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FLUORIDE IN DRINKING WATER AND URINE: A CROSS-SECTIONAL STUDY AMONG SCHOOL CHILDREN IN KUALA KUBU BHARU, HULU SELANGOR

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FLUORIDE IN DRINKING WATER AND URINE: A CROSS-SECTIONAL STUDY AMONG SCHOOL CHILDREN IN KUALA KUBU BHARU, HULU SELANGOR.

BY

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ABSTRACT

FLUORIDE IN DRINKING WATER AND URINE: A CROSS-SECTIONAL STUDY AMONG SCHOOL CHILDREN IN KUALA KUBU BHARU, HULU SELANGOR

Introduction: Fluoride naturally contained in all natural waters at different amounts. Fluoride in groundwater is usually about 1 ppm while in rivers and lakes, fluoride concentration is less than 0.5 ppm. Numerous countries have added fluoride in drinking water with the main purpose to avoid tooth decay by giving continuous and consistent contact with low amounts of fluoride. Water fluoridation is the most practical strategy for conveying fluoride to the community and decreasing tooth decay by 25% in children and grown-ups (CDC., 2016). **Objective**: The aims of this study were to determine the levels of fluoride in drinking water and levels of urinary fluoride, to determine whether fluoride in both drinking water and urine are under the acceptable range stated by National Drinking Water Quality Standards (NDWQS) and NIOSH Method 8308 respectively, to determine significant different in urinary fluoride between male and female respondents, and to determine relationship between fluoride levels in drinking water and urinary fluoride among respondents. **Method**: A cross-sectional study was conducted among school children aged 14 years old at a selected school in Kuala Kubu Bharu, Hulu Selangor. They were selected based on several criteria, then a briefing was given to selected respondents before distribute a set of questionnaire. After obtaining parents' permission, a set of high-density polyethylene bottle (HDPE) and plastic bottle for drinking water and urine samples respectively for 2 consecutive days. Both samples were immediately analyzed using a HACH Brand Direct Reading Spectrophotometer model DR/ 1900. Method 8029 was accepted by the EPA for reporting of drinking water and wastewater analysis purposes. **Results:** Fluoride levels in drinking water ranges between 0.41 – 0.59 ppm with a median of 0.46 (±0.04) while urinary fluoride, which was normally distributed, ranges between 0.45 – 2.29 ppm with a mean 1.48 (±0.43). There was no significant difference in urinary fluoride between male and female respondents ($p<0.05$). There was no significant relationship between fluoride levels in drinking water and urinary fluoride levels among respondents ($p<0.05$). The median value fluoride in drinking water obtained was 0.46 which still in the range of NDWQS standards. Urinary fluoride was within the range stated by NIOSH. **Conclusion**: It was found that levels of fluoride in both drinking water and urine were within safe limit.

Keywords: *Fluoride, drinking water, urinary fluoride, Kuala Kubu Bharu*

ABSTRAK

FLUORIDA DALAM AIR MINUMAN DAN AIR KENCING: KAJIAN RENTAS DALAM KALANGAN PELAJAR SEKOLAH DI KUALA KUBU BHARU, HULU SELANGOR

