fluorida. Ini menunjukkan bahawa untuk bergerak ke hadapan bagi menerima sokongan fluoridasi air perlu mengatasi cabaran pengaruh sentimen anti-fluorida.

Kata kunci: Pengetahuan, Persepsi, Fluorida, Air Minuman, Putrajaya

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LIST OF ABBREVIATIONS

ADA	American Dental Association
DOSM	Department of Statistics Malaysia
HMC	Hamad Medical Corporation
IBM SPSS	IBM Statistical Package for Social Sciences
IQ	Intelligence quotient
ISO	International Organization for Standardization
JKEUPM	The University Ethics Committee involving Human Subjects of Universiti Putra Malaysia
WTP	Water Treatment Plant
MOH	Ministry of Health
mtDNA	Mitochondrial DNA
NSDWQ	National Standard Drinking Water Quality
NICE	National Institute of Health and Care Excellence
PTD	Probably toxic dose
WHO	World Health Organization

CHAPTER 1

INTRODUCTION

1.1 Background of the Study

Fluoride is a common inorganic anion of fluorine that is found in the natural environment (Thippeswamy et al., 2021). It is extremely soluble in water and may also be found in varied proportions in air, soil, salts, food, and dental products, making it a constant presence in people's life. The food and beverages become one of the sources for fluoride consumption since they are made with water containing fluoride. Meanwhile, Shaharuddin et al. (2009) define fluoride as an electronegative element spread widely in the earth's crust at 0.06 to 0.09% concentration. From a chemical point of view, fluoride is very reactive because of its small atomic radius (Kanduti et al., 2016). Furthermore, fluoride is one of the halides that is abundant in granitic terrains, and it is most likely to have bad health consequences when taken in large quantities as a water supply (Adimalla & Venkatayogi, 2017).

The fluoride presence is ubiquitous. Fluoride can be found in public water systems due to the weathering of rocks containing fluoride or fluorine compounds, which causes runoff, as well as erosion and leaching of soils into groundwater (Tahir & Rasheed, 2013). Normally, some groundwater may have higher levels of fluoride compared to natural springs that naturally contain high fluoride levels depending upon

location and usually presence in not more than 0.3 ppm (Main, 2015). It can also be produced synthetically for daily use in drinking water, and dental use in toothpaste and mouthwashes as well as other variety of chemical products (Brazier, 2018) such as refrigerants, aerosol propellants, and polymers for plastic, electronic ceramics, brick industries and pipe linings. Nevertheless, due to the variability in the water content, it is very common for fluoride to be found in the drinking water that is an important dietary source in human daily life (Aoun, 2018).

Thippeswamy et al. (2021) suggested that fluoride content differs from one location to another. Recently, in Malaysia, a rising trend in demand for water consumption can be clearly seen (Anang et al., 2020; Hu et al., 2021). This makes the population become more vulnerable to exposure to higher concentration of fluoride. Majority of Malaysia public obtain artificially fluoridated processed water with the level of 0.5 mg/L (Shaharuddin et al., 2009). In line with the consumption of water containing fluoride with an increasing concern of adverse health effects, guideline fluoride value was suggested to ensure the drinking water safety (U.S. Environmental Protection Agency, 2018). World Health Organization (WHO) has recommended the permissible limit for fluoride concentration in drinking water that must be less than 1.5 mg/L after considering the water intake of the population and from other sources (World Health Organization, 2011).

Even so, the public may still be exposed to high fluoride concentration if they consume fluoridated drinking water together with other dietary sources in a huge amount. Their uncertainty about the drinking water fluoridation might indicate a lack of levels of health literacy or the ability of an individual to access, understand and

comprehend upon health information and make decisions in an appropriate manner (Sabbahi et al., 2009). Despite the role played by the general public to determine the introduction of fluoride in drinking water, the relations of drinking water fluoridation awareness and stance regarding benefits or harm remain poorly understood (Armfield & Akers, 2010). Given that the efficacy of water fluoridation tends to be impacted by the existence of supportive or opposing groups, knowledge remains restricted, and they believe risk to be greater than research shows (Mork & Griffin, 2015). Therefore, studying knowledge and perception on drinking water fluoridation is crucial for surveillance of the education program and generation of preventive programs to avoid questionable perceived health risks.

1.2 Problem Statement

Despite the fact that a number of research papers have been published in peer-reviewed journals demonstrating that fluoride in drinking water causes detrimental effects to health, the awareness on fluoridation of drinking water in urban areas has not received much attention. Studies have been focusing on the evaluation of the potential of fluoride toxicity on human oral health such as among residents living in rural areas, medical practitioners or school teachers (Sajjan, 2016; Victory et al., 2017; Baltaci et al., 2019). Narrowing down to a Malaysia, there is a lack of study about the knowledge and perception concerning the addition of fluoride in drinking water among the public. This complexity is the fact that a number of alternatives to maintain an adequate fluoridation of drinking water or reduce excess levels of fluoride intake from drinking water that have been reported may not be well-known and understood by the public coming from urban settings. Discontinuation of the addition of fluoride in

public drinking water supply resulted in significant increase of treatment cost from dental caries (McLaren et al., 2017; Meyer et al., 2018).

Furthermore, fluoride was beneficial for dental health in low amounts but toxic in large doses, so there was a trade-off (Aggeborn & Ohman, 2021). Yet, millions of urban residents do not know what fluoridated drinking water is or its preventive benefits. According to Horowitz et al. (2013), adults were aware of fluoride with 98% but as many as 58% of them were not aware of its purpose. The lack of knowledge on the function of the fluoride addition in drinking water therefore may result in less- or overconsumption of the amount of fluoride by individuals. Along the line, residents may overlook the risk following the exposure of fluoride through their dietary intake which then leads to poor health quality. A study conducted by Maybury et al. (2021) highlighted the frequency and incidence of dental caries clearly imply that the public needs to be more aware of the importance of the presence of fluoride in water as a means of prevention.

Moreover, public perceptions on fluoridated drinking water have focused on various themes including the factors influencing the perceptions which include thoughts of the public on health risks related to drinking water (Doria, 2010). The public perceptions on detrimental effects after the consumption of fluoridated drinking water plays a huge role in health-seeking attitudes and practices (Slagle et al., 2015). Due to a lot of contributing factors, public, especially urban residents may face misperceptions which interfere with the decision making that should be effective and comprehensive or fail to compel with continuous beliefs that the safety and effectiveness are equate with the actual purpose of water fluoridation.

1.3 Study Justification

There is no literature on the level of awareness and perception of the urban residents living in Malaysia regarding the addition of fluoride in drinking water supply. In view of above facts, this study will attempt to address the gap by seeing whether the level of knowledge and perception of Precinct 9 residents on the fluoridation of drinking water is too poor or good. From the evidence and the data itself, this study will provide an insight for local authorities to refer to in order to incorporate better approaches and educational promotions on promoting the significance of fluoridation of drinking water. The appropriate actions eventually could ensure the safety of drinking water and sustainable utilization of water resources.

This study can become the baseline in the future for others to study on the level of knowledge of fluoride in drinking water among the similar study population or study area. Therefore, it will help the public to be more aware of the addition of fluoride in their drinking water as they know that it can as well give adverse effects towards their prolonged health effects aside from its preventive benefits. This study will also give an overview on the current public awareness on fluoride relation with drinking water which can result in a good public health knowledge such as consuming adequate fluoride intake through adequate drinking water consumption regardless of socio-demographic background.

Next, conducting this study magnifies the perceived perception of the public living in urban areas on the safety and effectiveness of fluoridation of drinking water in their water supply. Overall, this study provides an understanding on the importance

of prioritizing the public's opinion on the drinking water fluoridation in their living areas. The results developed in this study will enrich existing perception data as well as the effects from less or overconsumption of fluoride.

1.4 Significance of Study

This quantitative study serves to provide a secondary source of information on the evidence of the level of knowledge and perception regarding the fluoride in drinking water among residents living in urban areas. This form of analysis can be used by the authorities to update or change the existing legislation relating to the danger fluoride imposed upon the population's health towards the exposure of too low or high level of fluoride present in drinking water consumed accordingly. As a result, the goal of this cross-sectional study was to provide a space for planners and policymakers to design adequate watershed management in order to provide clean and safe fluoridated drinking water to the people.

1.5 Research Questions

- i. What are the socio-demographic characteristics of the Precinct 9 residents?
- ii. What is the level of knowledge of the fluoride in drinking water among residents in Precinct 9?
- iii. Is there any association between the socio-demographic characteristics and the level of knowledge of the fluoride in drinking water among residents in Precinct 9?

- iv. What is the perception of the fluoride in drinking water among residents in Precinct 9?
- v. Is there any association between the socio-demographic characteristics and the perception of the fluoride in drinking water among residents in Precinct 9?

1.6 Research Objectives

1.6.1 General Objectives

To determine the level of knowledge and perception of fluoride in drinking water among residents living in Precinct 9, Putrajaya.

1.6.2 Specific Objectives

Specifically, the objectives formulated for this proposed research are as follows:

- i. To determine the socio-demographic characteristics of the Precinct 9 residents.
- ii. To identify the level of knowledge of the fluoride in drinking water among residents in Precinct 9.
- iii. To determine the association between the socio-demographic characteristics and the level of knowledge of the fluoride in drinking water among residents in Precinct 9.
- iv. To evaluate the perception of the fluoride in drinking water among residents in Precinct 9.

- v. To determine the association between the socio-demographic characteristics and the perception of the fluoride in drinking water among residents in Precinct 9.

1.7 Research Hypothesis

Research hypothesis of the study was as follows:

- i. The knowledge of the fluoride in drinking water among Precinct 9 residents is good.
- ii. There is a significant association between the socio-demographic characteristics and the level of knowledge of the fluoride in drinking water among residents in Precinct 9
- iii. The perception of the fluoride in drinking water among residents in Precinct 9 is good.
- iv. There is a significant association between the socio-demographic characteristics and the perception of the fluoride in drinking water among residents in Precinct 9

1.8 Variables

1.8.1 Independent Variable

Socio-demographic characteristics (age, gender, educational level and duration of residency).

1.8.2 Dependent Variable

Level of knowledge and perception concerning the addition of fluoride in drinking water

1.9 Definition of Terms

1.9.1 Conceptual Definition

Knowledge

The fact or condition of knowing something with familiarity gained from experience or association (Merriam-Webster, 2021).

Perception

An idea, a belief, or an image a person has as a result of how they see or understand something (Oxford Learner's Dictionaries, n.d.).

Fluoridation of drinking water

Process of adding fluoride to the water supply to an optimum level that allows everyone to enjoy its beneficial effects (Department of Health Western Australia, n.d.).

Urban residents

Inhabitants who have non-agricultural jobs in a region surrounding a city very developed with a density of human structures and high population density (National Geographic Society, 2011).

1.9.1 Operational Definition

Knowledge

The information on the level of understanding for an individual is measured through a section on knowledge from an online self-administered questionnaire that is distributed in Google Forms.

Perception

Thought processes and responses to the perceived safety and effectiveness of the addition of fluoride in drinking water gained through a section on perception from an online self-administered questionnaire that is distributed in Google Forms.

Fluoridation of drinking water

The addition of fluoride into drinking water supply in relation with the level or knowledge and perception of the urban residents obtained through questionnaire.

Urban residents

Population living in an established planned city with dense residential zones and significant economic growth receiving water supply from water distribution network.

1.10 Conceptual Framework

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

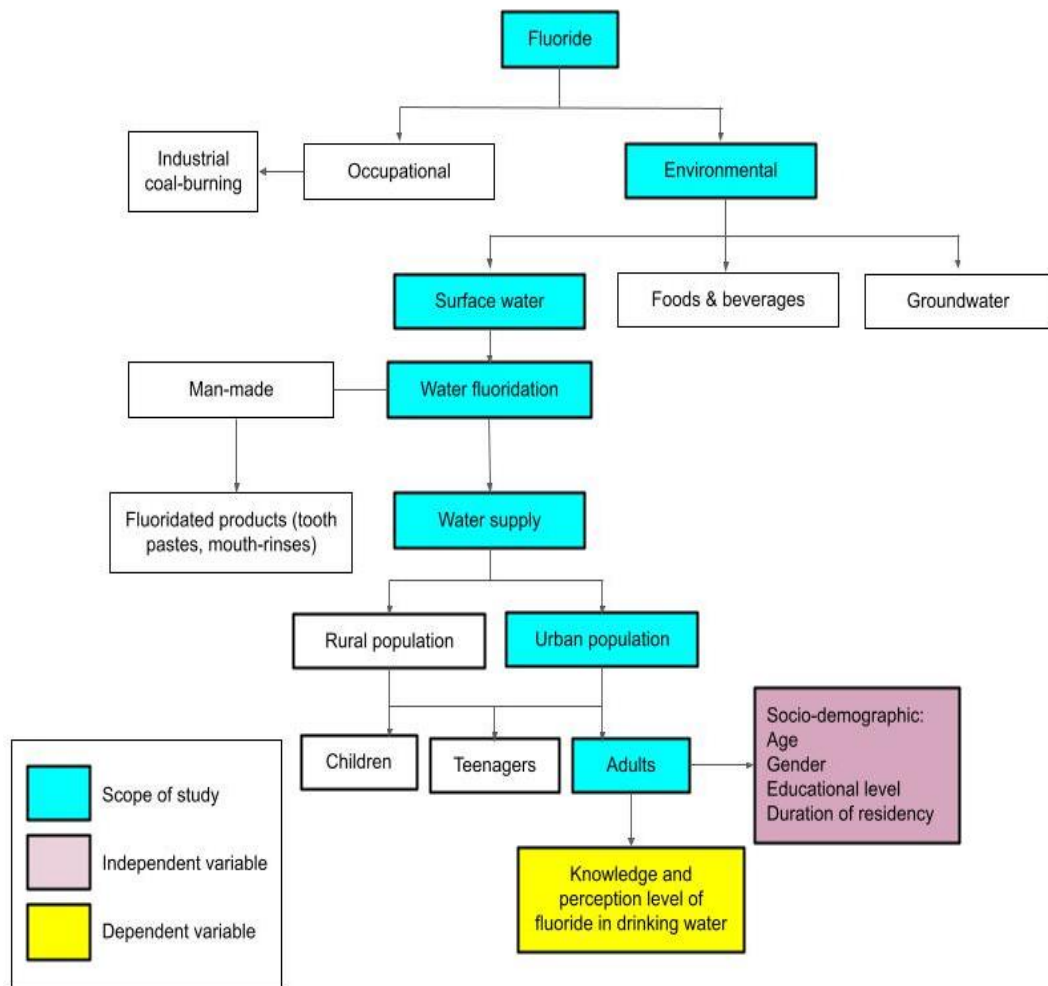


Figure 1.1 Conceptual Framework

Figure 1.1 illustrated the research conceptual framework of this study. Based on Figure 1.1, the independent variable were socio-demographic characteristics (age, gender, educational level and duration of residency), while the dependent variable was the level of knowledge and perception of the fluoride in drinking water.

The residents tend to be exposed to fluoride in their major dietary source, via water supply aside from other contributing sources like food, beverages and dental products. As for the indicator, yellow filled boxes indicated the dependent variable, purple filled box indicated the independent variable and blue filled boxes indicated the variables under study and the uncoloured boxes referred to the variables that were not being studied.

CHAPTER 2

LITERATURE REVIEW

Fluoride is one of a few elements holding delicate balance in the human body with either beneficial additive or toxic contaminants. Therefore, this review chapter takes a look at the overview of fluoride and its metabolism to provide a clearer picture of its mechanism in affecting human health. Furthermore, accumulation of fluoride in the drinking water is outlined. Next, water fluoridation is described based on data reported in the literature. Salt- and milk fluoridation is also described briefly. The benefits of fluoride intake and possible health effects following the exposure to fluoride in drinking water including dental fluorosis, skeletal fluorosis, dental caries and other health effects from either low or excessive fluoridated-water consumption from previous research conducted are also discussed. Moreover, the similar studies related to fluoride in drinking water are explained. Finally, the limitations of previous research are stated.

2.1 Overview of Fluoride

Fluorine levels in soil are around 330 ppm. Fluorine is the halogen group's lightest component, accounting for 0.08% of the earth's crust and having the greatest electronegativity of other elements in the environment (Stephen & Niyi, 2014).

Fluorine is a univalent gaseous halogen with a delicate yellow-green colour and the highest chemical reactivity of any other element (Dey & Giri 2016). Fluorine is typically found as fluoride in aqueous solutions because it has a strong tendency to acquire a negative charge.

Fluoride exists as a natural compound of fluorine that is rare as it is the 13th most abundant elements on earth widely distributed by weight percent of 0.054% (Budisa et al., 2014) such as fluorspar (CaF_2), fluorapatite ($\text{Ca}_5(\text{PO}_4)_3$), and cryolite (Na_3AlF_6). Fluoride is one type of mineral occurring in all natural water bodies and ubiquitously present in nature as well as all mineralized tissues of the body in trace amounts (Ullah et al., 2017). Thippeswamy et al. (2021) stated that fluoride can be found naturally such as from volcanic activity, water, food and soil and can as well be chemically synthesized. Because of its high reactivity, this anion can form compounds with water and other substances easily.

2.2 Fluoride Accumulation in Drinking Water

There are a number of ways fluoride makes its way into drinking water. Since 1951, U.S. Public Health Service has been adding fluoride into the public source of drinking water (Guissouma et al., 2017). More than 200 million people worldwide, most of whom live in poor countries, are believed to be drinking water with fluoride levels surpassing the World Health Organization's recommended limit of 1.5 mg/L (World Health Organization, 2011).

On the other hand, the standard fluoride level in drinking water in Malaysia is set to be in the range of 0.4 - 0.6 mg/L in line with the National Standard for Drinking water Quality (NSDWQ) (Ministry of Health, 2019). In the United States, the recommendation as lowered to 0.7 mg/L has been put into question among the public as too high and too low (U.S. Public Health Service). It is undeniable that every human being has the natural right to safe drinking water. Thippeswamy et al. (2010) suggested 0.05 to 0.07 mg/kg body weight as per the American Academy of Pediatrics as the optimum health benefits following the potential dietary exposure to fluoride from drinking water.

2.3 Fluoridation

Population-based public health programmes aim to deliver frequent, low-level fluoride exposure in the community through acceptable ways such as fluoridated water, salt, and milk (Idowu et al., 2019). Fluoride is used in a variety of ways to prevent dental cavities (Marinho, 2015). Fluoridated salt is available in 23 nations, and community water fluoridation is currently being introduced in 25 countries (Pollick, 2013). If the fluoride concentration in drinking water is low, fluoridation can be used, whereas defluoridation can be used to lower the fluoride content (Giwa et al., 2021).

2.3.1 Water Fluoridation

Significant levels of fluoride are naturally present in many water supplies. Water fluoridation method is the most successfully adopted method (Ullah & Zafar, 2015) where fluoride is added into drinking water and public water supplies with the target of preventing tooth decay from happening. Fluoridation of community drinking water sources is highly supported by the American Dental Association (ADA) (American Dental Association, n. d.). Fluoride is often used in water fluoridation because it is effective in decontaminating water and preventing tooth decay by exposing people to low doses of fluoride on a regular basis (U.S. Centers for Disease Control and Prevention, 2019).