Pengenalan: Fluorida secara semulajadi terkandung dalam semua air semulajadi dengan jumlah yang berbeza. Fluorida dalam air bawah tanah biasanya kira-kira 1 ppm manakala di sungai dan tasik, kadar fluorida kurang daripada 0.5 ppm. Banyak negara telah menambah fluorida dalam air minuman dengan tujuan utama untuk mengelakkan kerosakan gigi dengan memberikan hubungan berterusan dan konsisten dengan jumlah fluorida yang rendah. Fluoridasi air adalah strategi yang paling praktikal untuk menyampaikan fluoride kepada masyarakat dan mengurangkan kerosakan gigi sebanyak 25% pada kanak-kanak dan orang dewasa (CDC., 2016).**Objektif:** Matlamat kajian ini adalah untuk menentukan tahap fluorida dalam air minuman dan tahap fluorida kencing, untuk menentukan sama ada fluorida dalam air minuman dan air kencing berada di bawah julat yang boleh diterima oleh Standard Kualiti Air Minum Kebangsaan (NDWQS) dan kaedah NIOSH 8308, untuk menentukan perbezaan fluoride dalam air kencing antara responden lelaki dan wanita, dan menentukan hubungan antara tahap fluorida dalam air minuman dan fluorida dalam air kencing dalam kalangan responden. **Kaedah:** Kajian keratin rentas telah dijalankan dalam kalangan kanak-kanak sekolah berumur 14 tahun di sekolah terpilih di Kuala Kubu Bharu , Hulu Selangor. Mereka dipilih berdasarkan beberapa kriteria, maka taklimat diberikan kepada responden terpilih sebelum mengedarkan satu set soal selidik. Setelah mendapatkan kebenaran ibu bapa, satu set botol polietilena berkepadatan tinggi (HDPE) dan botol plastik untuk air minum dan sampel air kencing masing-masing selama 2 hari berturut-turut. Kedua-dua sampel itu dianalisis dengan segera menggunakan model Spektrofotometer HACH Direct DR / 1900 secara bacaan langsung. Kaedah 8029 diterima oleh EPA untuk melaporkan keperluan air minuman dan analisis air kumbahan. Keputusan: Tahap fluorida dalam air minuman berkisar antara 0.41 - 0.59 ppm dengan median 0.46 (± 0.04) manakala fluorida kencing, yang biasanya diedarkan, antara 0.45 - 2.29 ppm dengan purata 1.48 (± 0.43). Tidak terdapat perbezaan yang signifikan mengenai fluorida dalam air kencing antara responden lelaki dan wanita ($p < 0.05$). Tiada hubungan yang signifikan antara tahap fluorida dalam air minuman dan tahap fluorida dalam air kencing dalam kalangan responden ($p < 0.05$). Nilai median fluorida dalam air minuman yang diperolehi adalah 0.46 yang masih dalam lingkungan piawai NDWQS. Fluorida dalam air kencing berada dalam nilai yang dinyatakan oleh NIOSH. Kesimpulan: Tahap fluorida dalam kedua-dua air minuman dan air kencing berada dalam batas yang selamat.

Kata kunci: Fluorida, air minuman, fluorida kencing, Kuala Kubu Bharu

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LIST OF ABBREVIATIONS

WHO	World Health Organizations
NDWQS	National Drinking Water Quality Standards
NMAM	NIOSH Manual Analytical Method
HDPE	High density polyethylene
EDTA	Ethylenediaminetetraacetic acid
EFSA	European Food Safety Association
EPA	Environmental Protection Agency
PAHO	Pan American Health Organization
IQ	Intelligent Quotient
PAK-EPA	Pakistan Environmental Protection Agency
FUFE	Fractional Urinary Fluoride Excretion
pH	Potential of Hydrogen
HF	Hydrogen Fluoride
TDFI	Total daily fluoride intake
DUFE	Daily urinary fluoride excretion

DMFT	Decayed, missing or filled permanent teeth
SPSS	Statistical Package for the Social Sciences
CDC	Communicable Disease Control

CHAPTER 1

INTRODUCTION

1.1 Research Background

Water is very crucial for human health and welfare. All human have rights to access clean drinking water. Approximately, 780 million in the worldwide did not received clean and safe water while 2.5 billion people lack of proper sanitation. Water also processed as a drinking water to be safely consume by human (Rahamanian et al., 2015). In Malaysia, water facilities supplied from treated surface water and groundwater to be distribute to the community as drinking water in various forms such as tap water, bottled drinking water and bottled mineral water. Surface water such as from Sungai Langat, Sungai Selangor, Sungai Kinta in West Coast Peninsular Malaysia is used for drinking purposes (Ab Razak et al., 2017).

Fluoride naturally contained in all natural waters at different amounts. Fluoride in groundwater is usually about 1 ppm while in rivers and lakes, fluoride concentration is less than 0.5 ppm. In groundwater, the concentrations of fluoride depend on the nature of rocks and the existence of fluoride-bearing minerals (Fawell & Bailey, 2006). Numerous countries have added fluoride in drinking water with the main purpose to avoid tooth decay by giving continuous and consistent contact with low amounts of fluoride. Water fluoridation is the most practical strategy for conveying fluoride to the community and decreasing tooth decay by 25% in children and grown-ups (CDC., 2016).

The World Health Organization's (WHO) recommended range for optimal concentration based on the climatic conditions is 0.5 ppm to 1.0 ppm while the recommended Guideline Value is 1.5 ppm (WHO,2004). Kumar et al., (2017) stated that dental and skeletal fluorosis occurred with exposure fluoride concentration of more than 1.5 ppm. Maximum acceptable value for National Drinking Water Quality Standards (NDWQS) stated by Ministry of Health Malaysia is in the range of 0.4ppm to 0.6 ppm (Engineering of Research Division, 2010).

Human also exposed to fluoride from other sources such as from dental products, foods and air. There are foods containing fluoride such as dairy products (0.25pm), grain and cereal products (0.42 ppm), and potatoes (0.49 ppm) while examples of dental products containing fluoride are toothpastes, treatment gels, and mouth rinses which fluoride levels from these sources can be more than 1000 ppm (US Public Health Service, 1991). Fluorides also can be released to the environment via combustion of coals, brick making and waste and process water from many types of industrial activities (Sun et al., 2017). Besides, fluoride from anthropogenic sources such as steel manufacture, nickel production, and pesticide that contained fluoride can causes fluoride to be released to environment (Lewandowska, Falkowska & Jóźwik , 2012).

Fluoride is excreted mainly from the kidneys but also can be eliminated through faeces, sweat and breast milk. Half of the absorbed amount of fluoride excreted rapidly in urine with biological half-life of two and nine hours and the rest accumulated in bones and eliminated very slowly. The slow excretion may cause fluorosis due to the accumulation of fluoride in the body in chronic over-exposure (Queensland Government, 2015).

Table 1. 1: Countries that Fluoridate their Water (British Fluoridation Society, 2012)

Country	Number of People Drinking Artificially Fluoridated Water	% of Population
Argentina	3,100,000	19%
Australia	17,600,000	80%
Brazil	73,200,000	41%
Brunei	375,000	95%
Canada	14,260,000	44%
Chile	11,800,000	70%
Fiji	300,000	36%
Guatemala	1,800,000	13%
Guyana	45,000	62%
Hong Kong	6,968,000	100%

Irish Republic	3,250,000	73%
Israel	5,270,000	70%
Libya	400,000	22%
Malaysia	**20,700,000**	**75.5%**
New Zealand	2,330,000	61%
Panama	510,000	15%
Papa New Guinea	102,000	6%
Peru	500,000	2%
Serbia	300,000	3%
Singapore	5,080,000	100%
South Korea	2,820,000	6%
Spain	4,250,000	11%
United Kingdom	5,797,000	11%
United States	194,206,000	64%
Vietnam	3,500,000	4%
Total	369,656,000	5%

1.2 Problem Statement

Fluoride is currently used worldwide with an estimated 370 million people receiving artificially fluoridated water while only 50 million are exposed to naturally fluoridated water or water with optimum level of fluoride (Tiemann,2013). However, excessive fluoride which exceed the Guideline Value by WHO may potentially cause several adverse effects to health including dental and skeletal fluorosis and may also cause lower Intelligent Quotient (IQ) in children.

There was a study conducted by Karimzade et al., (2014) stated that children aged 9-12 years old who are living in regions with high concentration of fluoride in drinking water had lower mean IQ than those lived in less concentration of fluoride region. Percentage of students who are retarded, borderline, and dull was higher in high fluoride region than in low fluoride region. This study also mentioned that high levels of fluoride also can cause dental and skeletal fluorosis, increased bone fractures, decreased birth rates and increased rates of urolithiasis.

The aims of this study were to determine levels of fluoride in drinking water and levels of urinary fluoride, to determine whether fluoride in both drinking water and urine are under the acceptable range stated by NDWQS and NIOSH manual of analytical method 8308 (NMAM) (Schlecht & OConnor, 2003) respectively, to determine significant difference in urinary fluoride between male and female respondents, and to determine relationship between fluoride levels in drinking water and urinary fluoride among respondents.