According to Goodarzi et al. (2016), water fluoridation is the most effective technique to ensure the community's oral health. In Australia, Brazil, Chile, Canada, China, Malaysia, New Zealand, the Republic of Ireland, Singapore, Spain, the United Kingdom, and the United States, extensive water fluoridation programmes have been implemented (O'Mullane et al., 2016). Nevertheless, fluoridated drinking water is the most important determinant in fluoride content in the dietary intake (Robert et al., 2020). In Malaysia, water fluoridation began in 1972 to reduce dental caries which leads to around 20.7 million or up to 75% of the country's population receiving fluoridated water (Karim et al., 2020). In the twentieth century, water fluoridation was heralded as one of the best achievements for public health as it is known to be the simplest strategy in maintaining a constant fluoride concentration in drinking water (Aoun, 2018).

The American Dental Association (ADA) has recommended fluoridation of municipal water systems as a safe, effective, and necessary technique of preventing tooth decay (Division of Government and Public Affairs, 2017).

In terms of efficacy, recent research continues to indicate that water fluoridation protects against dental cavities. The safety, effectiveness of water fluoridation as a huge contributor to the significant decline in dental caries is agreed by many (Peckham & Awofeso, 2014). WHO has advised community water fluoridation, which is the practice of increasing the quantity of fluoride in drinking water to prevent tooth decay (World Health Organization, 2011).

Next, fluoridation of community drinking water is a safe, cost-effective, and efficient way to eliminate dental decay in people of all ages and socio-economic backgrounds, establishing the framework for comprehensive community caries-prevention strategies (U.S. Centers for Disease Control and Prevention, 2020). In contrast to this widespread acceptance of water fluoridation and its benefits, some general public still stand in the opposition (Tiemann, 2013).

There is a growing worries about fluoridation in public water supplies for political, moral, ethical, economic, and safety reasons (Unde et al., 2018) due to its questionable effectiveness in preventing caries for contemporary society; its safety such as health effects from deposited fluoride in bones with high affinity for calcium that is absorbed but not excreted, its administration through public water supplies and removal or deciding the one's water supply is fluoridated or not.

2.3.2 Salt Fluoridation

Apart from drinking water, researchers and policy makers explored different fluoride delivery vehicles by the addition of fluoride to milk, table salt and many others as the alternatives for areas without adequate water fluoridation (Ashkenazi et al., 2014). Fluoride exposure is also possible via bioavailable fluoride found in fluoridated salt (Garcia-Perez et al., 2013). Salt with added fluoride was assumed to be useful for human consumption when it is perceived to be the better product from the public health point of view (Barker et al., 2016).

One of the common uses of fluoridated salt is for food items such as bread (O'Mullane, 2016) in order to increase the frequency of daily contacts of fluoride with teeth. This approach has significant potential to prevent dental cavities since it is far less expensive than water fluoridation systems, with an estimated cost of 10 to 100 times less (Pollick and Francisco, 2015) for preventing caries that are accessible and applicable to all. Fluoridation of salt must be used in combination with fluoride in dentifrices for the maximum benefit. As part of a salt fluoridation programme, an effective surveillance system is essential to guarantee a balance between the anticaries effect of fluoride (benefit) and the prevention of dental fluorosis (risk) (Walsh & Cury, 2018).

2.3.3 Milk Fluoridation

Milk fluoridation is known as one of the widely used preventive methods for decades. Fluoride acts in both topical and systematic in a similar way as fluoride in

water (Banoczy, 2013). The quantity of fluoride necessary is determined by the age of the children, the fluoride content of the local water supply, and the amount of fluoridated milk ingested each day (Watson et al., 2011).

Milk has been shown to be a somewhat cost-effective carrier for fluoride in the prevention of dental cavities in economic evaluations (Marino, 2011). Moreover, fluoridation of milk is generally beneficial in the prevention of tooth cavities (Aoun et al., 2018). But, fluoride distribution by milk fluoridation is ineffective when compared to other fluoridation techniques (Ullah et al., 2017).

2.4 Fluoride Metabolism

Ingestion, inhalation, dermal contact, and, most importantly, drinking water are all ways that fluoride enters the human body in a chemically soluble state (Demelash et al., 2019). Fluoride is absorbed into the gastrointestinal system after intake, with up to 90% of it passing through the stomach and 77% passing through the proximal section of the small intestine, with the remainder passing via the feces (Buzalaf & Whitford, 2011). Fluoride is transported into the bloodstream and distributed through the organism (Fawell et al., 2006) and subsequently binds to plasma protein.

The fluoride that is transported in plasma appears in two forms which is ionic fluoride and designated non-ionic fluoride consisting of lipid-soluble organic fluoro-compounds (Martinez-Mier, 2012). Ionic fluoride is readily excreted because it does not bind to plasma proteins. The majority of the ingested fluoride that is not absorbed by mineralized tissues is eliminated in urine, with just a small quantity released in

perspiration and feces (Fawell et al., 2006). The kidneys mainly aid in the removal of fluoride in the body.

Fluoride metabolism can be influenced by a variety of factors. Acid-base illnesses, physical activity, circadian rhythm, hormones, renal function, inherited predispositions, and food are all common contributors (Buzalaf & Whitford 2011). A combination of all these possible fluoride carriers, as well as a complicated fluoride availability influence the fluoride excretion (Idowu et al., 2019).

2.5 Beneficial Effects of Adequate Fluoride Intake

Kimambo et al. (2019) highlighted that it is generally recognized that this essential micronutrient has both favorable and harmful impacts on the population's health when consumed from drinking water and other sources.

Fluoride in the right dosage can help prevent and manage tooth decay in both children and adults (U.S. Centers for Disease Control and Prevention, 2021). Low amounts of fluoride consumption tend to prevent dental caries (World Health Organization, 2018).

The fluoride concentration ranging from 0.6 to 1.2 mg/L in drinking water as set by the Ministry of Health (MOH) (Ministry of Health, 2019) is beneficial for development of bones and teeth. The drinking water fluoridation for the public illustrates an effective purpose in reducing dental caries (U.S. Public Health Service, 2015).

Fluoride has been touted by several studies as one of the most effective strategies to prevent tooth cavities. Because fluoride has a topical effect on tooth decay prevention, only topical fluoride treatments are likely to provide the entire spectrum of fluoride benefits (Peckham & Awofeso, 2014). Regardless of birth cohort, Australian adults who had a long history of drinking fluoridated water had significantly fewer decayed permanent teeth than those who had just a short history of drinking fluoridated water (Slade et al., 2013). Hence, it is advised that community water fluoridation be used since it can give a safe and effective 25% reduction in tooth decay in children and adults (U.S. Centers for Disease Control and Prevention, 2019).

2.6 Harmful Effects of Inadequate Fluoride Intake

Fluoride exposure is identified to be influenced by geology (Craig et al., 2015) and climatic type. As a result of their huge volume of water consumption, populations living in hot regions are particularly vulnerable to excessive fluoride ingestion (Dongzagla et al., 2021). Fluoride is a micronutrient that is essential for bone formation and growth (Chen et al., 2020). However, fluorosis and fluoride consumption have a dose response relationship, which means that as fluoride intake increases, so does the prevalence and severity of fluorosis (Bhagavatula et al., 2017). A research in Iran found that a fluoride concentration of 0.5 mg/L had an effect on human thyroid hormone function (Kheradpisheh et al., 2018).

There is much evidence presenting both lower and excessive exposure to fluoride concentration and its risk to teeth and bones, however there are significant differences between them. Excessive consumption of fluoride dominantly through fluoridated drinking water while teeth are being formed causes different types of fluorosis. Fluorosis affects teeth and bones (World Health Organization, 2018). Enamel development (dental or enamel fluorosis) and bone homeostasis (skeletal fluorosis) are resulted from systemic effect of the fluoride ingested (Everett, 2011) in which they undergo different mechanisms of action of fluoride development since they are formed in totally distinct ways. One example between dental fluorosis and skeletal fluorosis is the mineralization (calcification) process they undergo.

2.6.1 Dental Fluorosis

Fluoride is an essential component of human health. Fluoride exposure at high levels for extended periods of time can result in a variety of health concerns, ranging from tooth loss to excruciating discomfort (Ramadan and Ghandourb, 2016). Due to greater water consumption in Africa's warmer areas, high fluoride levels in drinking water produce a high prevalence of dental fluorosis (Malago et al., 2017).

The prevalence of dental fluorosis was considerably higher in the high-fluoride exposure group than in the normal-fluoride exposure group (Yu et al., 2018). This disease creates white or brown discolouration or patches on the enamel, or tooth surface (Colgate, 2021).

Dental fluorosis is on the rise, according to Iheozor et al. (2015). Because the essential time of development of dental fluorosis is confined to the child's age, when they are still going through the pre-eruptive systemic effect of their teeth, dental fluorosis is more severe among children and young people living in fluoridated areas (Pretty et al., 2016). Children aged 8 and younger are the most vulnerable to dental fluorosis since their permanent teeth are still forming (U.S. Centers for Disease Control and Prevention 2021).

2.6.2 Skeletal Fluorosis

Long-term exposure to an excessive amount of fluoride can cause skeletal fluorosis (World Health Organization, 2018). Any person regardless of age difference can still be exposed to the risk perpetuated of skeletal fluorosis throughout the person's life (Cury et al., 2019). There are variable degrees of locomotor disability, in the range of simple mechanical back pain until crippling locomotor impairment that is more severe.

In a cross-sectional study, Zhou et al. (2019) looked at the relationship between low-to-moderate fluoride exposure and relative mtDNA levels in connection to dental fluorosis in children. Children aged 7 to 13 years old were chosen at random from low-to-moderate fluoride districts in Tianjin, China. Their findings demonstrated a positive relationship between low-to-moderate water fluoride and urine fluoride concentrations and dental fluorosis prevalence, with gender acting as a possible modifier.

2.6.3 Dental Caries

Fluoride consumption in low quantities on a regular basis is widely associated to dental caries, which is caused by bacteria's pre-eruptive and post-eruptive metabolism (TenCate & Buzalaf, 2019). A systematic review revealed that the risk of developing caries lesions or experience is higher in developed countries than low socioeconomic countries (Schwendicke, 2015). According to Rathee and Sapra (2021), WHO Global Oral Health Data Bank showed that the recent dental caries prevalence is up to 49% to 83%.

Fluoride of drinking water decreases the onset of dental caries and delays or reverses the course of existing lesions in as many as 86% of dentists and 78% of medical practitioners. However, Petersen and Ogawa (2016) stated that even though dental caries can largely be prevented, it still remains a global public health issue affecting the vast majority of adults and around 60 to 90% school children.

Dental caries also prevailed in China and Chongqing (Zheng et al., 2020). The researchers added that the children were exposed to fluoride from groundwater beginning with the period of permanent formation of teeth and maturation of enamel, reflecting dental fluorosis since the children grow up at the places since birth.

2.6.4 Other Possible Health Effects

Excessive fluoride in drinking water causes most cases of morbidity in Africa (Malago et al., 2017). The larger the quantity of fluoride swallowed and absorbed, the greater the risk of cardiac arrest and death (Cury et al., 2019). Fluoride is an important micronutrient for the development of bones and teeth in children, however a research in Iran found that a 0.5 mg/L dosage of fluoride affects the function of human thyroid hormones (Kheradpisheh et al., 2018). Grandjean and Landrigan (2015) revealed that fluoride exposure may also be neurotoxic to fetus development.

It has also been suggested in other studies that relationship exists between lower intelligence levels in children's and high levels of fluoride in water (Duan et al., 2018). Barberio et al. (2017) found that staying in places with artificially fluoridated water has no harmful impact on IQ, cognitive development, or learning difficulties.

However, a research conducted in Mexico by Bashash et al. (2017) found that children whose mothers drank more fluoridated water during pregnancy children have a higher intelligence quotient (IQ). The latter study done in Canada by Green et al. (2019) reached a similar outcome in their research of children whose moms drank fluoridated water whereby there was a drop of about 4 IQ points for an increase of 1 mg of fluoride consumption. Almost all of the research, which were from various nations, indicated a negative or no link between fluoride levels in the water and IQ deficiencies in a community water fluoridation programme (Broadbent et al., 2015; Jimenez et al., 2017; Razdan et al., 2017; Till et al., 2020; and Wang et al., 2020).

2.7 Specific Studies Related with Knowledge and Perception on Fluoride in Drinking Water

Because the public is the major beneficiary of clean and safe water supplies and the first to experience the repercussions of poor water quality, the World Health Organization recognises the importance of public participation in drinking water quality surveillance (World Health Organization, 2011). Thus, a comprehensive understanding of the fluoride presence, its optimal concentration, advantages as well as detrimental effects greatly potentiate the use of fluoride with reducing the risk of fluorosis.

Kebede et al. (2016) stated that in general, people of all groups felt that drinking water from a treated source is better as treated pipe water is very safe to be consumed. They added that despite the fact that none of the participants mentioned the word "fluoride" as a cause of fluorosis, they all agreed that the health issue is caused by drinking water that contains "poor minerals". This study also found that attention and approaches through education and intervention programs on fluoride and its consequences to health must be given to women since most women are in child-bearing age.

According to data collected from national distributions in South Carolina and West Virginia, approximately 67% of respondents agreed or strongly agreed that their municipality fluoridates its water at 0.7 mg/L, while 33% said their municipality does not fluoridate at the recommended policy level or that they do not know if their community fluoridates at this level (Walker et al., 2020). The researchers added that

according to about 40% of respondents, water fluoridation policy is an evenly applied policy across the United States. From this, it can be concluded that there are mixed perspectives among the respondents regarding the community water fluoridation programme as some opt out to having a water system with no fluoride added in their drinking water. The findings of their study also opened up new possibilities for improving transparency and knowledge exchange among stakeholders.

Another recent study conducted by Sabti et al. (2019) among dentists and medical practitioners found that both groups have low level of awareness regarding the water fluoridation benefits, risks and status in their area, Kuwait with dentist (38%) significantly more aware as compared to physicians (25%). In addition, the researchers found that 58% of dentists have the belief that they have sufficient general knowledge on fluoridation of water whereas only 11% of medical practitioners believed so with both groups believing the need for further information on water fluoridation.

2.8 Limitations

Any survey, which is limited only to public perception, may be biased and lead the concerned authority to make an incorrect policy decision. Information communication on preventive methods and mitigation is not mentioned which might lead to wrong perception among the community (Kebede et al., 2016). Another potential limitation that should be considered is on the alternative fluoride sources, such as tea or fluoridated dentifrices that may also play a role in total fluoride intake at high levels especially in children's dentifrices (Zohouri et al., 2013).

Quantitative studies suffer from limitations on the consideration of drinking water as the only source of exposure (Ameer et al., 2018). As there are other contributions on fluoride exposure like food, the researcher stated that high incidences of skeletal fluorosis linked with a level more than 1.4 mg/litre in drinking water cannot be ruled out as a result of other exposures.

2.9 Summary

The summary of this literature review is that it focused on overviewing the fluoride and assessing its concentration in drinking water. This literature also describes water-, milk- and salt fluoridation aside from fluoride metabolism. Also, the benefits of adequate fluoride intake in the general population along with the harmful effects are highlighted by providing information from previous research conducted on dental fluorosis, skeletal fluorosis, dental caries and others. Lastly, the limitations of previous research are listed.

CHAPTER 3

METHODOLOGY

3.1 Research Design

In this research, a quantitative method was used to collect information as it helped to obtain understanding, and collect data in order to attain statistical data. This was a cross-sectional study designed to determine the knowledge and perception of the fluoride in drinking water among residents living in Precinct 9, Putrajaya. Due to the time factor, cross-sectional study eased the data collection by distributing the survey through online data entry form, specifically Google Forms to a chosen sample in the targeted population.

3.2 Study Location

The proposed study was carried out at Precinct 9, Putrajaya. Putrajaya is situated in the west-central of Peninsular Malaysia. The area of Putrajaya is 49 km² and geographically situated at 2° 53' 20" N to 2° 57' 55" N latitude and 101° 37' 50" E and 101° 43' 20" E longitude (Almdhun et al. 2018). Putrajaya is divided into 20 precincts. Except for a few Precincts, such as Precinct 20, which is designated as a Muslim cemetery, practically all of the Precincts include residential zones.

This study selected Precinct 9, Putrajaya as the site of data collection because Precinct 9 is designated for medium- and high-density residential development so, the majority of Precinct 9's neighbourhood is mainly composed of flats and apartments, resulting in the highest population density in Putrajaya. With that, the socio-demographic characteristics and educational backgrounds of the population in the study area varies. The justification for this choice was also based on the major requirement of water fluoride data availability in an existing planned city where the water supply is now fluoridated and delivered to residential areas via water pipes. The Sungai Semenyih Water Treatment Plant in Putrajaya's Precinct 19 is one of the certified Water Treatment Plan (WTP) by the International Organization for Standardization (ISO). The water treatment facility focuses on its capabilities, public safety, and water treatment process and operating action plan (SelangorKini 2019).

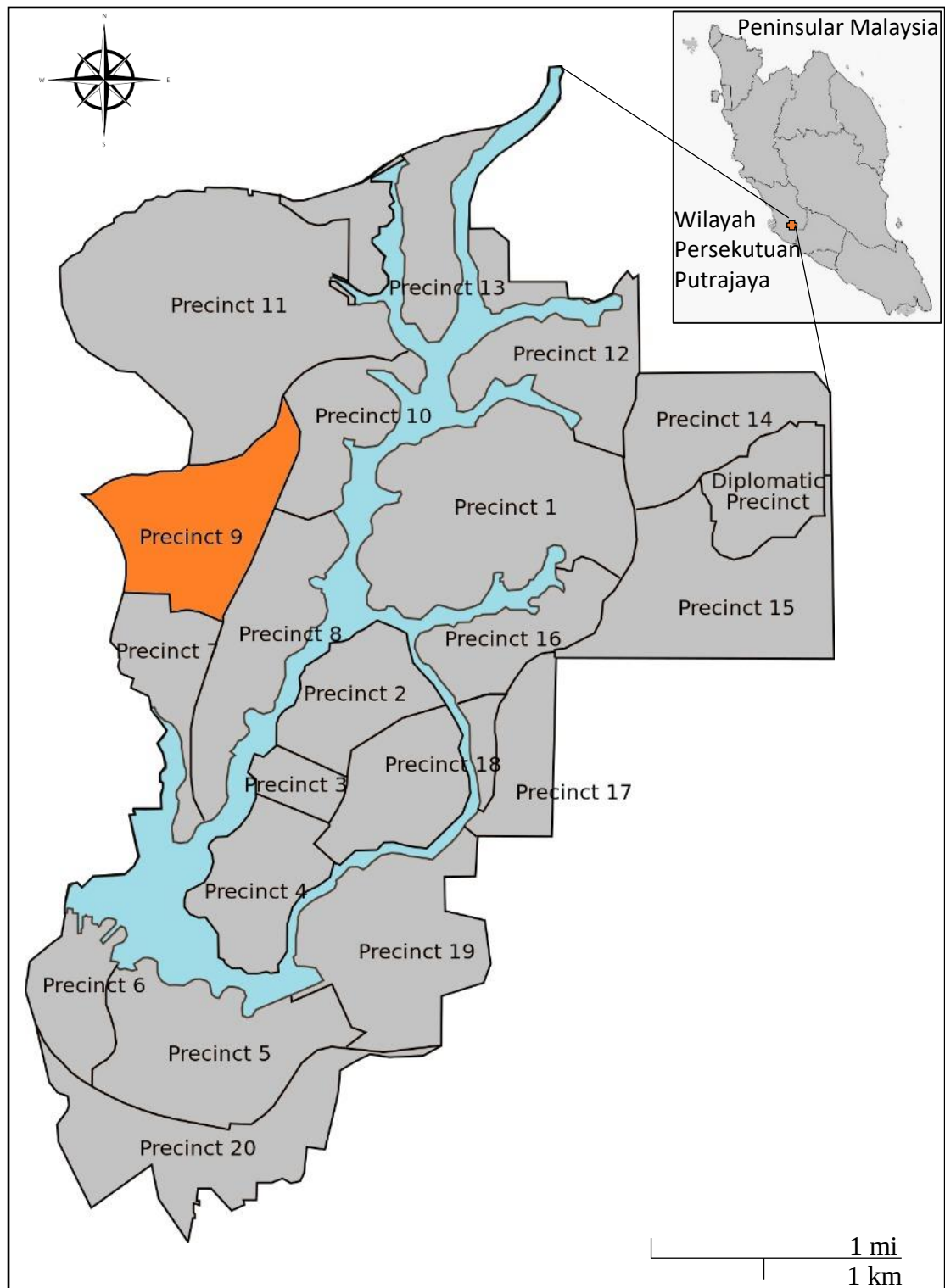


Figure 3.1 Map of Precinct 9, Putrajaya

3.3 Study Duration

In this research, the study was conducted from November 2021 until December 2021.