1.3 Research Question

i. What are the levels of fluoride in drinking water among respondents?

ii. What are the urinary fluoride levels among respondents?

iii. Is there any significant difference in urinary fluoride level between gender?

iv. Is there any relationship between fluoride levels in drinking water and urinary fluoride levels among school students?

v. Is the drinking water fluoride within National Drinking Water Quality Standards (NDWQS)?

vi. Is the urinary fluoride levels within range stated in NIOSH manual of analytical method 8308 (NMAM) 8308?

1.4 Study Justification

Based on the National Drinking Water Quality Standards (NDWQS), the maximum acceptable value for fluoride in Malaysia is between 0.4 - 0.6 ppm which is much lower than what is recommended by WHO (up to 1.5 ppm). This shows that Malaysia require much lower concentration of fluoride in drinking water to achieve its role to prevent tooth decay. NDWQS had different standard compared to WHO because adaptation of local conditions such as climate and altitude. Hotter climates country such as Malaysia, people consume more frequent water, thus level of fluoride in drinking water modified based on average daily intake (AbuZeid & El Hatow, 2015).

The Sungai Selangor Dam is an important part of the Sungai Selangor Water Supply Phase 3 (SSP3) in providing additional water supply for 2 million residents and industries in Selangor including Hulu Selangor and Klang Valley (Rwoo et al., 2017). Based on Puncak Niaga Sdn Bhd (n.d), one of the big challenges in the process of water treatment is to follow the designated quality based on NDWQS issued by Ministry of Health. This means that it is not easy to keep fluoride level in drinking water within the NDWQS. Thus, it is crucial to know the level of fluoride in drinking water from the water treatment plant in Hulu Selangor, one of the areas served by Sungai Selangor Dam.

Therefore, by conducting this study, it will provide data about the levels of fluoride in drinking water and its relationship with urinary fluoride among schoolchildren. Besides, this study can also give better understanding, knowledge and awareness of fluoride in drinking water and its health effects to humans. Once the findings are obtained, recommendations can be given if any adverse effects relating to excessive fluoride exposure are observed.

1.5 Objectives

1.5.1 General Objective

To determine fluoride levels in drinking water and urine among school children

1.5.2 Specific Objectives

i. To determine levels of fluoride in drinking water among school children.

ii. To determine urinary fluoride levels in school children.

iii. To determine significant difference in urinary fluoride between male and female respondents.

iv. To determine relationship between fluoride levels in drinking water and urinary fluoride among respondents.

v. To compare drinking water fluoride with National Drinking Water Quality Standards (NDWQS).

vi. To compare urinary fluoride levels with range stated in NIOSH manual of analytical method 8308 (NMAM).

1.6 Hypothesis

i. There is a significant relationship between fluoride levels in drinking water and urinary fluoride among respondents.

ii. There is a significant difference in urinary fluoride between male and female respondents

iii. There is a significant difference between fluoride in drinking water with National Drinking Water Quality Standards (NDWQS).

iv. There is significant difference between urinary fluoride levels with range stated in NMAM 8308.

1.7 Variables

1.7.1 Independent Variables

Drinking Water

1.7.2 Dependent Variables

Urinary Fluoride level

1.8 Definition of Terms

1.8.1 Conceptual Definition

Fluoride in Drinking Water

Fluoride found naturally in rocks, soil and water and has been added to drinking water for dental coverage. Too high levels of fluoride in drinking water can lead to fluorosis, spots on the teeth (Peterborough Public Health, 2018).

School Children

School children can be divided into two which are primary and secondary children whose 7-12 years old and 13-17 years old respectively.

Urinary Fluoride

Urine is the most effective biomarker of contemporary fluoride intake. Assessment of renal fluoride is used for surveillance of exposure of fluoride (WHO, 2014).

1.8.2 Operational Definition

Fluoridated Drinking Water

The maximum acceptable value for fluoride in Malaysia is only between 0.4-0.6 ppm based on the NDWQS. Drinking water samples will be collected using 50 ml cleaned High-density polyethylene (HDPE) bottles then analysed to determine levels of fluoride in drinking water (Shaharuddin et al., 2009).

School Children

Secondary school children aged 14 years old. The school children are recruited from SMK Ampang Pecah, Kuala Kubu Bharu.

Urinary Fluoride level

Fluoride excreted mainly via urine. Thus, urine is collected from each respondent to determine the level of fluoride excreted in plastic bottles which has been added with 0.2 g EDTA for preservation (NMAM 8308).

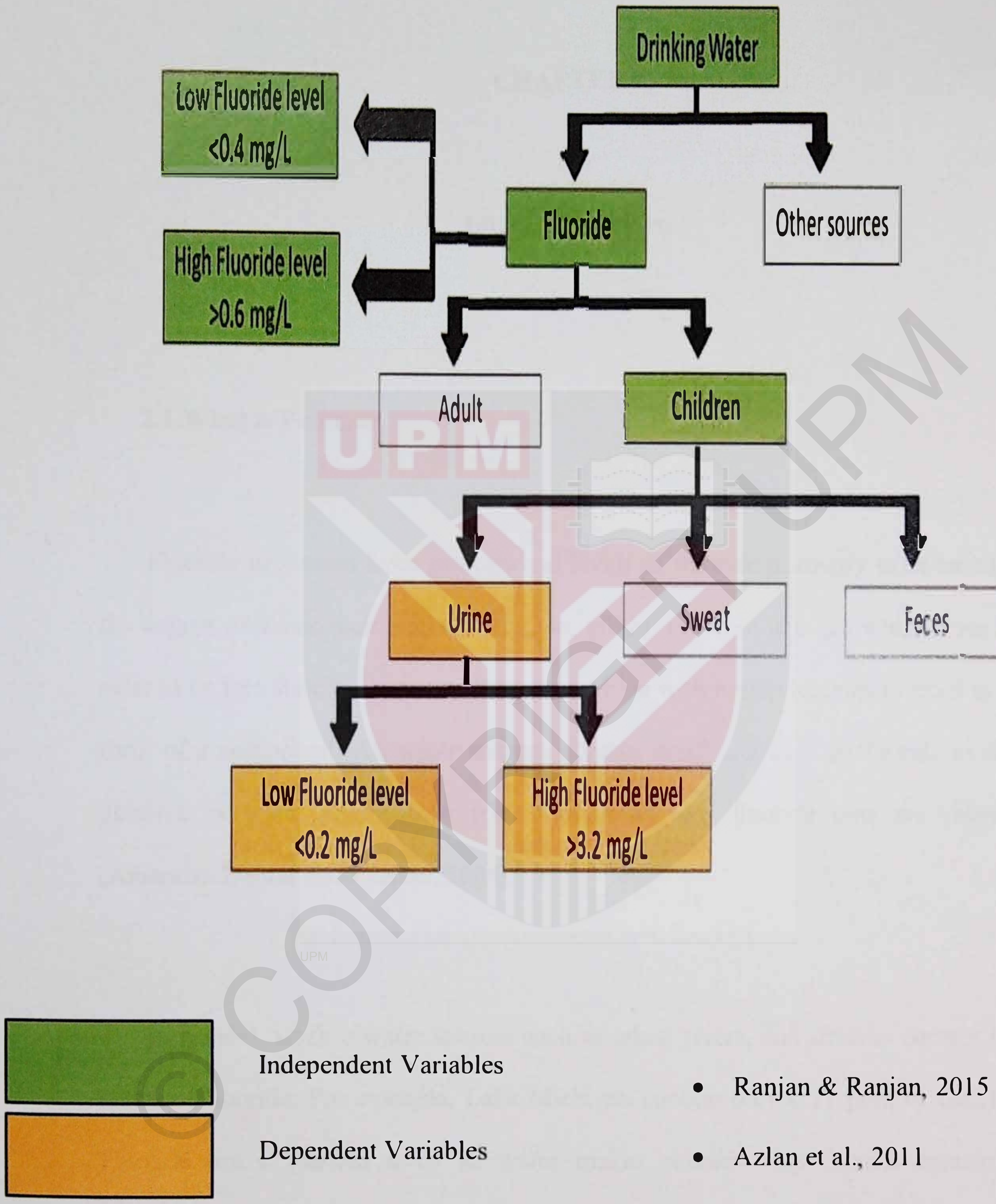

Figure 1. 1: Conceptual Framework

CHAPTER 2

Literature Review

2.1 What is Fluoride

Fluoride originates from geology and levels of fluoride primarily exist based on the degree of water-rock interactions (Joo, 2012). Fluorine is a gas which does not exist in its free state in nature, as it must combine with other elements to exist in the form of a compound. All water sources contain small amounts of fluoride as they dissolve as water passes over rock formations thus fluoride ions are released (American Dental Association, 2005).