3.4 Sampling

3.4.1 Study Population

In research from Department of Statistics Malaysia (DOSM) [MyCensus2020], (2020) the total population of Putrajaya is 103,700 people with population density 2,103 people per km² consisting of 48,600 males to 55,100 females with gender ratio of 88 males to 100 females. The population living in Precinct 9, Putrajaya with various backgrounds were the respondents involved in this study. After identifying the total population, the researcher reached the accessible population to draw sample.

3.4.2 Study Sample

The study sample of this research was chosen based on the inclusive and exclusive criteria.

3.4.3 Sampling Frame

The sampling frame was a list of elements from which a sample may be drawn. In this study, the sampling frame was adults residing in Precinct 9, Putrajaya based on the inclusive and exclusive criteria of the study.

3.4.4 Sampling Unit

In this study, the sampling unit was the selected residents from Precinct 9, Putrajaya. Table 3.1 showed the required criteria for when the respondents were eligible after fulfilling the inclusive and exclusive criteria.

Table 3.1 Eligibility Criteria

Inclusive Criteria	Exclusive Criteria
• Adults age 18 years old and above • Residents of Precinct 9, Putrajaya	• Sick or mentally disabled individuals

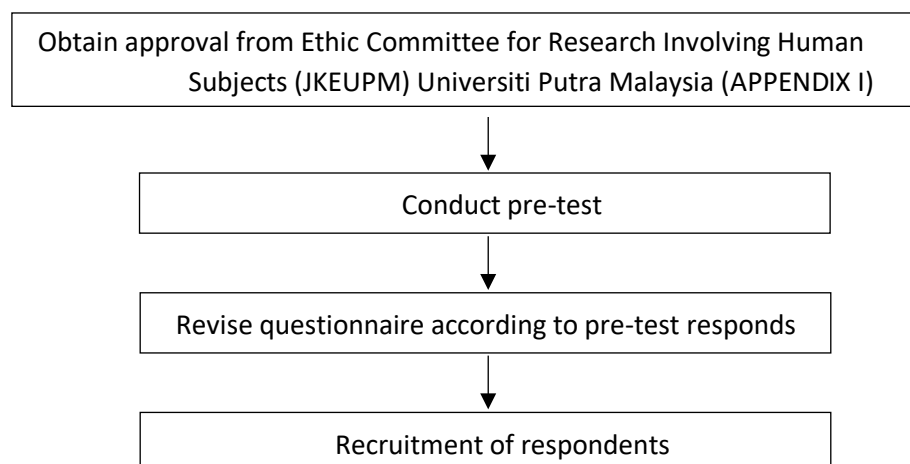
3.4.5 Sampling Method

In this study, the sampling method used to approach the respondents was by using a non-probability sampling method which was a purposive sampling. This method was applied to choose the respondents that match with the characteristics of this study. Only those matches with the inclusive and exclusive criteria were chosen to proceed answering the questionnaire until the sufficient sample size was reached for this study. The consent form was distributed to each of the respondent to allow voluntary participation and permission.

3.4.6 Data Collection

This study was conducted after receiving approval from The University Ethics Committee involving Human Subjects of Universiti Putra Malaysia, JKEUPM. Then, the data was collected by means of an online questionnaire. Based on Figure 3.2 Research Flowchart, after receiving approval from JKEUPM, the first sampling procedure was done by administering a test-retest reliability on the questionnaire to ensure the reliability and adapt the suitable questions according to the study population and study location. This procedure was very important in order to obtain accurate results and good interpretation.

Next, consent forms was distributed and the questionnaire in dual language (English and Malay, in such cases where respondents might request either version of language for the questionnaire) will be administered to the representative sample to further filter the residents according to the inclusive criteria. The survey was distributed online to residents living in Precinct 9, Putrajaya. The questionnaire took about 5 minutes to be completed. The consent form and survey forms were set out in APPENDIX III and APPENDIX VI respectively.



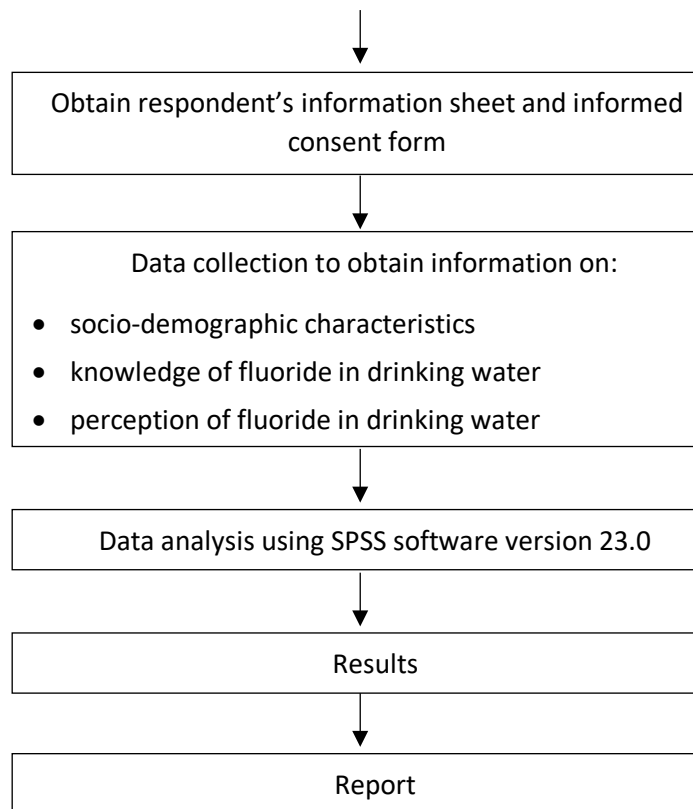


Figure 3.2 Research Flowchart

3.4.7 Sample Size

The study was designed to determine the knowledge and perception concerning the fluoride in drinking water among residents of Precinct 9, Putrajaya within 5% of the true prevalence with 95% confidence.

3.4.8 Sample Size Estimation

The sample size calculation was determined following the objectives of the study. The formula for calculating the sample size was shown as in Table 3.2 Sample Size Calculation below:

Table 3.2 Sample Size Calculation

Objective	Formula	Reference	Total sample size (n)
To identify the level of knowledge of the fluoride in drinking water among residents in Precinct 9.	The sample size equation was used in this study to calculate an adequate sample size: $N = \frac{Z^2_{1-\alpha/2} P(1 - P)}{d^2}$ Where, N = Sample size Where, Z = 1.96 for 95% confidence interval P = Expected proportion d = confidence interval expressed as decimal (Margin of error is ±5% or 0.05)	Based on the previous research, the level of knowledge on the presence of fluoride in drinking water is P = 79.5% (Quinonez & Locker, 2009).	n = 196

To determine the association between the socio-demographic characteristics and the level of knowledge of the fluoride in drinking water among residents in Precinct 9.

The sample size was determined by using the formula:

$$\delta = |P_2 - P_1|, \quad \bar{P} = \frac{P_1 + rP_2}{r+1} \quad \text{and} \quad \bar{Q} = 1 - \bar{P}$$

$$m = \frac{m'}{4} \left[1 + \sqrt{1 + \frac{2(r+1)}{rm'\delta}} \right]^2 \quad (*)$$

$$\text{where } m' = \frac{\left[z_{\alpha} \sqrt{(r+1)\bar{P}\bar{Q}} + z_{\beta} \sqrt{(rP_1Q_1 + P_2Q_2)} \right]^2}{r\delta^2}$$

$$N = (r+1)m$$

Note: (*) is corrected with continuity

Based on the previous research conducted by Sutharsan et al. (2020), n = 106 males are more aware in terms of fluoride in drinking water as compared to females.

Percent of unexposed with outcome (Female = 9%)

Percent of exposed with outcome (Male = 33%)

To evaluate the perception of the fluoride in drinking water among residents in Precinct 9.

The sample size equation was used in this study to calculate an adequate sample size:

$$N = \frac{Z^2_{1-\alpha/2} P(1 - P)}{d^2}$$

Where,

N = Sample size

Z = 1.96 for 95% confidence interval

P = Expected proportion

d = confidence interval expressed as decimal (Margin of error is $\pm 5\%$ or 0.05)

Based on the previous n = 125 research, the perception of the presence of fluoride in drinking water is P = 91.1% (Epidemiology Branch, 2011).

To determine the association between the socio-demographic characteristics and the perception of the fluoride in drinking water among residents in Precinct 9.

The sample size was determined by using the formula:

$$\delta = |P_2 - P_1|, \quad \bar{P} = \frac{P_1 + rP_2}{r+1} \quad \text{and} \quad \bar{Q} = 1 - \bar{P}$$

$$m = \frac{m'}{4} \left[1 + \sqrt{1 + \frac{2(r+1)}{m'\delta}} \right]^2 \quad (*)$$

where

$$m' = \frac{\left[z_{\alpha} \sqrt{(r+1)P\bar{Q}} + z_{\beta} \sqrt{(rPQ_1 + P_2Q_2)} \right]^2}{r\delta^2}$$

$$N = (r+1)m$$

Note: (*) is corrected with continuity

Based on the previous n = 200 research conducted by Mork and Griffin (2015),

Percent of unexposed with outcome (Persons with less than a high school education = 47.32%)

Percent of exposed with outcome (Persons with more than a high school education = 67.89%)

By referring to the highest number of sample sizes from previous studies and considering 20% for non-response rate, missing data, unavailability of subjects or refusal to participate, the adjustment for estimated response rate was calculated.

$$\begin{aligned} N &= n + 20\% \\ &= 200 + 20\% \\ &= 240 \text{ respondents.} \end{aligned}$$

Thus, the sample size required for this study was 240 respondents.

3.5 Research Instrument

3.5.1 Questionnaire

Baseline measures included a 21-item survey reproduced questions based on the questions used previously by several similar published literature on knowledge and perception towards the addition of fluoride to public drinking water supplies; 4 items for socio-demographic information, 11 items for knowledge and 6 items for perception (APPENDIX IV). Relevant questions were extracted and written in concise, research-centered and ethically appropriate. Surveys were made into one form, an online questionnaire. The respondents were asked to fill up the questionnaire that was adapted and modified according to the setting of this study. The questionnaire was available in English and Malay language using back-to-back translation methods to facilitate easy understanding by the respondents. The bilingual questionnaire was divided into three sections; Section A: Socio-demographic Characteristics, Section B: Knowledge of Fluoride in Drinking Water and Section C: Perception of Fluoride in Drinking Water.

The details for the questionnaire used in this study were as attached in APPENDIX IV. Respondents were allowed to participate voluntarily. The components of questionnaires were explained as below:

Section A: Socio-demographic Characteristics

This section sought some basic breakdown information but did not require the identifiable information about individuals. This was to ensure that there was a verification that all study subjects have fulfilled the inclusive and exclusive criteria and completed the surveys. It was a structured questionnaire whereby the types of questions are close-ended questions. The items consisted of the age, gender, educational level and duration of residency of respondents. This section was adapted from the (Environmental Health Directorate, 2012). Details of the questions are shown in Table 3.3.

Table 3.3 Socio-demographic Characteristics and Components

No.	Socio-demographic variables	Scales/Categories
1.	Age	18-64 years old, more than 64 years old
2.	Gender	Male, female
3.	Educational level	Primary education, secondary education, tertiary education, no formal education
4.	Duration of residency	Less than a year, 1-5 years, 6-10 years, more than 10 years

Section B: Knowledge of Fluoride in Drinking Water

The knowledge of fluoride in drinking water consists of 11 items with all of them were open-ended and close-ended questions regarding the presence of fluoride in drinking water.

1. Do you know what fluoride is? Yes, no or not sure
2. Have you heard or read about fluoride before? Yes, no or not sure
3. Where did you hear(s) or read(s) about fluoride? Print media, electronic media, educational institution, friends, not applicable or others
4. Do you know there is the addition of fluoride in your drinking water? Yes, no, not sure
5. Do you know the purpose of the addition of fluoride in drinking water? Yes, no or not sure
6. What is/are the purpose(s) of the addition of fluoride in drinking water?
Prevent dental caries, preserve oral health, strengthening bones, not sure
7. Do you know the optimal level of fluoride addition in drinking water that is implemented by the National Standard Drinking Water Quality (NSDWQ)?
Yes, no or not sure
8. Lack of fluoride exposure can cause diseases. Yes, no, not sure
9. What is/are the health effect(s) that may be caused by lack of fluoride exposure in drinking water? Weak bone structure, tooth decay or not sure
10. Excessive of fluoride exposure can cause diseases. Yes, no or not sure

11. What is/are the health effect(s) that may be caused by excessive levels of fluoride exposure in drinking water? Dental fluorosis, skeletal fluorosis, insulin secretion problem, neural development problem, thyroid gland problem or not sure

The level of knowledge was assessed in this study using reliable questionnaires adapted and modified from (Wilger et al., 2004; Quinonez & Locker, 2009; Environmental Health Directorate, 2012; Sabti et al., 2019). Respondents were asked to tick their choice which best reflected their existing knowledge.

Each open-ended questions had a test score of '1' for each answers chosen. For the respondents who knew the answer hence, choose more than one answer, they achieved more scores according to their total choice of answers per questions except for those who chose 'not applicable' which has the test score of '0'. Next, for the close-ended questions, "yes" had a test score of '1' and "no" or "not sure" had a test score of '0'. The total score obtained in each section was summed up before being divided with the total questions from each section and further multiplied with 100%. Following the results, the categorization of the level of knowledge fell under either poor, moderate or good knowledge on fluoride in drinking water. Scores of <50%, 51%-75% or 76%-100% was categorized as poor, moderate or good knowledge (Vanaja et al., 2016).

Section C: Perception on Fluoride in Drinking Water

The study was a cross-sectional study, based on an online survey that examined public perceptions of fluoride drinking water. The perception on fluoride in drinking water was measured using six items with open-ended and close-ended questions. For this section, the respondents were asked regarding their thoughts and beliefs on the addition of fluoride in drinking water, its purpose, safety, effectiveness and the choice of drinking water supply. This section was modified according to the setting of this study from (Environmental Health Directorate, 2012; Whyman et al., 2016).

This section consisted of open-ended and closed-ended questions. For the close-ended questions, the correct answer, labelled as “yes” had a test score of ‘1’ and “no” or “not sure” had a test score of ‘0’. Each open-ended questions had a test score of ‘1’ for each answers chosen. For the respondents who knew hence, choose more than one answer, they achieved more scores depending on their total choice of answers per questions except for those who had chosen ‘not applicable’ which had the test score of ‘0’. Next, the total score obtained in each section was summed up and divided with the total questions from each section and further multiplied with 100%. The scoring system generally used to evaluate the level of perception among study population (Razak et al., 2016). The perception was categorized into 5 levels which were very low, low, medium, high and very high according to the range of scores obtained by each respondents at 10-20%, 21-35%, 36-60%, 61-85% and 86-99% (Jusoh et al., 2015).

3.6 Data Analysis

The data collected from the questionnaire was executed using IBM Statistical Package for Social Sciences (SPSS) Version 23.0. All data obtained from the questionnaire was double entered in the Microsoft excel before being entered and double checked in the SPSS software to ensure its consistency. The summary of data analysis were as follow:

3.6.1 Exploration of Data

An inference was made for the variables measured based on the results obtained.

3.6.2 Univariate Analysis

Descriptive analysis was conducted to analyse the socio-demographic characteristics of residents including their age group, gender, educational level and residential duration. The results were presented into a descriptive table categorically as frequencies and percentages and continuously as mean, and standard deviation. The level of knowledge on the presence of fluoride in drinking water as well as the perception of the urban residents towards the addition of fluoride in drinking water was summarized in frequencies and percentages.

3.6.3 Bivariate Analysis

Chi-square was used for the comparisons of the discrete data in relations with the objective on determining the association between the socio-demographic characteristics and level of knowledge of the urban residents on fluoride in drinking water and determining the association between the socio-demographic characteristics and perception of the urban residents on the addition of fluoride into drinking water. P-values less than 0.05 ($P < 0.05$) was considered statistically significant. The statistical analysis for each respective objectives was summarized as shown in the table below (Table 3.4).

Table 3.4 Research Objectives and Statistical Test

Objectives		Statistical Test
I.	To determine the socio-demographic characteristics of the Precinct 9, Putrajaya residents	Descriptive analysis
II.	To identify the level of knowledge of the urban residents on the addition of fluoride in drinking water	Descriptive analysis
III.	To determine the association between the socio-demographic characteristics and level of knowledge of the urban residents on the addition of fluoride in drinking water	Chi-square If data is not normal, Fischer's Exact Test

IV.	To evaluate the perception of the urban residents on the safety and effectiveness and risks of the addition of fluoride in drinking water	Descriptive analysis
V.	To determine the association between the socio-demographic characteristics and perception of the urban residents on the addition of fluoride in drinking water	Chi-square If data is not normal, Fischer's Exact Test

3.7 Reliability Analysis

Knowledge and perception on the addition of fluoride in drinking water has a Cronbach's alpha value of 0.771 which falls on a good scale of internal consistency. No questions were added or removed from this construct because virtually all the items are vital to the research objectives. APPENDIX II showed the initial internal consistency of the latent construct of knowledge and perception of fluoride in drinking water.

3.8 Quality Assurance and Quality Control

The modified questionnaire that was used in this study has undergone an internal consistency to ensure the quality control of the questionnaire by using Cronbach's Alpha. Cronbach's Alpha value was obtained by running the IBM SPSS Version 23.0. The questionnaire survey was pre-tested before distributed to the respondents to ensure the effectiveness and identify any misinterpretations.

The study population that was involved in the pre-testing is 10% from the actual sample size. The recruited subjects have the similar characteristics with the actual subject and was not included in the study sample. Therefore, 20 respondents has been involved in the survey pre-testing. After the pre-testing, the questionnaire was proven to be feasible. Hence, no modification was made.

3.9 Ethical Consideration

In this proposed study, ethical approval (JKEUPM-2021-739) was required to obtain consent from the Ethics Committee for Research Involving Human Subjects Universiti Putra Malaysia, JKEUPM. Respondent's informed consent was given prior to answering the questionnaire (refer to APPENDIX III). A detailed explanation about the study was given along with the status of voluntariness to the respondents in the introductory part of the online form so that the selected residents participated in this study voluntarily and not by forceful measures from any parties.

The participants have the right to quit from the study and there was no penalty given to them for leaving the study. All the confidentiality of the data were strictly kept as private, controlled in encrypted form and maintained as only the researchers and supervisor could retrieve it. This was to ensure the participants' privacy and confidentiality is protected. The questionnaire (refer to APPENDIX IV) was made to be anonymous from private data of respondents.

3.10 Expected Outcome

This study is among one of very few that is expected to explore the level of knowledge of fluoride in drinking water among urban residents in Malaysia. Therefore, information of the public awareness regarding fluoride presence in the drinking water supply can be used for similar future studies.

Furthermore, the expected finding of this study is that the association between the socio-demographic characteristics and the level of knowledge regarding fluoride in drinking water will be looked into in more detail. This is because, there might be different opinions on the use of fluoridated water among individuals of different age, gender or educational level.

This study also expects that there will be a clear outcome on the perception of urban residents on the safety and effectiveness of the addition of fluoride in drinking water. Thus, suggestions can be made in order to prevent fluoride-related disease among urban residents of all backgrounds.

CHAPTER 4

RESULTS

4.1 Introduction

The relevant techniques needed to be employed in this chapter were presented in the previous chapter.

This chapter presents descriptive analysis of the research data, socio-demographic characteristics. The respondents involved in the descriptive cross-sectional study were 240 individuals. SPSS Version 23.0 and Microsoft Excel 2013 was used to achieve the results that were answered via Google form. Recent chapter was divided into six parts: first was the descriptive statistics. Second part presented the level of knowledge on fluoride in drinking water among the residents living in urban area, specifically Precinct 9, Putrajaya. Third part presented the relationship between socio-demographic characteristics and level of knowledge on fluoride in drinking water among Precinct 9 residents. It was followed by the perception on fluoride in drinking water among residents living in Precinct 9, Putrajaya. The last part presents the association between the socio-demographic background of the residents with their perception regarding fluoride in drinking water.

4.2 Descriptive Statistics

The descriptive statistics of respondents was shown by frequency and percentages, mean and standard deviation (Table 4.1). All of the options of the socio-demographic characteristics were already grouped in the close-ended questions.

4.2.1 Socio-demographic Characteristics of respondents

The responses to the questionnaire supplied some basic information on the socio-demographics of the focus group members. A total of 240 respondents (99 males and 141 females) completed the questionnaire, giving a response rate of 100%. From 240 participants, most of whom were in the 18-64 years old age category, female and tertiary education graduates. The distribution of the study sample according to age, gender, educational level and residential duration was summarized in Table 4.1.

Table 4.1 Characteristics of Participants (n=240)

Socio-demographic characteristics	Frequency, n (%)	Mean $\pm$ SD
Age group		1.11 $\pm$ 0.317
18-64 years old	213 (88.8)	
Above 64 years old	27 (11.2)	
Gender		1.59 $\pm$ 0.493
Male	99 (41.2)	
Female	141 (58.8)	

Educational level		2.91 ± 0.317
	Primary education	0 (0.0)
	Secondary education	24 (10.0)
	Tertiary education	214 (89.2)
	No formal education	2 (0.8)
Residential		3.14 ± 1.064
Duration		
	Less than a year	29 (12.1)
	1-5 years	34 (14.2)
	5-10 years	52 (21.7)
	More than 10 years	125 (52.1)

As noted in Table 4.1, 240 individuals participated in this study. As many as 213 (88.8%) participants from 18 to 64 years age dominated the respondents, followed by 27 (11.2%) participants from the age group of more than 64 years old. The female participants were 141 (58.8%), while the male participants were 99 (41.2%). Of all the educational status, a total of 214 (89.2%) individuals received tertiary education, followed by 24 (10.0%) individuals who received secondary education and 2 (0.08%) individuals who did not receive any formal education with none (0.0%) of them receiving only up to primary education. There was only two individuals without any formal education most possibly because they were from the older age group who just moved in the study area along with their children from other regions. Next, no individuals received only up to primary education because the respondents continue their education to either secondary or tertiary education level. Other than that, a total of 125 (52.1%) participants have lived in the study location for more than ten years,

followed by 52 (21.7%) of 5 to 10 years of residential duration, 34 (14.2%) of 1 to 5 years of residential duration and 29 (12.1%) of less than a year of residential duration.

4.3 Knowledge of Fluoride in Drinking Water

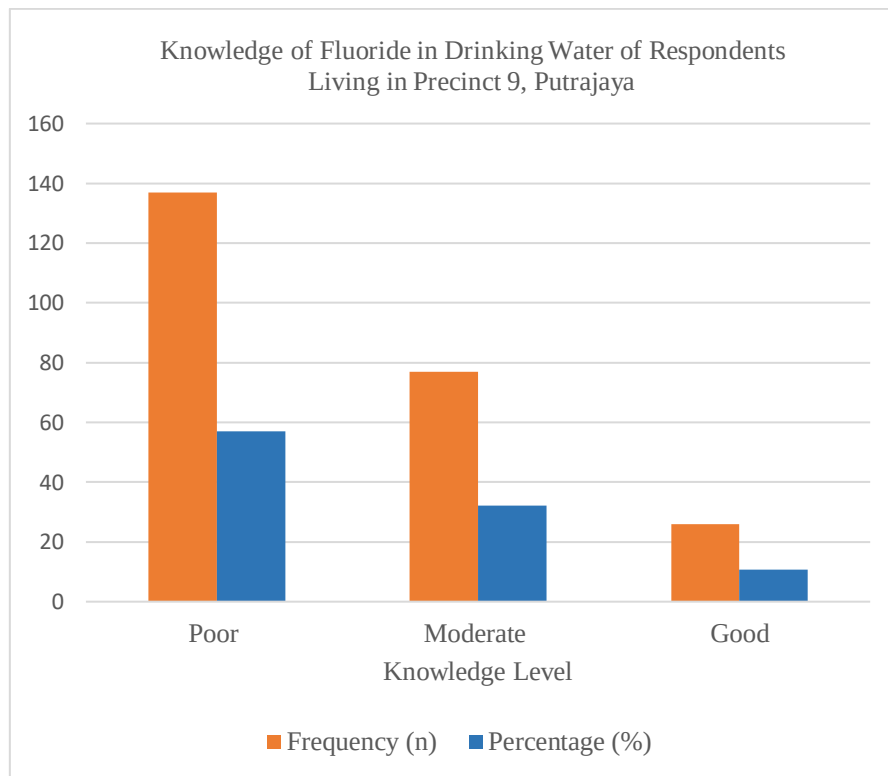


Figure 4.1 Knowledge of Fluoride in Drinking Water of respondents living in Precinct 9, Putrajaya

Figure 4.1 showed that approximately 137 (57.1%) participants were recorded to have poor knowledge. In comparison, 77 (32.1%) participants had moderate knowledge and 26 (10.8%) participants had good knowledge regarding fluoride and its purpose, benefits and risks following the addition into the public drinking water supply.

Table 4.2 Knowledge Items

Knowledge items	Frequency, N (%)
Knowledge on understanding of fluoride	169 (70.4)
Knowledge on the presence of fluoride	194 (80.8)
Knowledge on fluoride addition into drinking water	149 (62.1)
Knowledge on purpose of fluoride addition into drinking water	104 (43.3)
1. Prevent dental caries	107 (44.6)
2. Preserve oral health	103 (42.9)
3. Strengthening bones	55 (22.9)
Source of information of the presence of fluoride in drinking water	
Print media	59 (24.6)
Electronic media	162 (67.5)
Educational institution	130 (54.2)
Friends	46 (19.2)
Others	7 (2.9)
Knowledge on the optimal level of fluoride addition in drinking water by the NSDWQ	26 (10.8)
Knowledge on staidness of lack of fluoride	127 (52.9)
1. Tooth decay	174 (72.5)
2. Weakness in bone structure	89 (37.1)

Knowledge on staidness of excessive of fluoride	140 (58.3)
1. Dental fluorosis	150 (62.5)
2. Skeletal fluorosis	108 (45.0)
3. Insulin secretion problem	58 (24.2)
4. Neural development problem	59 (24.6)
5. Thyroid gland problem	52 (21.7)

According to Table 4.2, 149 (62.1%) participants had general knowledge regarding the presence of fluoride in their drinking water. Still, only a total of 104 (43.3%) participants were aware of the purpose of the fluoride addition into drinking water. As many as 127 (52.9%) participants knew that lack of fluoride in drinking water might cause diseases, with up to 174 (72.5%) participants knowing that tooth decay was one of the diseases caused by lack of fluoride exposure whereas only 89 (37.1%) participants knew that weakness in bones structure was also one of the possible health effects due to an insufficient fluoride intake.

Table 4.2 presented a total of 140 (58.3%) participants who knew possible health risks associated with fluoridated drinking water in their community. The main diseases resulting from overexposure to fluoride that the participants mostly recognized were dental fluorosis (62.5%), followed by skeletal fluorosis (45.0%), neural development problem (24.6%), insulin secretion problem (24.2%) and thyroid gland problem (21.7%).

4.3.1 Sources of Information

According to Table 4.2, a total of 162 (67.5%) participants received fluoride-related information from electronic media other than 130 (54.2%) participants obtained fluoride-related information from the educational institution. Next, the information received from print media was as low as 59 (24.6%) participants and 46 (19.2%) participants obtained the knowledge on fluoride from their friends, and only 7 (2.9%) participants obtained the information on fluoride from other sources with “dentist”, “family”, “nurse”, “health festival”, “educational fair” and “local authorities” also being a common response.

4.4 Association between Socio-demographic Characteristics and Knowledge Level on Fluoride in Drinking Water among Residents in Precinct 9, Putrajaya

Table 4.3 Association between Socio-demographic Characteristics and Knowledge Level on Fluoride in Drinking Water among the Respondents

Socio-demographic characteristics		Knowledge level, N = 240 (%)			Expected count, χ^2	p-value ($p < 0.05$)
		Poor (n = 137)	Moderate (n = 77)	Good (n = 26)		
Age	18-64 years old	122 (89.1%)	70 (90.9%)	21 (80.77%)	0.341 ^a	
	Above 64 years old	15 (10.9%)	7 (5.1%)	5 (19.2%)		

Gender	Male	58 (42.3%)	31 (40.3%)	10 (38.5%)	0.926 ^a
	Female	79 (57.7%)	46 (59.7%)	16 (61.5%)	
Educational level	Primary education	0 (0.0%)	0 (0.0%)	0 (0.0%)	0.002^a
	Secondary education	22 (16.1%)	2 (2.6%)	0 (0.0%)	
	Tertiary education	114 (83.2%)	74 (96.1%)	26 (100%)	
	No formal education	1 (0.7%)	1 (1.3%)	0 (0.0%)	
Residential duration	Less than 1 year	16 (11.7%)	10 (13.0%)	3 (11.5%)	0.655 ^a
	1-5 years	21 (15.3%)	7 (9.1%)	6 (23.1%)	
	6-10 years	30 (21.9%)	16 (20.8%)	6 (23.1%)	
	More than 10 years	70 (51.1%)	44 (57.1%)	11 (42.3%)	

a = Fischer Exact Test, **p-value is significant at p<0.05**

Based on the table of results shown in Table 4.3, the p-value = 0.02 ($p < 0.05$) obtained from Fischer Exact Test showed a significant association between respondents' educational level and knowledge level. However, age, gender and duration of residency were not significantly associated with the knowledge level of fluoride in drinking water among residents in Precinct 9, Putrajaya.

There were 26 respondents with good knowledge level who entirely graduated from tertiary education (100%) with no graduates of other educational level. Next, nearly half (83.2%) of tertiary education graduates were categorized as having poor knowledge level as compared to 22 (16.1%) secondary education graduates and 1 (0.7%) respondents with no formal education. On the other hand, 74 (96.1%) of tertiary education graduates were at the moderate knowledge level followed by 2 (2.6%) secondary education graduates and 1 (1.3%) participants who did not received any formal education.

Referring to Table 4.3, when comparisons were made between age groups, there were 70 (90.9%) respondents age of 18-64 years old who scored moderate level of knowledge regarding fluoride and another 122 (89.1%) respondents that scored poor level of knowledge while only 7 (5.1%) and 15 (10.9%) of respondents scored moderate and poor level of knowledge respectively among those aged above 64 years old. Furthermore, among the younger age group (18-64 years old) living in Precinct 9, Putrajaya, 21 (80.8%) respondents scored good in terms of their knowledge regarding fluoride, as compared to only 5 (19.2%) respondents aged above 64 years old.

Based on gender, it was reported that both male, n=58 (42.3%) and female, n=79 (57.7%) respondents were considered as having poor knowledge on fluoride. Among male respondents, it was reported that 31 (40.3%) of them were moderately knowledgeable with regards to fluoride, which was lower as compared to 46 (59.7%) of female respondents. Only 10 (38.5%) male respondents was categorized as having good knowledge level on fluoride in comparison to 16 (61.5%) female respondents.

Based on the residential area, the respondents who lived in Precinct 9, Putrajaya for more than 10 years were classified as the highest category with 11 (42.3%) respondents having good knowledge, 44 (57.1%) respondents with moderate knowledge and 70 (51.1%) with poor knowledge whereas other duration of residencies scored far below 50% for all knowledge level (Table 4.3).

4.5 Perception on fluoride in Drinking Water

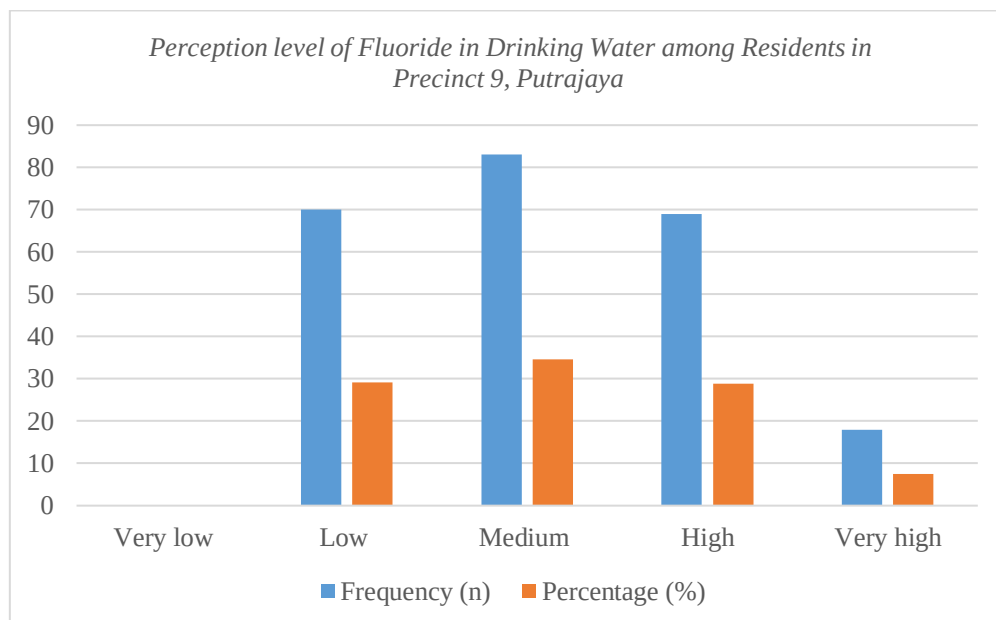


Figure 4.2 Perception level of Fluoride in Drinking Water among Residents in Precinct 9, Putrajaya

According to Figure 4.2, the highest frequency of the respondents were categorized as having medium perception level towards the fluoride in the drinking water which was 83 (34.6%) respondents followed by 70 (29.2%) and 69 (28.8%) respondents who had low and high perception level respectively. Meanwhile, minority of 18 (7.5%) respondents very highly perceived fluoride positively with none respondents having a very low perception level towards fluoride.

Table 4.4 Perception Items

Perception items	Frequency, N (%)
The most common source of drinking water	
1. Tap water	122 (50.8)
2. Store bought bottled water	78 (32.5)
3. Others (eg: water filter)	40 (16.7)
Reason(s) of choice of drinking water source	
1. The taste, smell and colour of the drinking water	143 (59.6)
2. Save money and time	137 (57.1)
3. Guarantee safety of the drinking water	168 (70.0)
Perception on the safety of fluoride addition into drinking water	123 (40.1)
Perception on the effectiveness of fluoride addition into drinking water	85 (27.7)
Perception on the usefulness of fluoride addition in drinking water to prevent tooth decay	134 (43.6)
Agreeness on the addition of fluoride in drinking water	123 (40.1)

Based on the Table 4.4, half of population in Precinct 9, n=122 (50.8%) commonly used tap water as their source of drinking water, followed by store-bought bottled water, n=78 (32.5%) and lastly other source of drinking water, n=40 (16.7%) including filtered water.

Considering the perception on the choice of sources of drinking water, “Guarantee safety of drinking water”, was the most frequently cited reasons with 168 (70.0%) respondents. Other reasons were “taste, smell and colour of the drinking water”, (143; 59.6%) and “save money and time”, (137; 57.1%). Since the respondents were allowed to choose for more than one answer on their reasons of choice, the frequency of the reasons of choice with their most common source of drinking were not in the same amount as the total of respondents.

Among the respondents, 123 (40.1%) of respondents had perceived fluoride as safe to be added into the drinking water and 85 (27.7%) individuals perceived fluoride as an effective measures in promoting a better health with 134 (43.6%) individuals had believed on the effectiveness of the fluoride in the drinking water in preventing tooth decay. Overall, 123 (40.1%) respondents agreed on the addition of fluoride into drinking water (Table 4.4).

4.6 Association between Socio-demographic Characteristics and Perception of Fluoride in Drinking Water among Residents in Precinct 9, Putrajaya

Table 4.5 shows the association between the level of perception on fluoride in drinking water among residents in Precinct 9 based on socio-demographic characteristics using the Fischer Exact Test. The Fischer Exact analysis showed that there was no significant association between all of the socio-demographic characteristics and perception level of fluoride in drinking water among residents in Precinct 9, Putrajaya.

Table 4.5 Association between Socio-demographic Characteristics and Perception of Fluoride in Drinking Water among Residents in Precinct 9, Putrajaya

Socio-demographic characteristics	Perception level (%)					Expected count, χ^2	p-value ($p < 0.05$)
	Very low (n = 0)	Low (n = 70)	Medium (n = 83)	High (n = 69)	Very high (n = 18)		

Age	18-64 years old	0 (0.0%)	67 (95.7%)	71 (85.5%)	59 (85.5%)	16 (88.9%)	0.122 ^a
	Above 64 years old	0 (0.0%)	3 (4.3%)	12 (14.5%)	10 (14.5%)	2 (11.1%)	
Gender	Male	0 (0.0%)	30 (42.9%)	37 (44.6%)	27 (39.1%)	5 (27.8%)	0.605 ^a
	Female	0 (0.0%)	40 (57.1%)	46 (55.4%)	42 (60.9%)	13 (72.2%)	
Educational level	Primary education only	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0.005^a
	Secondary education only	0 (0.0%)	15 (21.4%)	6 (7.3%)	3 (4.3%)	0 (0.0%)	
	Tertiary education	0 (0.0%)	54 (77.1%)	77 (92.8%)	65 (94.2%)	18 (100.0%)	

	No formal education	0 (0.0%)	1 (1.4%)	0 (0.0%)	1 (1.4%)	0 (0.0%)	
Residential duration	Less than 1 year	0 (0.0%)	6 (8.6%)	11 (13.3%)	9 (13.0%)	3 (16.7%)	0.893 ^a
	1-5 years	0 (0.0%)	12 (17.1%)	10 (12.0%)	10 (14.5%)	2 (11.1%)	
	6-10 years	0 (0.0%)	18 (25.7%)	19 (22.9%)	11 (15.9%)	4 (22.2%)	
	More than 10 years	0 (0.0%)	34 (48.6%)	43 (51.8%)	39 (56.5%)	9 (50%)	

a = Fischer Exact Test, **p-value is significant at p<0.05**

Based on Table 4.5, the p-value is 0.005 ($p < 0.05$) showed that there was a significant association between the educational level and perception level among respondents. On the other hand, there was no significant association between each level of socio-demographic characteristics and perception level on fluoride in drinking water.