In general, surface water sources such as lakes, rivers, and streams contain low levels of fluoride. For example, Lake Michigan contain only 0.17 ppm of fluoride. Fluoride ion is carried away as water makes contact with fluoride-containing minerals when water moves through the earth (American Dental Association, 2005). Higher levels of naturally occurring fluoride are often associated with well water where fluoride has dissolved from the rock formations into the groundwater (Tiemann, 2013). However, levels of fluoride in groundwater are based on factors such as the depth at which water is found and the amount of fluoride bearing minerals in the area. For example, natural level of fluoride in groundwater in United States varies from very low levels to over 4 ppm. Fluoride is also present in some foods and beverages with varying levels (American Dental Association, 2005).

2.2 Sources of Fluoride

Fluoride intake can be from natural or manmade sources. Fluoride can exist on vegetation that contaminated with fluoride-rich industrial effluents or soil that contain high fluoride and in water either naturally or because of industrial discharge of fluoride. Natural processes such as erosion, hydraulic leaching and volcanic activity may causes fluoride in soluble form distributed over the earth's surface and released to atmosphere. Mining and manufacturing process also can be sources of fluoride released (Ranjan & Ranjan, 2015). Besides, fluoride can also be found in insecticides, in petroleum and aluminium industries, in dietary supplements and toothpaste (up to 1mg/g of toothpaste). Fluoride in the form of hydrogen fluoride is used in semiconductor industries, the manufacture of chemicals, solvents, and plastics and also used in laundries (WHO, 2000).

2.2.1 Fluoride in Drinking water

Fluoride naturally occurs in public water systems from the runoff weathering of fluoride-containing rocks and soils, then leaching from soils into the groundwater. Besides, coal-fired power plants and other industrial sources release atmospheric deposition of fluoride-containing emissions which is found in water in the way either by direct deposition or by deposition to soils and subsequent runoff into water. High levels of fluoride in drinking water are found in areas of Colorado (11.2 ppm), Oklahoma (12.0 ppm), New Mexico (13.0 ppm), and Idaho (15.9 ppm) (National Research Council, 2006). In groundwater, fluoride level vary with the type of rock in which the water flows through but do not usually exceed 10 ppm (WHO,2004). However, there are groundwater exceed 10ppm in terms of fluoride level. For example, Ahmed et al. (2012) found that residents in Sindh province, Pakistan have been consumed groundwater that had fluoride as high as 7 - 32 ppm.

Fluoride in drinking water is well-documented has an important role to protect teeth from decay (Arvin et al., 2018). Fluoride is added to public drinking water supplies for protection from dental caries (National Research Council, 2006). Fluorosilicic acid is a compound that is usually used to fluoridate water supplies with two additives, which are sodium fluorosilicate and sodium fluoride (U.S. Department of Health and Human Services Federal Panel on Community Water Fluoridation, 2015). CDC (2002) estimates that about 162 million people (65.8% of the population served by public water systems) received optimally fluoridated water in 2000.

Fluoride can be one of the contaminants in the drinking water regulated by EPA because it can occur at toxic levels at more than 4 ppm (National Research Council, 2006). In areas in Rift Valley and Highland of Ethiopia, the most crucial source of dietary fluoride is drinking water (75% to 90%) (Kebede et al., 2016). Fluoride contained in drinking water may act as a natural contaminant or as an additive in the purpose to provide protection to public health from dental caries (National Research Council, 2006).

In Malaysia, fluoridation is a safe, cost-effective, practical and socially equitable way to prevent and control dental caries in all age, race, income, and level of education (Figure 2.1). Fluoride added to public water supplies to the optimum level of 0.5 ppm only when there is insufficient natural fluoride content. However, fluoride levels must be monitored periodically and adjusted to maintain its levels and reduce fluctuations (Malaysia Dental Council, 2009).