As for the educational level of respondents, 54 (77.1%) of tertiary education graduates was the highest category under the low perception level followed by 15 (21.4%) graduates of secondary education and respondent with no formal education with a total of 1 (1.4%) The medium perception level was the highest among 77 (92.8%) tertiary education graduates followed by 6 (7.3%) secondary education graduates and 0 (0.0%) for both primary education graduates and those with no formal education. Based on the tabulated data on the high perception level, those graduated at tertiary education level also have the highest total of respondents with 65 (94.2%) as compared to those graduating with secondary education which was at 3 (4.3%) and 1 (1.4%) respondent who did not received any formal education. Only the respondents from tertiary education level have scored a very high perception level for 18 (100.0%) respondents with none (0.0%) from other educational level.

Comparing the age group of 18-64 years old with those above 64 years old, those with medium perception level were the highest among the first age category with 71 (85.5%) than those form the second age category at 12 (14.5%) of respondents. Those with low, high and very high perception level were also showing a significantly higher frequency for 18-64 years old respondents at 67 (95.7%), 59 (85.5%) and 16 (88.9%) respectively compared to those above 64 years old at 3 (4.3%), 10 (14.5%)

and 2 (11.1%) respectively. There was none of respondents from any socio-demographic background with a very low perception level.

Male respondents in all stages from low, n=30 (42.9%), medium, n=37 (44.6%), high, n=27 (39.1%) and very high, n=5 (27.8%) perception level scored lower as compared to female respondents in terms of their perception level at low, n=40 (57.1%), medium, n=46 (55.4%), high, n=42 (60.9%) and very high, n=13 (72.2%).

Respondents living for more than 10 years were abundantly present in the medium perception level with a total of 43 (51.8%) respondents. Similarly, respondents with 6-10 years and less than one year living experience in the study site were also found to be present for 19 (22.9%) and 11 (13.3%) respondents respectively. Meanwhile, 12 (17.1%) respondents with a residential duration of 1-5 years are at the highest in terms of the low perception level compared to other category. Among all respondents, those with more than 10 years of living experience in the study site were at the highest in terms of very high perception level with 9 (50%) respondents followed by 4 (22.2%) respondents of 6-10 years, 3 (16.7%) less than one year and 2 (11.1%) 1-5 years of residential duration. The level of perception showed a descending trend for those scoring at high perception level starting from respondents who lived in the study area for more than 10 years, N=39(56.5%), those living for 6-10 years, N=11 (15.9%), those living for 1-5 years, N=10 (14.5%) and those living for less than one year in the study site, N=9 (13.0%).

CHAPTER 5

DISCUSSION

5.1 Introduction

Inadequate fluoride intake have the potential to cause adverse health effects towards the consumers. Up to now, the majority of the knowledge enhancement efforts have focused on better understanding of the fluoride and related influences on the human through drinking water consumption. Therefore, the purpose of this study was to determine the levels of knowledge for fluoridated drinking water among adult participants in Precinct 9, Putrajaya and to report their perception levels on fluoride in drinking water, its benefits and risks as well as the association.

This chapter discussed the overall information of the presented research in terms of the benefits and risks on the safety effect as well as the conclusions and main contributions of the trust in choosing for the main water source, which has been studied in this thesis. This chapter also conversed the result used in this research in relation to the related literatures of fluoride knowledge and perception in Putrajaya, specifically Precinct 9. The present study also provided some interesting results regarding indicators of knowledge and perception of the general urban population on this subject.

5.2 Descriptive Statistics

5.2.1 Socio-demographic Characteristics of the Respondents

This was the first research in Putrajaya to investigate citizens' knowledge and perceptions about fluoride and fluoridated drinking water. The overall response rate to the survey was optimal (100%). In this study, the number of participants that were aged 18 to 64 years old, female, have finished tertiary education and lived in Precinct 9, Putrajaya for more than 10 years dominated the percentage in their respective socio-demographic characteristics. The former study did identify the higher participation from respondents who were aged between 18 to 64 years old, which was 213 (88.8%) respondents as compared to 27 (11.3%) respondents who were aged more than 64 years old. Considering the attribution of age ratio in the urban area, the most populated younger age group was ascribed to the age group which dominated the respondents who were progressive enough to reside in the study area. According to the Department of Statistics Malaysia Official Portal (2021), as much as 22.7 million (69.6%) of Malaysians were categorized under 18 to 64 years old with another 2.4 million (7.4%) of those more than 64 years old.

The result of the descriptive statistics of categorized knowledge and perception on fluoride revealed that as many as 99 (41.3%) of respondents were male and 141 (58.8%) of respondents were female. The reason behind this imbalanced distribution was due to the gender ratio in Putrajaya where there was 88 males to 100 females (Department of Statistics Malaysia, 2020). Comparably, another study conducted by Blumer et al. (2018) highlighted that 85% female residents dominated the participation

in their survey with only 15% male. These considerations explained why female were more likely to participate in this study.

The dominating age group had higher chances of understanding and awareness on fluoride in drinking water due to possible higher education exposure. From the survey, educational status acted as a lever that indirectly raised an overall knowledge and perception of fluorides among higher education graduates of Precinct 9, Putrajaya. A study done by Blumer et al. (2018) yield a similar result with this study in terms of the educational level in which 63% respondents were graduates of tertiary education. This could clarify why most respondents who participated in this study had a tertiary education level.

Next, the duration of residency showed that the majority of the respondents have been Precinct 9 residents for over 10 years. This has likely resulted in a small overestimation of the exposure to overall fluorides knowledge and perception across the different community or newcomers. In the present study, the residents who lived longer in the study area showed that they scored higher in terms of all levels of knowledge and perception of overall fluorides, with poor level of knowledge and perception being the most significant frequency.

5.3 Knowledge of Fluoride in Drinking Water

Public awareness level information was extracted using scoring system from questionnaire survey filled by the respondents. The scoring system results indicated that more than half of the urban residents who participated in this study (137; 57.1%) were unaware of the existence of, let alone the context of the fluoride addition into their drinking water supply. This study demonstrated that respondents were generally not familiar with fluoride as only 26 out of 240 (10.8%) respondents having good knowledge level, indicating very low awareness level on the overall fluoride presence and purpose through its addition into drinking water. However, few participants reported knowing what fluoride was (169; 70.4%), or the addition of fluoride into drinking water (149; 62.1%). In contrast to this, a study conducted by Kakti (2018) concluded that the majority of the respondents aged 18 to 30 years old (79%) had good knowledge of the fluoride presence in the drinking water they consumed. Consistently, the most recent cross-sectional study by Almebo et al. (2021) among the community of Ethiopia reported that a total of 348 (85.9%) of the interviewed household had good knowledge on fluoride.

The present study revealed deficiencies in the knowledge and understanding of the purpose of the fluoride addition into their drinking water. About 107 (44.6%) and 103 (42.9%) believed that the drinking water that undergoes fluoridation helped in preventing dental caries and preserving oral health. However, most participants in this study were unaware of its value in strengthening bones. The few who were familiar with the term (fluoride in drinking water) were 55 (22.9%) respondents.

It was striking that knowledge of its use was not high. This was possible because the major public health objective focus on the community knowledge of interventions related to oral health, including the addition of fluoride into drinking water (U. S. Department of Health and Human Services, 2020). Moreover, American Dental Association (ADA) and the National Institute of Health and Care Excellence (NICE) put a great emphasis on dental caries detection and prevention in any health-care program as the most important elements (Department of Scientific Information ADA, 2021).

Another finding in this study was that 127 (52.9%) participants answered that tooth decay was known to occur if there was lack of fluoride exposure than those 89 (37.1%) participants who answered weakness in bone structure as another probable effect. This information on the knowledge regarding insufficient fluoride is beneficial as it has been proven that in 2013, a dramatically improves in Malaysia's piped water supplies resulted in more than 80% of Malaysian receiving fluoridated drinking water which significantly reduced the tooth decay problems over the time (Karim et al., 2021). This was possible because the concentration of fluoride in drinking water was not affected when boiled, unless filtered through the water filtration system. Besides, the National Health and Medical Research Council (2017) outlined that fluoride helped to prevent tooth decay by preventing damage and assisting in tooth restoration.

Studies have shown that public knowledge on dental diseases following the exposure to inadequate fluoride intake directly influenced the public health acquisition, including water fluoridation. The studies included a research done by Nurul et al. (2017) who reported that taking fluoride in excess from uncontrolled or

untested sources can cause dental fluorosis. Similarly, this study revealed that 150 (62.5%) participants acknowledged dental fluorosis as a health issue arising from excessive fluoridated drinking water consumption.

This study also found that the result of little knowledge on overexposure to fluoride for all other possible diseases including skeletal fluorosis, insulin secretion problem, neural development problem and thyroid gland problem was below 50%. Some dentists and medical practitioners in a study conducted by Sabti et al. (2019) felt fluoride may harm general human health, produce allergies in some people, have a detrimental influence on human bones, cause cancer in humans, induce neurological side effects, and be environmentally costly.

Despite multiple scientific researchers have been conducted to prove how effective fluoride was in preventing skeletal-related diseases as well as oral and dental health through its addition into drinking water system, there was still many negative opinions and beliefs that did not supported water fluoridation. Seymour et al. (2015) found that there had been an increase in anti-fluoridators who opted for removal of fluoride from their drinking water. Similar with the previous study, in 2013, a Florida county reversed their decision of removing fluoridation entirely and decided to fluoridate them again due to the public opposition on the fluoridation back in 2011 as they claimed local government have no right to administer fluoridation without the public consensus (Pinellas County Utilities, 2017). The Fluoride Action Network (FAN) was among one of many group actively going against the idea of adding fluoride into the drinking water as they believed water fluoridation is a relic of the past (Fluoride Action Network, 2021). Therefore, it was very important to conduct this kind

of study because there were many flourishing rumors when it comes to the use of fluoride, and by clarifying the situation with the scientific knowledge and source references, it could be possible to disprove the rumors among anti-fluoride groups.

5.3.1 Sources of Information

In this study, a total of 162 (67.5%) respondents obtained fluoride-related information mainly from electronic media. Electronic media had become quick, cheap and easier to access for any informations searches (Shearer & Mitchell, 2021). They added that readers obtained information through digital content of any electronic media devices such as smartphone, personal computer, radio and television. Therefore, the percentage of participants who had heard or read about fluoride from electronic media was the highest.

In the present group of participants, there was also some information received from printed educational institution, media and friends. In a recent study conducted by Lowry et al (2021), a total of 283 (37%) out of 761 participants had read about fluoridation from local newspapers and minority believed that their water supply has been fluoridated. People relied on salesperson from a department store as their source of information regarding household water filters, according to studies performed in Newfoundland and Ontario (Sarkar et al., 2012). Other sources of information that were stated by the participants include dentists. Correspondingly, communities that did not visited the dentist missed out on the informations related with fluoride, which might lead to an increase in dental caries and tooth damage cases. (Barker et al., 2016).

5.4 Association between Socio-demographic Characteristics with Knowledge Level of Fluoride in Drinking Water among Residents in Precinct 9, Putrajaya

There have been no previous studies linking the perception of residents in Putrajaya towards fluoride in drinking water with their socio-demographic characteristics. In this study, it can be concluded that there were a significant association between the educational status with the knowledge level as well as the educational status towards fluoride and its addition into drinking water system. Thus, failed to reject the null hypothesis. Findings from this study also indicated that with the use of Fischer Exact test, there was no statistically significant association between the categories of all socio-demographic characteristics with knowledge level and perception level. It was revealed that those with higher educational level were more knowledgeable compared to those with lower educational level in terms of fluoride.

A query was set up to investigate which of the group of participants' educational level given high knowledge as evidence, knew well about overall fluoride. The approximate estimates showed that the percentage of all levels of knowledge about fluoride and its addition into drinking water were the most abundance in tertiary education level. Of the total number of surveyed residents, 100% tertiary education graduates fell under the good knowledge category with 96.1% and 83.2% of them falls under moderate and poor knowledge levels regarding fluoride in drinking water respectively ($p=0.002$). According to Blumer et al. (2018), fathers (84%) and mothers (88%) with a higher education level were aware of the advantages and 37% were in favour of fluoride consumption through drinking water. Furthermore, there was a need for early intervention to increase awareness among children about oral health, mandate

the involvement of educated parents throughout the prevention process (Alkhtib & Morawala, 2018; Mamat, 2018). A recent study conducted by Muralidharan and Paul (2018), however, found no substantial improvement from the fresh graduates and preclinical batch of tertiary education regarding the knowledge on fluoride.

5.5 Perception on Fluoride in Drinking Water

This study revealed that 50.4% of participants used tap water without filtration system at home which was slightly lower than a study conducted by Leavy et al. (2012) where 60% of children consumed tap water in the Pennyslavinia area. At the same time, almost one-third of the participants from our study consumed store-bought water bottled while only a minority used a filtration system. On the other hand, a previous study reported that 48% of the public living in Western Newfoundland, Canada used a water filter at home (Ochoo, 2017) because these filtered water systems used reverse osmosis to remove any naturally existing or added fluoride from municipal water. In addition, the participants' preferences were in line with a prospective study at Hamad Medical Corporation (HMC) among parents where more than two-third of parents chose bottled water as the best water choice for their children whereas 33% answered likely yes and yes with another 32% answered no and definitely no for the consumption of tap water as the drinking water source for their children (Hendaus et al., 2019). The reason for not choosing tap water was due to the taste, smell and concern that tap water might cause unspecified sickness.

Nonetheless, this study found 68 (70%) respondents stated unequivocally that they made choices with regards to their drinking water supply over the safety it provides. Cury et al. (2019) conducted a descriptive review focusing on the risks of usage of water fluoridation and the probably toxic dose (PTD) for a 20kg child aged 5 to 6 years old. A result from the study revealed that the fluoridated drinking water is extremely safe in terms of acute fluoride toxicity it may provide because as much as 143 litres of water needed to be consumed by the child weighing 20kg in order to be exposed to 5.0mg F/kg PTD. This study's findings were also consistent with the most recent evidence published by Berhe et al. (2020) suggesting the perception of fluoridated drinking water that was safe as the majority of respondents agreed that drinking safe and sufficient water avoided waterborne diseases in the Tigray area of northern Ethiopia. The majority of responders felt the treated water was clean, and the water they have treated was completely safe, according to their perspectives (United Nations Human Settlements Programme, 2015).

From this study, the results of questions on perceptions regarding the use of fluoride and its safety highlighted as much as 123 (40.1%) of participants perceived the fluoride addition into drinking water as safe to be consumed. This actually corresponded well with a recent Canadian water attitude research, where 90% of Canadians feel extremely or moderately confidence in the safety and purity of the water in their homes, and they were more confident than they were previously. (GlobeScan, 2017). According to the participants' perceptions, the majority believed the treated water was clean, and the water they have treated was entirely safe (United Nations Human Settlements Programme, 2015).

Next, the study found that slightly more than half of the participants made choices for their drinking water source according to the taste, smell and colour of the drinking water itself. Likewise, Butt (2010) discovered that the physical qualities like colour, clarity, odour, taste, and smell were used to judge the quality of public drinking water in Newfoundland. When people lose trust in the quality of their water, they resorted to bottled water, roadside springs, and at-home treatment methods, according to the research. Nevertheless, according to Napier (2008), water with a foul odour did not always mean it was harmful to drink, and clear water with a pleasant taste did not always mean it was safe. However, among Malaysians, other important parameters to ensure good water quality such as the fluoride concentration in drinking water was more emphasized than the taste, smell and clarity (Bahari et al., 2018).

This study also indicated that 137 (57.1%) participants preferred fluoride to be available through cheap and time saving drinking water sources rather than other means. The study results were quite similar with previous literature which pointed out dentists demonstrated a lack of awareness of fluorides' principal mechanism of action, which might lead to erroneous conclusions about its usefulness in various age groups. (Bansal et al., 2012). In the present study, one of the participants who had heard or read about fluoride from their dentist might received inaccurate information on how effective fluoride was. In contrast, Perrella and Kiss (2015) conducted a study among residents of Waterloo, Ontario where there was an overturned of its water fluoridation during 2010 referendum. Their experiments showed that in comparison to respondents who knew about water fluoridation opposition by a national advocacy group had a lower perception level than those who were told that the government and WHO supported fluoridation.

5.6 Association between Socio-demographic Characteristics with Perception Level of Fluoride in Drinking Water among Residents in Precinct 9, Putrajaya

The present study showed that the educational level was the only variable that statistically associated with the level of perception. The vast majority of the tertiary education graduates who participated in the study perceived that it was not appropriate to add fluoride into drinking water. In contrast, a small minority of individuals perceived fluoridated drinking water as safe for daily consumption ($p=0.005$, Fischer Exact Test). Overall, only tertiary education graduates have a high perception level of fluoride in drinking water compared to other individuals from different educational levels. Perception results may vary in forms as public were exposed to fluoride through different mediums. Similar findings were also reported in a previous study, when compared to other categories of respondents, such as high school graduates and those who did not complete high school, college graduates (67.9%) had a greater likelihood of considering CWF as safe (Mork & Griffin, 2015). This discovery was also similar with previous study conducted via telephone survey among public regarding their perception towards their drinking water where higher educated respondents perceived their water supplies as satisfying (completely satisfied/very satisfied) than less educated respondents (Ochoo, 2017). Contradiction amongst participants from different group of specialist was also evident when undergraduate dental education was discovered to play a substantial influence in the prevention of multifactorial disorders such as caries, which cannot be avoided by fluoride ingestion. As a result, there appear to be some scepticism and uncertainty when it comes to fluoride understanding and application (Akbar et al., 2018).

All of the variables were independent variables. It was attributable to the fact that the items assessed in the perception assessment were not specific enough to describe the respondents' personal opinion regarding the drinking water fluoridation 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.

5.7 Limitations

The study's main flaw was the small sample size, which may not be representative. This is owing to the fact that this study's sample size is confined to a particular urban site. The study focus is on urban residents; just one region in the Putrajaya compared with the general population of Putrajaya. This study might provide different results if it was conducted in urban areas or a few other regions, with various sub-populations, or in locales with a varied history of water fluoridation difficulties.

Other limitations include a lack of thorough inquiries, since we had limited scope to investigate the various reasons, and so more research is needed to confirm the specific age and income differential in public awareness and satisfaction with fluoride in their water supply. Furthermore, any study that focuses solely on public opinion may be skewed, leading the relevant authority to make a bad policy choice.

Another limitation was this study does not included public knowledge baseline of fluoride from multiple sources as it only focuses on their awareness and beliefs regarding the presence of fluoride in the drinking water. The participants might misinterpret the possible effects from lack or excessive intake of fluoride that were asked specifically for fluoride in drinking water by other sources such as topical fluoride (toothpaste and food).

CHAPTER 6

CONCLUSION AND RECOMMENDATIONS FOR FUTURE RESEARCH

6.1 Conclusion

This study looked at the citizens' knowledge and perceptions of the purpose, advantages, and associated human health concerns in Precinct 9, Putrajaya. Furthermore, being one of the few studies to look at the acceptability of fluoridated drinking water in an urban setting, this study provides a little but significant contribution. It was one of the few studies that look at the relationship between residents' socio-demographic features and their awareness and perceptions of fluoride in their drinking water.

The findings showed that the general population in Precinct 9 had poor knowledge and a medium perception of fluoride in drinking water. Despite the fact that the participants were in favour of water fluoridation and believed it was safe, certain issues emerged, such as a lack of understanding of the goal of fluoride addition and a negative assessment of its efficacy. Although there were small percent of residents that shows poor perception, it can be improved further by a good propagation of policies and measures by the authority.

6.2 Recommendations

When making generalisations to other urban populations, other socio-demographic strata, or different geographic regions of fluoridated drinking water for various age groups and educational status in the future, care must be taken to ensure that the study site and demographic characteristics of the participants are reasonably representative. In this study, no other groups of primary education graduates were found eligible to become respondents, as we only obtained responses from little individual with no formal education, and many with secondary and tertiary education background. So, further studies need to sample and a balanced number of participation from individuals with different educational status in the study would be able to yield the most accurate level of knowledge and perception towards fluoride in drinking water.

Furthermore, in the long run, different relevant authorities should focus on implementing grassroots awareness programmes to enhance both public understanding of fluoride in drinking water and public opinion toward its addition into the drinking water supply. As a result, it is relevant to bridge the gap between fluoride addition to drinking water for daily use, which is an appropriate way of providing a proven preventative for skeletal and dental disorders under specified conditions, and public knowledge of the hazards associated with it. Low-income urban groups would have to first obtain and believe information regarding fluoride's safety and advantages from trustworthy, credible sources.

REFERENCES

- Adimalla, N., & Venkatayogi, S. (2017). Mechanism of fluoride enrichment in groundwater of hard rock aquifers in Medak, Telangana State, South India. *Environmental Earth Sciences*, 76(1), 1–10. <https://doi.org/10.1007/s12665-016-6362-2>
- Aggeborn, L., & Ohman, M. (2021). The effects of fluoride in drinking water. *Journal of Political Economy*, 129(2), 465–491. <https://doi.org/10.1086/711915>
- Akbar, A. A., Al-Sumait, N., Al-Yahya, H., Sabti, M. Y., & Qudei-mat, M. A. (2018). Knowledge, Attitude, and Barriers to Fluoride Application as a Preventive Measure among Oral Health Care Providers. *International Journal of Dentistry*. <https://doi.org/10.1155/2018/8908924>
- Alkhtib, A., & Morawala, A. (2018). Knowledge, Attitudes, and Practices of Mothers of Preschool Children about Oral Health in Qatar: A Cross-Sectional Survey. *Dentistry Journal*, 6(4), 51–51.
- Almdhun, H. M., Mallak, S. K., Aburas, M. M., Said, M. A., & Ghadiri, S. M. (2018). Measuring and predicting urban growth patterns and trends in Putrajaya, Malaysia. *IOP Conference Series Earth Environmental Science*, 169, 012114. <https://doi.org/10.1088/1755-1315/169/1/012114>
- Almebo, A., Mangasha, H. B., Ashuro, Z., Soboksa, N. E., Kanno, G. G., Negassa, B., Mangasha, A. E., Ayinallem, A. E., & Aregu, M. B. (2021). Utilization of Community-Level Fluoride-Filtered Water and its Associated Factors in Dugda Woreda of East Shewa Zone, Oromia Region, Ethiopia. *Environmental Health Insights*, 15. <https://doi.org/10.1177/11786302211052384>
- Ameer, N., Mustafa, G., Khan, I., Zahid, M., Yasinzai, M., Shahab, S., Asghar, N.,

Ullah, I., Ahmad, A., Munir, I., Khan, H., Badshah, S., Shahid, I., Ahmad, M. N., Zia, A., & Ahmad, S. (2018). Chemical sensors: Promising tools for the online monitoring of fluorides. *Fluoride*, 51(3), 252–266.

American Dental Association. (n.d.). Fluoride in Water. Retrieved on June 8, 2021, from <https://www.ada.org/en/public-programs/advocating-for-the-public/fluoride-and-fluoridation>

Anang, Z., Padli, J., Kamaludin, M., & Sathasivam, S. (2017). The Effect of Climate Change on Water Resources Using Panel Approach: The Case of Malaysia. *International Journal of Academic Research in Business and Social Sciences*, 7(11), 141–152. <https://doi.org/10.6007/ijarbss/v7-i11/3446>

Aoun, A., Darwiche, F., Al Hayek, S., & Doumit, J. (2018). The fluoride debate: the pros and cons of fluoridation. *Preventive Nutrition and Food Science*, 23(3), 171–180. <https://doi.org/10.3746/pnf.2018.23.3.171>

Armfield, J. M., & Akers, H. F. (2010). Risk perception and water fluoridation support and opposition in Australia. *Journal of Public Health Dentistry*, 70(1), 58–66. <https://doi.org/10.1111/j.1752-7325.2009.00144.x>

Ashkenazi, M., Bidoosi, M., & Levin, L. (2014). Effect of preventive oral hygiene measures on the development of new carious lesions. *Oral Health and Preventive Dentistry*, 12(1):61–9.

Bahari, M., Filzah, A., Kamil, M., Akbar, N. A., Mizad, M., Onn Malaysia, H., & Pahat, B. (2018). Evaluation of fluoride concentration in water filter system for households. *International Journal of Integrated Engineering*, 10(2), 123–127. <https://doi.org/10.30880/ijie.2018.10.02.023>

- Baltaci, E., Baygin, O., Tuzuner, T., & Korkmaz, F. M. (2019). Evaluation of the knowledge, attitudes and behaviors of pre-school teachers on oral and dental health in the city center of Trabzon. *European Oral Research*, 53(1), 12–20. <https://doi.org/10.26650/eor.20199213>
- Bansal, R., Bolin, K. A., Abdellatif, H. M. % Shulman, J. D. (2012). Knowledge, attitude and use of fluorides among dentists in Texas. *Journal of Contemporary Dental Practice*, 13(3), 371-375.
- Banoczy, J., Rugg-Gunn, A., & Woodward, M. (2013). Milk fluoridation for the prevention of dental caries. *Acta Medica Academica*, 42(2):156-67. http://www.ama.ba/index.php/ama/article/view/186/pdf_19
- Barberio, A. M., Quinonez, C., Hosein, F. S., & McLaren, L. (2017). Fluoride exposure and reported learning disability diagnosis among Canadian children: Implications for community water fluoridation. *Canadian Journal of Public Health*, 108(3), e229–e239. <https://doi.org/10.17269/CJPH.108.5951>
- Barker, J. C., Guerra, C., Gonzalez-Vargas, M. J., & Hoeft, K. S. (2016). Acceptability of salt fluoridation in a rural latino community in the United States: An ethnographic study. *PLoS ONE*, 11(7), 1–23. <https://doi.org/10.1371/journal.pone.0158540>
- Bashash, M., Thomas, D., Hu, H., Martinez-Mier, E. A., Sanchez, B. N., Basu, N., Peterson, K. E., Ettinger, A. S., Wright, R., Zhang, Z., Liu, Y., Schnaas, L., Mercado-Garcia, A., Tellez-Rojo, M. M., & Hernandez-Avila, M. (2017). Prenatal fluoride exposure and cognitive outcomes in children at 4 and 6–12 years of age in Mexico. *Environmental Health Perspectives*, 125(9), 1–12.

<https://doi.org/10.1289/EHP655>

- Berhe, A. A., Aregay, A. D., Abreha, A. A., Aregay, A. B., Gebretsadik, A. W., Negash, D. Z., Gebreegziabher, E. G., Demoz, K. G., Fenta, K. A., & Mamo, N. B. (2020). Knowledge, Attitude, and Practices on Water, Sanitation, and Hygiene among Rural Residents in Tigray Region, Northern Ethiopia. *Journal of Environmental and Public Health*. <https://doi.org/10.1155/2020/5460168>
- Bhagavatula, P., Levy, S. M., Broffit, B. Weber-Gasparoni, K. & Warren, J. J. (2017). Timing of fluoride intake and dental fluorosis on late-erupting permanent teeth. *Community Dental Oral Epidemiology*, 176(3), 139–148. <https://doi.org/10.1111/cdoe.12187>.Timing
- Blumer, S., Ratson, T., Peretz, B., & Dagon, N. (2018). Parents’ attitude towards the use of fluorides and fissure sealants and its effect on their children’s oral health. *Journal of Clinical Pediatric Dentistry*, 42(1), 6–10. <https://doi.org/10.17796/1053-4628-42.1.2>
- Brazier, Y. (2018, February). Why do we have fluoride in our water? Medical News Today. Retrieved on June 11, 2021, from <https://www.medicalnewstoday.com/articles/154164>
- Broadbent, J. M., Thomson, W. M., Ramrakha, S., Moffitt, T. E., Zeng, J., Foster Page, L. A., & Poulton, R. (2015). Community Water Fluoridation and Intelligence: Prospective Study in New Zealand. *American Journal of Public Health*, 105(1), 72–76. <https://doi.org/10.2105/AJPH.2013.301857>
- Budisa, N., Kubyshkin, V., & Schulze-Makuch, D. (2014). Fluorine-rich planetary environments as possible Habitats for life. *Life*, 4(3), 374–385.

- Butt, K. D. (2010). Perceptions of Public Drinking Water in Newfoundland and Labrador: a Mixed Methods Study. Memorial University Digital Archive Initiative. <http://collections.mun.ca/cdm/ref/collection/theses4/id/73522>
- Buzalaf, M. A. R., & Whitford, G. M. (2011). Fluoride metabolism. *Monographs in Oral Science*, 22, 20–36. <https://doi.org/10.1159/000325107>
- Chen, Q., Jia, C., Wei, J. & Dong, F. (2020). Geochemical process of groundwater fluoride evolution along global coastal plains: Evidence from the comparison in seawater intrusion area and soil salinization area. *Chemical Geology*. <https://doi.org/10.1016/j.chemgeo.2020.119779>
- Colgate. (2021, April 8). Fluorosis. Retrieved on June 11, 2021, from <https://www.colgate.com/en-my/oral-health/fluoride/fluorosis>
- Craig, L., Lutz, A., Berry, K. A., & Yang, W. (2015). Recommendations for fluoride limits in drinking water based on estimated daily fluoride intake in the Upper East Region, Ghana. *Science of the Total Environment*, 532, 127–137. <https://doi.org/10.1016/j.scitotenv.2015.05.126>
- Cury, J. A., Ricomini-Filho, A. P., Perecin Berti, F. L., & Tabchoury, C. P. M. (2019). Systemic effects (Risks) of water fluoridation. *Brazilian Dental Journal*, 30(5), 421–428. <https://doi.org/10.1590/0103-6440201903124>
- Demelash, H., Beyene, A., Abebe, Z., & Melese, A. (2019). Fluoride concentration in ground water and prevalence of dental fluorosis in Ethiopian Rift Valley: Systematic review and meta-analysis. *BMC Public Health*, 19(1), 1–9. <https://doi.org/10.1186/s12889-019-7646-8>

Department of Health Western Australia. (n.d.). Fluoridated drinking water. Government of Western Australia. Retrieved on August 6, 2021, from https://www.healthywa.wa.gov.au/Articles/F_I/Fluoridated-drinking-water

Department of Statistics Malaysia Official Portal. (n.d.). Retrieved on December 12, 2021, from https://www.dosm.gov.my/v1/index.php?r=column/cthemByCat&cat=155&bul_id=ZjJOSnpJR21sQWVUcUp6ODRudm5JZz09&menu_id=L0pheU43NWJwRWVSZklWdzQ4TlhUUT09

Department of Statistics Malaysia. [MyCensus2020]. (2020, November 7). *Statistik Wilayah Persekutuan Putrajaya*. [Facebook].

Department of Scientific Information ADA (2021). Caries Risk Assessment and Management. Retrieved on June 8, 2021, from <https://www.ada.org/resources/research/science-and-research-institute/oral-health-topics/caries-risk-assessment-and-management>

Dey, S., & Giri, B. (2016). Fluoride Fact on Human Health and Health Problems: A Review. *Medical & Clinical Reviews*, 2(1), 1–6. <https://doi.org/10.21767/2471-299x.1000011>

Division of Government and Public Affairs. (2017). American Dental Association Fluoridation Policy. Retrieved on June 8, 2021, from <https://www.ada.org/en/public-programs/advocating-for-the-public/fluoride-and-fluoridation/ada-fluoridation-policy>

Dongzagla, A., Jewitt, S., & O'Hara, S. (2021). Seasonality in faecal contamination of drinking water sources in the Jirapa and Kassena-Nankana Municipalities of

Ghana. *Science of the Total Environment*, 752.
<https://doi.org/10.1016/j.scitotenv.2020.141846>

Doria, M. (2010). Factors influencing public perception of drinking water quality. *Water Policy* 12, 1–19. <http://dx.doi.org/10.2166/wp.2009.051>.

Duan, Q., Jiao, J., Chen, X., & Wang, X. (2018). Association between water fluoride and the level of children's intelligence: a dose–response meta-analysis. *Public Health*, 154, 87–97. <https://doi.org/10.1016/j.puhe.2017.08.013>

Hendaus, M. A., Siddid, K., Alqadi, M., Siddiqui, F., Kunhiabdullah, S. & Alhammadi, A. H. (2019). Parental perception of fluoridated tap water. *Journal of Family Medicine and Primary Car*, 8(4), 1440-1446

Environmental Health Directorate (2012). *Water Fluoridation Survey, Yanchep*. Perth: Department of Health Western Australia.

Epidemiology Branch (2011). *Water Fluoridation Survey, Bunbury Area*. Perth: Department of Health Western Australia.

Everett, E. T. (2011). Critical reviews in oral biology & medicine: Fluoride's effects on the formation of teeth and bones, and the influence of genetics. *Journal of Dental Research*, 90(5), 552–560. <https://doi.org/10.1177/0022034510384626>

Fawell, J., Bailey, K., Chilton, J., Dahi, E., Fewtrell, L., & Magara, Y. (2006). Fluoride in drinking-water. London: World Health Organization (WHO).

Fluoride Action Network. (2021). Fluoride Action Network. Retrieved on December 5, 2021, from <https://fluoridealert.org/>

Garcia-Perez, A., Irigoyen-Camacho, M. E., & Borges-Yanez, A. (2013). Fluorosis

and dental caries in mexican schoolchildren residing in areas with different water fluoride concentrations and receiving fluoridated salt. *Caries Research*, 47(4), 299–308. <https://doi.org/10.1159/000346616>

Giwa, A. S., Memon, A. G., Ahmad, J., Ismail, T., Abbasi, S. A., Kamran, K., Wang, B., Segun, B., & Seydou, H. (2021). Assessment of high fluoride in water sources and endemic fluorosis in the North-Eastern communities of Gombe State, Nigeria. *Environmental Pollutants and Bioavailability*, 33(1), 31–40. <https://doi.org/10.1080/26395940.2021.1908849>

GlobeScan, 2017. RBC Canadian Water Attitudes Study. http://www.rbc.com/community-sustainability/_assets-custom/pdf/CWAS-2017-report.pdf

Goodarzi, F., Mahvi, A. H., Hosseini, M., Nedjat, S., Nabizadeh Nodehi, R., Kharazifard, M. J., Parvizishad, M., & Cheraghi, Z. (2016). The prevalence of dental fluorosis and exposure to fluoride in drinking water: A systematic review. *Journal of Dental Research, Dental Clinics, Dental Prospects*, 10(3), 127–135. <https://doi.org/10.15171/joddd.2016.021>

Grandjean, P., & Landrigan, P. J. (2015). Neurobehavioural effects of developmental toxicity. *The Lancet Neurology*, 13(3), 330–338. [https://doi.org/10.1016/S1474-4422\(13\)70278-3](https://doi.org/10.1016/S1474-4422(13)70278-3).

Green, R., Lanphear, B., Hornung, R., Flora, D., Martinez-Mier, E. A., Neufeld, R., Ayotte, P., Muckle, G., & Till, C. (2019). Association between Maternal Fluoride Exposure during Pregnancy and IQ Scores in Offspring in Canada. *JAMA Pediatrics*, 173(10), 940–948. <https://doi.org/10.1001/jamapediatrics.2019.1729>

- Guissouma, W., Hakami, O., Al-Rajab, A. J., & Tarhouni, J. (2017). Risk assessment of fluoride exposure in drinking water of Tunisia. *Chemosphere*, 177, 102–108. <https://doi.org/10.1016/j.chemosphere.2017.03.011>
- Horowitz, A. M., Kleinman, D. V., & Wang, M. Q. (2013). What Maryland adults with young children know and do about preventing dental caries. *American Journal of Public Health*, 103(6), 69–76. <https://doi.org/10.2105/AJPH.2012.103669>
- Hu, Y., You, M., Liu, G., & Dong, Z. (2021). Spatial distribution and potential health risk of fluoride in drinking groundwater sources of Huaibei, Anhui Province. *Scientific Reports*, 11(1), 1–11. <https://doi.org/10.1038/s41598-021-87699-6>
- Idowu, O. S., Azevedo, L. B., Valentine, R. A., Swan, J., Vasantavada, P. V., Maguire, A., & Zohoori, F. V. (2019). The use of urinary fluoride excretion to facilitate monitoring fluoride intake: A systematic scoping review. *PLoS ONE*, 14(9), 1–17. <https://doi.org/10.1371/journal.pone.0222260>
- Iheozor-Ejiofor, Z., O'Malley, L. A., Glenny, A. M., Macey, R., Alam, R., Tugwell, P., Walsh, T., Welch, V., & Worthington, H. V. (2015). Water fluoridation for the prevention of dental caries. *Cochrane Database of Systematic Reviews*, 12. <https://doi.org/10.1002/14651858.CD010856>
- Jimenez, V. L., Lopez Guzman, O. D., Flores, C. M., Costilla-Salazar, R., Hernandez, C. J., Contreras, A. Y., & Rocha-Amador, D. O. (2017). In utero exposure to fluoride and cognitive development delay in infants. *NeuroToxicology*, 59, 65–70. <https://doi.org/10.1016/j.neuro.2016.12.011>
- Jusoh, A. J., Junainah, N., & Isa, M. (2015). The Usage of Prodigy Module in Generating Family Well-Being in Community The Usage of Prodigy Module in

- Generating Family Well-Being in Community. *International Journal of Contemporary Applied Sciences*, 2(9), 125-130.
- Kakti, A. (2018). Knowledge, Attitude, and Practice of Parents about Dental Fluorosis in their Children. *International Journal of Oral Care and Research*, 6(1), 41–43.
- Kanduti, D., Sterbenk, P., & Artnik, B. (2016). Fluoride: a Review of Use and Effects on Health. *Materia Socio Medica*, 28(2), 133. <https://doi.org/10.5455/msm.2016.28.133-137>
- Karim, A. F., Zym, Y., & Nor, M. N. (2020). Water Fluoridation and Oral Health in Malaysia: a Review of Literature. *Journal of Health and Translational Medicine*, 23(2), 76–91. <https://doi.org/10.22452/jummec.vol23no2.12>
- Kebede, A., Retta, N., Abuye, C., & Malde, M. K. (2016). Community knowledge, attitude and practices (KAP) on fluorosis and its mitigation in endemic areas of Ethiopia. *African Journal of Food, Agriculture, Nutrition and Development*, 16(1), 10711–10722. <https://doi.org/10.18697/ajfand.73.15480>
- KheradPisheh, Z., Mirzaei, M., Mahvi, A. H., Mokhtari, M., Azizi, R., Fallahzadeh, H., & Ehrampoush, M. H. (2018). Impact of drinking water fluoride on human thyroid hormones: A case-control study. *Scientific Reports*, 8(1), 1–7. <https://doi.org/10.1038/s41598-018-20696-4>
- Kimambo, V., Bhattacharya, P., Mtalo, F., Mtamba, J., & Ahmad, A. (2019). Fluoride occurrence in groundwater systems at global scale and status of defluoridation – State of the art. *Groundwater for Sustainable Development*, 9, 100223. <https://doi.org/10.1016/j.gsd.2019.100223>

- Leavy, J. E., Heyworth, J., Middleton, A., Rosenberg, M., Woloszyn, M. (2012). Tap into Good Teeth – A Western Australian pilot study of children’s drinking patterns. *Health Promotion Journal of Australia*, 23, 42-7.
- Lowry, R. J., Brophy, R., & Lennon, M. A. (2021). Public attitudes to water fluoridation in the North East of England. *British Dental Journal*, 1–4. <https://doi.org/10.1038/s41415-021-3074-0>
- Main, D. (2015, April). Facts about Fluoridation. Retrieved on April 6, 2021, from <https://www.livescience.com/37123-fluoridation.html>
- Malago, J. (2017). Fluoride Levels in Surface and Groundwater in Africa: A Review. *American Journal of Water Science and Engineering*, 3(1), 1. <https://doi.org/10.11648/j.ajwse.20170301.11>
- Mamat, Z. (2018). Parental Knowledge and Practices on Preschool Children Oral Healthcare in Nibong Tebal Penang, Malaysia. *JOJ Nursing & Health Care*, 7(4).
- Marinho, V. C. C. (2015). Fluoride gels for preventing dental caries in children and adolescents. *Cochrane database of systematic reviews*, 2(2), 2280–2280.
- Marino, R., Fajardo, J., & Morgan, M. (2011). Economic evaluation of dental caries prevention programs using milk and its products as the vehicle for fluorides: cost versus benefits. In: Watson RR, Gerald JK, Preedy VR editor(s). *Nutrients, Dietary Supplements, and Nutraceuticals: Cost Analysis Versus Clinical Benefits*. New York: Humana Press, 143-60.
- Martinez-Mier, E. A. (2012). Fluoride: Its metabolism, toxicity, and role in dental health. *Journal of Evidence-Based Complementary and Alternative Medicine*, 17(1), 28– 32. <https://doi.org/10.1177/2156587211428076>

- Maybury, C., Jacob, M., Flanders, J. M., & Horowitz, A. M. (2021). Seeking community water fluoridation information on state health department websites. *PLoS ONE*, *16*, 1–11. <https://doi.org/10.1371/journal.pone.0251139>
- McLaren, L., Patterson, S., Thawer, S., Faris, P., McNeil, D., Potestio, M. L., & Schwart, L. (2017). Exploring the short-term impact of community water fluoridation cessation on children's dental caries: a natural experiment in Alberta, Canada. *Public Health*, *146*, 56–64. <https://doi.org/10.1016/j.puhe.2016.12.040> PMID:28404475
- Merriam-Webster. (2019). Knowledge. Retrieved on August, 6, 2021 from https://www.merriam-webster.com/dictionary/knowledge?utm_campaign=sd&utm_medium=serp&utm_source=jsonld
- Meyer J, Margaritis V, Mendelsohn A. Consequences of community water fluoridation cessation for Medicaid-eligible children and adolescents in Juneau, Alaska. (2018). *BMC Oral Health*, *18*(1):1–10. <https://doi.org/10.1186/s12903-017-0444-8> PMID:29301577
- Ministry of Health. (2019). Drinking and Raw Water Quality Standard. *Engineering Services Division, Malaysia*, 4–6. <http://kmam.moh.gov.my/public-user/drinking-water-quality-standard.html>
- Mork, N., & Griffin, S. (2015). Perceived safety and benefit of community water fluoridation: 2009 HealthStyles survey. *Journal of Public Health Dentistry*, *75*(4), 327–336. <https://doi.org/10.1111/jphd.12104>

- Muralidharan, D., Pocha, S., & Paul, A. (2018). Topical fluoride use: Knowledge, attitudes and practices of undergraduate dental students of three Dental Colleges in South India. *European Journal of Dental Education*, 22(3), 444–450. <https://doi.org/10.1111/eje.12323>
- Napier, G. L, & Kodner, C. L. (2008). Health risks and benefits of bottled water. *Primary Care: Clinics in Office Practice*, 35(4), 789-802.
- National Geographic Society. (2011). Urban area. <https://www.nationalgeographic.org/encyclopedia/urban-area/>
- National Health and Medical Research Council. (2017). Information Paper - Water fluoridation: dental and other human health outcomes. Retrieved on December 17, 2021, from https://www.nhmrc.gov.au/_files_nhmrc/file/17378_nhmrc_-_information_paper.pdf
- Nurul, S. M. S., Ahmad, S. Z., Shaharuddin, M. S. & Zaenal, A. (2017). Fluoride in Drinking Water: a Comparison between Two Areas in Selangor and Kuala Lumpur, Malaysia. *2nd International Conference on Public Health 2017, Surakarta, Indonesia*, 121.
- Ochoo, B., Valcour, J., & Sarkar, A. (2017). Association between perceptions of public drinking water quality and actual drinking water quality: A community-based exploratory study in Newfoundland (Canada). *Environmental Research*, 159, 435–443. <https://doi.org/10.1016/j.envres.2017.08.019>
- O'Mullane, D. M., Baez, R. J., Jones, S., Lennon, M. A., Petersen, P. E., Rugg-Gunn, A. J., Whelton, H., & Whitford, G. M. (2016). Fluoride and oral health. *Community Dental Health*, 33(2), 69–99.

https://doi.org/10.1922/CDH_3707O'Mullane31

Oxford Learner's Dictionaries. (n.d.). Perception. Oxford University Press. Retrieved on August 6, 2021, from https://www.oxfordlearnersdictionaries.com/definition/american_english/perception

Peckham, S., & Awofeso, N. (2014). Water fluoridation: A critical review of the physiological effects of ingested fluoride as a public health intervention. *The Scientific World Journal*, 2014. <https://doi.org/10.1155/2014/293019>

Perrella, A. M. L., & Kiss, S. J. (2015). Risk perception, psychological heuristics and the water fluoridation controversy. *Canadian Journal of Public Health*, 106(4), 197–203. <https://doi.org/10.17269/CJPH.106.4828>

Petersen, P. E., & Ogawa, H. (2016). Prevention of dental caries through the use of fluoride – the WHO approach. *Community Dental Health*, 33(2), 66–68. https://doi.org/10.1922/CDH_Petersen03

Pinellas County Utilities. (2017). Pinellas County 2017 Consumer Confidence Water Quality Report. Retrieved on December 12, 2021, from http://www.pinellascounty.org/utilities/PDF/CCR_2017.pdf

Pollick, H. F. (2013). Salt fluoridation: a review. *The Journal of the California Dental Association*, 41(6), 395–7, 400–4. PMID: 23875431.

Pollick, H., & Francisco, S. (2015). Salt fluoridation: a review. *CDA Journal*, 41. https://www.researchgate.net/publication/251232842_Salt_fluoridation_a_review

- Pretty, I. A., Boothman, N., Morris, J., MacKay, L., Liu, Z., McGrady, M., & Goodwin, M. (2016). Prevalence and severity of dental fluorosis in four English cities. *Community Dental Health*, 33(4), 292–296. https://doi.org/10.1922 /CDH_3930Pretty05.
- Quinonez, C. R., & Locker, D. (2009). Public opinions on community water fluoridation. *Canadian Journal of Public Health*, 100(2), 96–100. <https://doi.org/10.1007/bf03405514>
- Ramadan, A., & Ghandourb, I. (2016). Dental fluorosis in two communities in Khartoum state, Sudan, with potable water fluoride levels of 1.36 and 0.45 mg/L. *Fluoride*, 49(4), 509–20
- Rathee, M., & Sapra., A. (2021). Dental Caries. StatPearls Publishing LLC. <https://www.ncbi.nlm.nih.gov/books/NBK551699/>
- Razak, N. H. A., Praveena, S. M., Aris, A. Z., & Hashim, Z. (2016). Quality of Kelantan drinking water and knowledge, attitude and practice among the population of Pasir Mas, Malaysia. *Public Health*, 131, 103–111. <https://doi.org/10.1016/j.puhe.2015.11.006>
- Razdan, P., Patthi, B., Kumar, J. K., Agnithori, N., Chaudhari, P., & Prasad, M. (2017). Effect of fluoride concentration in drinking water on intelligence quotient of 12–14- year-old children in Mathura district: a cross-sectional study. *Journal of International Society of Preventive & Community Dentistry*, 7(5), 252–258.
- Roberts, D. J., Morris, J., Wood, A., Verlander, N. Q., Leonardi, G. S., & Fletcher, T. (2020). Use of public water supply fluoride concentration as an indicator of population exposure to fluoride in England 1995–2015. *Environmental*

- Sabbahi, D. A., Lawrence, H. P., Limeback, H., & Rootman, I. (2009). Development and evaluation of an oral health literacy instrument for adults. *Community Dental and Oral Epidemiology*, 37, 451–62.
- Sabti, M. Y., Al-Yahya, H., Al-Sumait, N., Akbar, A. A., & Qudeimat, M. A. (2019). Dental and medical practitioners' perception of community water fluoridation as a caries preventive measure. *European Archives of Paediatric Dentistry*, 20(1), 53–61. <https://doi.org/10.1007/s40368-018-0385-1>
- Sajjan, P. (2016). Knowledge , attitude and practices of rural people about fluoride and fluorosis in Davengere district. *Journal of the Indian Association of Public Health Dentistry*, 20, 29-33.
- Sarkar, A., Krishnapillai, M., Valcour, J., (2012). A study of groundwater quality of private wells in Western Newfoundland communities. Harris Centre, Memorial University.
https://www.mun.ca/harriscentre/reports/water/1011_WATER_Sarkar_Final.pdf
- Schwendicke, F., Dorfer, C. E., Schlattmann, P., Foster, P. L., Thomson. W. M., & Paris S. (2015). Socioeconomic inequality and caries: a systematic review and meta-analysis. *Journal of Dental Research*, 94(1), 10-18.
- SelangorKini (2019) Sungai Semenyih Water Treatment Plant the nation's first plant to receive ISO 22301: 2012. Retrieved on July 30, 2021, from <https://selangorkini.my/en/2014/11/sg-semenyih-water-treatment-plant-the-nations-first-plant-to-receive-iso-223012012/>

- Seymour, B., Getman, R., Saraf, A., Zhang, L. H. & Kalenderian, E. (2015). When advocacy obscures accuracy online: digital pandemics of public health misinformation through an antifuoride case study. *American journal of public health, 105*, 517-523.
- Shaharuddin, M. S., Mohd, K. Y., Mohammed, I. Y., Mohammad, F. R., Syazwan, A. I., & Mohd, Y. A. (2009). Fluoride Concentration in Malaysian Drinking Water. & *Environmental Science, 6*(4), 417–420.
- Shearer, E., & Mitchell, A. (2021, January 12). *News Use across Social Media Platforms in 2020*. Pew Research Center's Journalism Project. <https://www.pewresearch.org/journalism/2021/01/12/news-use-across-social-media-platforms-in-2020/>
- Slade, G. D., Sanders, A. E., Do, L., Roberts-Thomson, K., & Spencer, A. J. (2013). Effects of fluoridated drinking water on dental caries in Australian adults. *Journal of Dental Research, 92*(4), 376–82.
- Slagle, K. M., Wilson, R. S., & Heeren, A. (2015). Seeking, thinking, acting: understanding suburban resident perceptions and behaviors related to stream quality. *Journal of the American Water Resources Association, 51*, 821–832.
- Stephen, P., & Niyi, A. (2014). Water Fluoridation: A Critical Review of the Physiological Effects of Ingested Fluoride as a Public Health Intervention. *The Scientific World Journal, 6*, 1–10.
- Sutharsan, G. S., Gheena, S., Ganesh, L. (2020). Knowledge and awareness about uses of fluoride among adults - a survey. *International Journal of Research in Pharmaceutical Sciences, 1888-1895*.

- Tahir, M. A., & Rasheed, H. (2013). Fluoride in the drinking water of Pakistan and the possible risk of crippling fluorosis. *Drinking Water Engineering and Science*, 6(1), 17–23. <https://doi.org/10.5194/dwes-6-17-2013>
- TenCate J. M., & Buzalaf, M. A. R. (2019). Fluoride mode of action: once there was an observant dentist. *Journal of Dental Research*, 98(7), 725–730. <https://doi.org/10.1177/0022034519831604>
- Thippeswamy, H. M., Kumar, N., Anand, S. R., Prashant, G. M., & Chandu, G. N. (2010). Fluoride content in bottled drinking waters, carbonated soft drinks and fruit juices in Davangere city, India. *Indian Journal of Dental Research*, 21(4), 528– 530. <https://doi.org/10.4103/0970-9290.74206>
- Thippeswamy, H. M., Nanditha Kumar, M., Girish, M., Prashanth, S. N., & Shanbhog, R. (2021). Linear regression approach for predicting fluoride concentrations in maternal serum, urine and cord blood of pregnant women consuming fluoride containing drinking water. *Clinical Epidemiology and Global Health*, 10, 100685. <https://doi.org/10.1016/j.cegh.2020.100685>
- Tiemann, M. (2013). Fluoride in drinking water: a review of fluoridation and regulation issues. Congressional Research Service.
- Till, C., Green, R., Flora, D., Hornung, R., Martinez-Mier, E. A., Blazer, M., Farmus, L., Ayotte, P., Muckle, G., & Lanphear, B. (2020). Fluoride exposure from infant formula and child IQ in a Canadian birth cohort. *Environment International*, 134, 105315. <https://doi.org/10.1016/j.envint.2019.105315>
- Ullah, R., & Zafar, M. S. (2015). Oral and dental delivery of fluoride: a review. *Fluoride*, 48, 195-204.

- Ullah, R., & Zafar, M. S., & Shahani, N. (2017). Potential fluoride toxicity from oral medicaments: A review. *Iranian Journal of Basic Medical Sciences*, 20(8), 841–848. <https://doi.org/10.22038/ijbms.2017.9104>
- Unde, M. P., Patil, R. U., & Dastoor, P. P. (2018). The untold story of fluoridation: revisiting the changing perspectives. *Indian Journal of Occupational and Environmental Medicine*, 22(3), 121-127.
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6309358/>
- United Nations Human Settlements Programme. (2015). Knowledge, attitudes and practices survey on water, sanitation and hygiene in Wundwin Township Myanmar, 1-49.
- U.S. Centers for Disease Control and Prevention. Water Fluoridation Basics (2019). Retrieved on June 8, 2021, from <https://www.cdc.gov/fluoridation/basics/index.htm#Basic>
- U.S. Centers for Disease Control and Prevention. (2020, January 15). Community Water Fluoridation. Retrieved on June 8, 2021, from <https://www.cdc.gov/fluoridation/index.html>
- U.S. Centers for Disease Control and Prevention. (2021, June 10). Fluorosis. Retrieved on June 20, 2021, from https://www.cdc.gov/fluoridation/faqs/dental_fluorosis/index.htm
- U.S. Centre for Disease Control and Prevention. (2021, April 21). Children's oral health. Retrieved on June 20, 2021, from <https://www.cdc.gov/oralhealth/basics/childrens-oral-health/index.html>

- U.S. Environmental Protection Agency (2018). Edition of the Drinking Water Standards and Health Advisories. Office of Water U.S. Environmental Protection Agency, Washington, DC, 822-F-18-001.
- U.S. Public Health Service. (2015). U.S. Public Health Service Recommendation for Fluoride Concentration in Drinking Water for the Prevention of Dental Caries. *Public Health Reports*, 130(8), 318–331.
- Vanaja, K., Banu, R., Reddy, L., Kumar, P. C., Srinivas, C., Rajani, T., Navyashree, & Shekar, H. S. (2016). A study on knowledge and awareness about tuberculosis in senior school children in Bangalore, India. *Indian Journal of Tuberculosis*, 63(3), 192–198. <https://doi.org/10.1016/j.ijtb.2015.07.001>
- Victory, K. R., Cabrera, N. L., Larson, D., Reynolds, K. A., Latura, J., Thomson, C. A, & Beamer, P. (2017). Comparison of fluoride levels in tap and bottled water and reported use of fluoride supplementation in a United States-Mexico border community. *Front Public Health*, 5(87).
- Walker, T., Dickes, L., & Crouch, E. (2020). Community water fluoridation perceptions and practice in the United States: Challenges in governance and implementation. *Water Policy*, 22(3), 365–375. <https://doi.org/10.2166/wp.2020.044>
- Walsh, K. I., & Cury, J. A. (2018). Fluoride concentrations in salt marketed in Managua, Nicaragua. *Brazilian Oral Research*, 32, 45. <https://doi.org/10.1590/1807-3107bor-2018.vol32.0045>
- Wang, M., Liu, L., Li, H., Li, Y., Liu, H., Hou, C., Zeng, Q., Li, P., Zhao, Q., Dong, L., Zhou, G., Yu, X., Liu, L., Guan, Q., Zhang, S., & Wang, A. (2020). Thyroid

function, intelligence, and low-moderate fluoride exposure among Chinese school-age children. *Environment International*, 134, 105229. <https://doi.org/10.1016/j.envint.2019.105229>

Watson, R. R., Gerald, J. K., & Preedy, V. R. (2011). *Nutrients, Dietary Supplements, and Nutraceuticals: Cost Analysis versus Clinical Benefits*. Human Press.

World Health Organization. (2011). *Guidelines for Drinking-Water Quality*, 4th ed. World Health Organization. Retrieved on June 8, 2021, from http://apps.who.int/iris/bitstream/10665/44584/1/9789241548151_eng.pdf

World Health Organization. (2018). Fluorosis. Retrieved on June 20, 2021, from <https://www.who.int/teams/environment-climate-change-and-health/water-sanitation-and-health/burden-of-disease/other-diseases-and-risks/fluorosis#:~:text=In%20skeletal%20fluorosis%2C%20fluoride%20accumulates,impairment%20of%20muscles%20and%20pain>

Whyman, R. A., Mahoney, E. K., & Borsting, T. (2016). Community water fluoridation: Attitudes and opinions from the New Zealand Oral Health Survey. *Australian and New Zealand Journal of Public Health*, 40(2), 186–192. <https://doi.org/10.1111/1753-6405.12408>

Wilger, J., Jhu, B. S., Cutrufelli, R., Ars, B. S. U., Pehrsson, P., Ars, U., Patterson, K. Y., Ars, U., Holden, J., Ars, M. S. U., & March, F. (2004). *Participant Knowledge of Fluoride in Drinking Water Based on a National Survey*, 65(87), 26008.

Yu, X., Chen, J., Li, Y., Liu, H., Hou, C., Zeng, Q., Cui, Y., Zhao, L., Li, P., Zhou, Z., Pang, S., Tang, S., Tian, K., Zhao, Q., Dong, L., Xu, C., Zhang, X., Zhang, S.,

- Liu, L., & Wang, A. (2018). Threshold effects of moderately excessive fluoride exposure on children's health: A potential association between dental fluorosis and loss of excellent intelligence. *Environment International*, 118, 116–124. <https://doi.org/10.1016/j.envint.2018.05.042>
- Zheng, D., Liu, Y., Luo, L., Shahid, M. Z., & Hou, D. (2020). Spatial variation and health risk assessment of fluoride in drinking water in the Chongqing urban areas, China. *Environmental Geochemistry and Health*, 42(9), 2925–2941. <https://doi.org/10.1007/s10653-020-00532-3>
- Zhou, G., Yang, L., Luo, C., Liu, H., Li, P., Cui, Y., Liu, L., Yu, X., Zeng, Q., Chen, J., Zhao, Q., Dong, L., Niu, Q., Zhang, S., & Wang, A. (2019). Low-to-moderate fluoride exposure, relative mitochondrial DNA levels, and dental fluorosis in Chinese children. *Environment International*, 127, 70–77. <https://doi.org/10.1016/j.envint.2019.03.033>
- Zohouri, F. V., Walls, R., Teasdale, A., Landes, D., Steen, I. N., Moynihan, P., Omid, N., & Maguire, A. (2013). Fractional urinary fluoride excretion of 6–7-year-old children attending schools in low-fluoride and naturally fluoridated areas in the UK. *The British Journal of Nutrition*, 109, 1903–1909.

APPENDICES

APPENDIX I

ITEM-TOTAL STATISTICS OF KNOWLEDGE AND PERCEPTION ON FLUORIDE IN DRINKING WATER

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item- Total Correlation	Cronbach's Alpha if Item Deleted
Do you know what fluoride is?	11.62	36.071	0.665	0.746
Have you heard or read about fluoride before?	11.50	38.087	0.357	0.762
Where did you hear(s) or read(s) about fluoride?	10.54	34.781	0.437	0.752
Do you know there is the addition of fluoride in your drinking water?	11.92	37.297	0.500	0.756
Do you know the purpose of the addition of fluoride in drinking water?	12.00	37.478	0.531	0.756
What is/are the purpose(s) of the addition of fluoride in drinking water?	10.67	27.797	0.687	0.720
Do you know the optimal level of fluoride addition in drinking water that is implemented by the National Standard Drinking Water Quality (NSDWQ)?	12.12	39.071	0.339	0.766
Lack of fluoride exposure can cause diseases.	11.83	36.232	0.650	0.747

What is/are the health effect(s) that may be caused by lack of fluoride exposure in drinking water?	11.12	37.679	0.390	0.760
Excessive of fluoride exposure can cause diseases.	11.71	37.694	0.381	0.760
What is/are the health effect(s) that may be caused by excessive levels of fluoride exposure in drinking water?	11.12	27.158	0.761	0.708
State the reason(s) of your choice of drinking water source.	10.46	37.998	0.199	0.771
Do you think the addition of fluoride to public drinking water is safe?	11.83	36.667	0.574	0.751
Do you think that the addition of fluoride to the public drinking water supply is effective?	11.42	36.601	0.020	0.840
Do you think that the addition of fluoride to public drinking water supply can help prevent tooth decay?	11.58	37.645	0.405	0.759
Are you into the addition of fluoride in drinking water?	11.67	37.797	0.366	0.761

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

Research title	: Knowledge And Perception of Fluoride in Drinking Water Among Residents in Precinct 9, Putrajaya.
Study Site	: Precinct 9, Putrajaya.
JKEUPM Ref No.	: JKEUPM-2021-739
Researcher	: Fatin Nor Athirah Binti Yahaya
Supervisor	: Dr Shahrudin Bin Mohd Sham

Documents received and reviewed with reference to the above study:

1. Ethics Application Form, Version 1 dated 21/09/2021
2. Respondent's Information Sheet / Consent (English), Version 1 dated 28/10/2021
3. Proposal (English), Version 2 dated 02/11/2021
4. Questionnaire / Interviews (English), Version 1 dated 21/09/2021
5. 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 02 NOVEMBER 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

APPENDIX III

RESPONDENT'S INFORMATION SHEET AND INFORMED CONSENT FORM



**JAWATANKUASA ETIKA UNIVERSITI UNTUK
PENYELIDIKAN MELIBATKAN MANUSIA
(JKEUPM) UNIVERSITI PUTRA MALAYSIA, 43400
UPM SERDANG, SELANGOR, MALAYSIA**

FORM 2.4: RESPONDENT'S INFORMATION SHEET AND INFORMED CONSENT FORM

Please read the following information carefully and do not hesitate to discuss any questions you may have with the researcher.

1. STUDY TITLE:

Knowledge and Perception of Fluoride in Drinking Water among Residents in Precinct 9, Putrajaya.

2. INTRODUCTION:

Fluoride is an ionized form of the element fluorine and is ubiquitous in the environment. 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.

Therefore, this study is carried out to determine the level of knowledge and perception of the fluoride in drinking water among residents in Precinct 9. This study would also intend to determine the significant association between socio-demographic characteristics and knowledge as well as perception of fluoride in drinking water among residents in Precinct 9.

3. WHAT WILL YOU HAVE TO DO?

This study is completely voluntary where respondents can withdraw at any point of time without any cost. All information will be kept confidential. A link to the online self-administered questionnaire will be distributed to the residents living in Precinct 9, Putrajaya who give their consents to participate voluntarily in the Section B, Knowledge on Fluoride in Drinking Water, Section C Perception on Fluoride in

Drinking Water. You will need to answer all questions as instructed. The questionnaire is estimated to take about 5 minutes.

4. WHO SHOULD NOT PARTICIPATE IN THE STUDY?

Sick or mentally disabled individuals should not participate in this study.

5. WHAT WILL BE THE BENEFITS OF THE STUDY:

(a) TO YOU AS THE SUBJECT?

All information obtained from this research will be able to help enhance the level of knowledge and perception on the addition of fluoride in drinking water in the urban community water supply system. The result of the study may help you identify the level of fluoride in drinking water that should be safe to be consumed and its efficacy towards health.

There will be no compensation or reward for your participation in this research. However, the collective/summarized results of this research can be obtained after the completion of this research at your request.

There will be no compensation or reward for your participation in this research. However, the collective/summarized results of this research can be obtained after the completion of this research at your request.

(b) TO THE INVESTIGATOR?

All the information from this research will be used to evaluate the level of knowledge and perception on the addition of fluoride in drinking water of the residents in Precinct 9, Putrajaya. This research could also be used as a reference towards other future research related to the awareness level and beliefs on community water fluoridation.

6. WHAT ARE THE POSSIBLE RISKS?

There are no possible risks that will be impacted from this study because it is not invasive.

7. WILL THE INFORMATION THAT YOU PROVIDE AND YOUR IDENTITY REMAIN CONFIDENTIAL?

Yes, all the information obtained in this research will be stored in a confidential manner, in accordance with regulation and/or laws concerned and only be used for research purposes. The data processing software will not contain your personal identifier or information. If the results of this research are published or presented to the public, your identity will not be revealed without your prior permission first. Only the research team is allowed to access your information. By signing this consent form, you are agreed to record review, information storage and data process as per described.

8. WHO SHOULD YOU CONTACT IF YOU HAVE ADDITIONAL QUESTIONS DURING THE COURSE OF THE RESEARCH?

If you have any questions about this study or your rights, please contact:

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Email: vera.yulyani@malahayati.ac.id

Please initial here if you have read and understood the contents of this page_____

9. CONSENT

I Identity Card No.
address.....

.....hereby voluntarily agree to take part in
the research stated above *(clinical /drug trial/video recording/ focus group/interview-based/
questionnaire-based).

I have been informed about the nature of the research in terms of methodology, possible
adverse

effects and complications (as written in the Respondent's Information Sheet). I understand
that I have the right to withdraw from this research at any time without giving any reason
whatsoever. I also understand that this study is confidential and all information provided with
regard to my identity will remain private and confidential.

I* wish / do not wish to know the results related to my participation in the research

I agree/do not agree that the images/photos/video recordings/voice recordings related to me
be used in any form of publication or presentation (if applicable)

* delete where necessary

Signature
(Respondent)

Signature
(Witness)

Date :.....

Name :.....

I/C No. :.....

I confirm that I have explained to the respondent the nature and purpose of the above-
mentioned research.

Date

Signature
(Researcher)



**JAWATANKUASA ETIKA UNIVERSITI UNTUK
PENYELIDIKAN MELIBATKAN MANUSIA
(JKEUPM) UNIVERSITI PUTRA MALAYSIA,
43400 UPM SERDANG, SELANGOR, MALAYSIA**

BORANG 2.4: PENERANGAN DAN PERSETUJUAN RESPONDEN

Sila baca maklumat berikut dengan teliti. Sekiranya anda mempunyai sebarang pertanyaan, sila kemukakan kepada penyelidik.

1. TAJUK KAJIAN

Pengetahuan dan Persepsi mengenai Fluorida dalam Air Minum antara Penduduk di Presint 9, Putrajaya.

2. PENGENALAN

Fluorida adalah bentuk terion dari unsur fluorin dan boleh dijumpai di mana-mana dalam persekitaran. Terdapat pelbagai sumber pendedahan kepada fluorida seperti melalui makanan, air dan penggunaan ubat gigi yang berlebihan. Namun begitu, air minuman menunjukkan keutamaan tertinggi kerana pendedahan fluorida kepada orang ramai melalui majoriti pengambilan fluorida melalui pencernaan.

Oleh itu, kajian ini dijalankan bertujuan untuk menentukan tahap pengetahuan dan persepsi mengenai fluorida dalam air minuman dalam kalangan penduduk di Presint 9, Putrajaya. Kajian ini juga bertujuan menentukan hubungan di antara ciri-ciri sosio-demografik dan pengetahuan serta persepsi residen urban di Putrajaya berkaitan dengan penambahan fluorida dalam air minuman.

3. APAKAH YANG PERLU ANDA LAKUKAN?

Kajian ini adalah sepenuhnya secara sukarela di mana responden boleh menarik diri pada bila-bila masa tanpa sebarang kesan. Segala informasi akan dirahsiakan. Sebuah rangkaian kepada soal selidik yang dikendalikan sendiri secara atas talian akan disebarkan kepada penduduk di Putrajaya yang memberi persetujuan untuk menyertai kajian ini secara sukarela. Soal selidik ini mengandungi tiga (3) bahagian, iaitu Bahagian A Ciri-ciri Sosio-demografik, Bahagian B Pengetahuan mengenai Fluorida dalam Air Minuman dan Bahagian C Persepsi mengenai Fluorida dalam Air Minuman. Anda perlu menjawab semua soalan seperti dalam arahan. Boring soal selidik ini dianggarkan mengambil masa selama 5 minit.

4. SIAPA YANG TIDAK BOLEH MENYERTAI KAJIAN INI?

Individu yang sakit atau kurang upaya dari segi mental tidak boleh menyertai kajian ini.

5. APAKAH FAEDAH MENYERTAI KAJIAN INI?

a) KEPADA ANDA SEBAGAI PESERTA?

Semua informasi yang diperolehi daripada kajian ini berupaya membantu meningkatkan tahap pengetahuan dan persepsi mengenai fluorida dalam air minuman. Hasil kajian mungkin membantu anda mengenalpasti tahap fluorida dalam air minuman yang sepatutnya selamat untuk dikonsumsi dan keberkesannya terhadap kesihatan.

Tiada kompensasi atau anugerah yang akan diberikan daripada penyertaan anda dalam kajian ini. Walaubagaimanapun, hasil kolektif daripada kajian ini boleh didapati selepas kajian selesai mengikut permintaan anda.

b) KEPADA PENYELIDIK?

Semua informasi daripada kajian ini akan digunakan untuk menyiasat tahap pengetahuan dan persepsi mengenai fluorida dalam air minuman dalam kalangan residen di Presint 9, Putrajaya. Kajian ini juga boleh digunakan sebagai rujukan untuk kajian akan datang berkaitan dengan tahap kesedaran dan kepercayaan terhadap fluoridasi air komuniti.

6. ADAKAH IA BERISIKO?

Tiada risiko yang bakal berlaku yang akan dipengaruhi oleh kajian kerana tidak invasif.

7. ADAKAH MAKLUMAT DAN IDENTITI SAYA KEKAL RAHSIA?

Ya, semua maklumat yang diperolehi dalam penyelidikan ini akan disimpan dan dilakukan secara rahsia, sesuai dengan peraturan dan/atau undang-undang yang berkaitan. Perisian pemprosesan data tidak akan mengandungi maklumat pengenalan atau informasi anda. Sekiranya hasil penyelidikan ini diterbitkan atau disampaikan kepada umum, identiti anda tidak akan didedahkan tanpa kebenaran anda terlebih dahulu. Hanya pasukan penyelidik yang dibenarkan mengakses maklumat anda. Dengan menandatangani borang persetujuan ini, ia menandakan anda bersetuju dengan tinjauan rekod, penyimpanan maklumat dan proses data seperti yang dijelaskan di atas.

**8. SIAPA YANG SAYA PERLU HUBUNGI SEKIRANYA SAYA
MEMPUNYAI SOALAN TAMBAHAN SEMASA MENGIKUTI
PENYELIDIKAN INI?**

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*Sila tandatangan di sini sekiranya anda telah membaca dan memahami kandungan
halaman ini*

9. PERSETUJUAN

Saya.....No Kad Pengenalan.....
beralamat.....
dengan ini bersetuju untuk mengambil bahagian secara sukarela dalam penyelidikan
yang tersebut di atas *(kajian klinikal/percubaan ubat-ubatan/rakaman
video/kumpulan sasaran/temuduga/ soal selidik).

Saya telah diberi penjelasan secara menyeluruh mengenai penyelidikan ini dari segi
metodologi, risiko dan komplikasi (seperti tertulis pada Helaiian Penerangan
Responden). Saya memahami bahawa saya berhak menarik diri dari penyelidikan ini
pada bila-bila masa tanpa memberi sebarang alasan.Saya juga memahami bahawa
sebarang maklumat yang berkaitan identiti saya akan dirahsiakan.

Saya* berminat / tidak berminat untuk mengetahui keputusan kajian yang
melibatkan saya.

I setuju/tidak bersetuju untuk imei/gambar/rakaman video/ rakaman suara digunakan
dalam apa jua bentuk penerbitan atau pembentangan. (sekiranya berkaitan).

*potong yang tidak berkenaan

Tandatangan
(Responden)

Tandatangan
(Saksi)

Tarikh :.....

Nama :.....

No. K/P:

Saya mengesahkan bahawa saya telah menerangkan kepada responden ini sifat dan
tujuan penyelidikan yang tersebut di atas.

Tarikh

Tandatangan
(Penyelidik)

APPENDIX IV

QUESTIONNAIRE



KNOWLEDGE AND PERCEPTION OF FLUORIDE IN DRINKING WATER AMONG RESIDENTS IN PRECINCT 9, PUTRAJAYA

**PENGETAHUAN DAN PERSEPSI MENGENAI FLUORIDA DALAM AIR
MINUMAN ANTARA PENDUDUK DI PRECINCT 9, PUTRAJAYA**

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 open-ended questions and has three sections which are:

Section A: Socio-demographic Characteristics

Section B: Knowledge of Fluoride in Drinking Water

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 terbuka dan mempunyai tiga bahagian, iaitu:

Bahagian A: Ciri-ciri Sosio-demografi

Bahagian B: Pengetahuan mengenai Fluorida di dalam Air Minuman

Bahagian C: Persepsi mengenai Fluorida di dalam Air Minuman.

Introduction

Fluoride is an ionized form of the element fluorine and is ubiquitous in the environment. In Malaysia, 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 - 0.6mg/L to make sure the public did not receive lack or excess fluoride in drinking water. 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 dan boleh dijumpai di mana-mana dalam persekitaran. Di Malaysia, 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 ialah 0.4mg/L - 0.6mg/L untuk memastikan orang ramai tidak kekurangan atau berlebihan menggunakan fluorida dalam air minuman. Terdapat pelbagai sumber pendedahan kepada fluorida seperti melalui makanan, air dan penggunaan ubat gigi yang berlebihan. Namun begitu, air minuman 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 BAHAGIAN A	: SOCIO-DEMOGRAPHIC CHARACTERISTICS : CIRI-CIRI SOSIO-DEMOGRAFIK
--------------------------------	---

1. Age / *Umur*

☐ 18-64 years old / *tahun*

☐ More than 64 years old / *Lebih dari 64 tahun*

2. Gender / *Jantina*

☐ Male / *Lelaki*

☐ Female / *Perempuan*

3. Educational level / *Tahap pendidikan:*

☐ Primary education / *Pengajian rendah*

☐ Secondary education / *Pengajian menengah*

☐ Tertiary education / *Pengajian tinggi*

☐ Did not receive any formal education / *Tidak menerima sebarang pendidikan formal*

4. How long have you lived in Precinct 9, Putrajaya? / *Sudah berapa lama anda tinggal di Presint 9, Putrajaya?*

☐ Less than a year / *Kurang dari setahun*

☐ 1-5 years / *tahun*

☐ 6-10 years / *tahun*

☐ More than 10 years / *Lebih dari 10 tahun*

SECTION B BAHAGIAN B	: KNOWLEDGE OF FLUORIDE IN DRINKING WATER : 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 pilih jawapan yang berkenaan.*

☐ Print media / *Media cetak*

☐ Electronic media / *Media elektronik*

☐ Educational institution / *Institusi pendidikan*

☐ Friends / *Rakan-rakan*

☐ Others, please specify / *Lain-lain, sila nyatakan:* _____

☐ Not applicable / *Tidak berkaitan*

8. Do you know there is the addition of fluoride into your drinking water? / *Adakah anda tahu terdapat penambahan fluorida ke 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 carries and / *Mengelakkan daripada karies gigi*

☐ Preserve oral health / *memelihara 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 fluorida boleh menyebabkan penyakit.*

☐

Yes / *Ya*

☐

No / *Tidak*

☐

Not sure / *Tidak pasti*

13. What is/are the health effect(s) that may be caused by lack of fluoride exposure in drinking water? / *Apakah masalah kesihatan yang disebabkan oleh kurang fluorida di dalam air minuman?*

☐

Weak bones structure / *Struktur tulang yang lemah*

☐

Tooth decay / *Pereputan gigi*

☐

Not sure / *Tidak pasti*

14. Excessive fluoride exposure can cause diseases. / *Pendedahan fluorida yang berlebihan boleh menyebabkan penyakit.*

☐

Yes / *Ya*

☐

No / *Tidak*

☐

Not sure / *Tidak pasti*

15. What is/are the health effect(s) that may be caused by excessive levels of fluoride exposure in drinking water? / *Apakah masalah kesihatan yang disebabkan oleh pendedahan fluorida yang berlebihan di dalam air minuman?*

☐

Dental fluorosis / *Fluorosis gigi*

☐

Skeletal fluorosis / *Fluorosis rangka*

☐

Insulin secretion problem / *Masalah rembesan insulin*

☐

Neural development problem / *Masalah perkembangan saraf*

☐

Thyroid gland problem / *Masalah kelenjar tiroid*

☐

Not sure / Tidak pasti

SECTION C BAHAGIAN C	: PERCEPTION OF FLUORIDE IN DRINKING WATER : 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 gunakan?*

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

☐ Store bought bottled water / *Air botol yang dibeli*

☐ Other, please specify / *Lain-lain, sila nyatakan:* _____

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*

☐ Other, please specify / *Lain-lain, sila nyatakan:* _____

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 dalam air minuman?*

☐ Yes / Ya

☐ No / Tidak

☐ Not sure / Tidak pasti

THANK YOU FOR YOUR COOPERATION AND FEEDBACKS.

**TERIMA KASIH ATAS KERJASAMA DAN MAKLUMBALAS YANG
DIBERIKAN.**