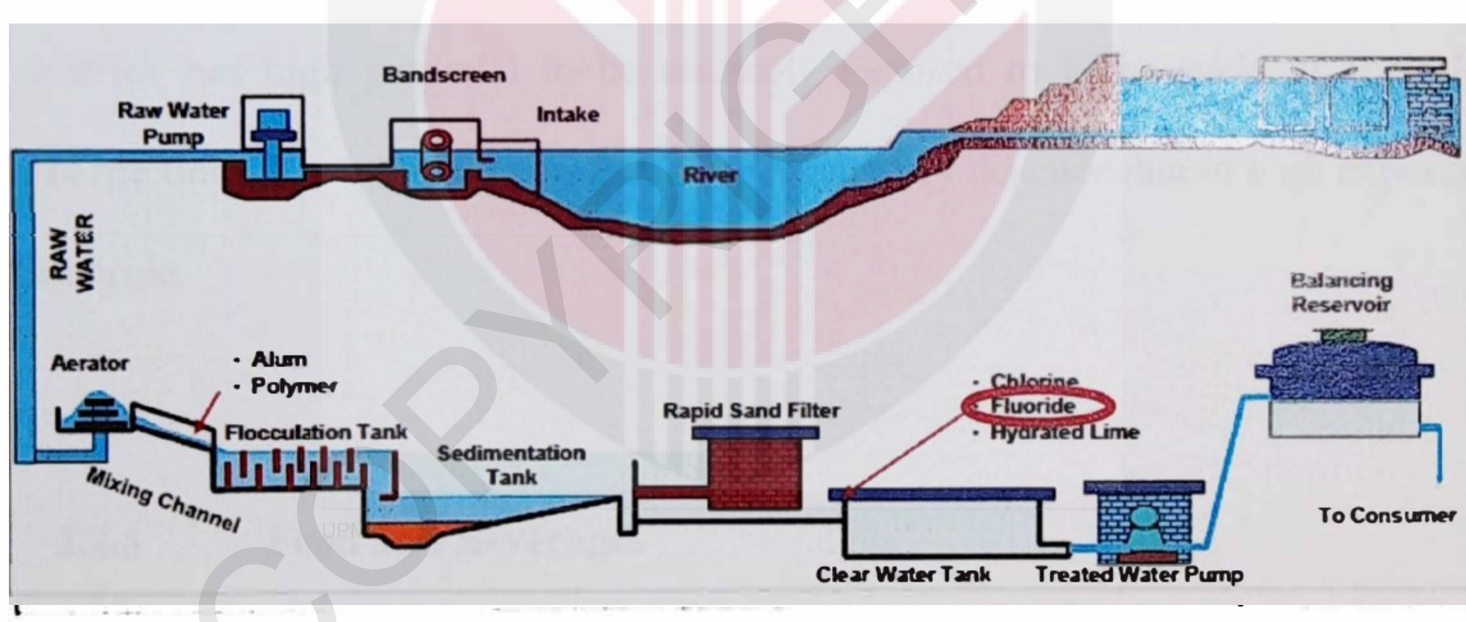

Figure 2. 1: Schematic Diagram of Full Conventional Water Treatment Process. (Puncak Niaga Sdn Bhd., n.d.).

2.2.2 Environmental Sources

Fluoride also exists in the environment. The level of fluoride of natural background is 0.5 ng/m^3. The levels will increase to 3 ng/m^3 if include the anthropogenic sources of emissions. In USA and Canada, levels of fluoride in the range of 0.02- 2.0 ug/m^3 can be found while in some provinces in China, indoor air contained fluoride concentrations ranging from 16 to 46 ug/m^3. This is because of indoor combustion of high-fluoride coal for cooking, drying and curing food (WHO, 2004). Fluoride is also a contaminant in industrial places. Workers in heavy industries such as aluminium, fertilizer, iron, oil refining, semi-conductor and steel industries has high potential to be routinely exposed to high levels of fluoride. Airborne fluoride can be a major factor for respiratory diseases due to high exposure of fluoride.

2.2.3 Food and Beverages

Exposure risks are also associated with consumption of several foods such as fish bones, vegetable, grains, canned meat and beverages (tea) (Kebede et al., 2016). European Food Safety Association (EFSA) had considered the German background exposure to fluoride from food based on intake of milk, meat, fish, eggs, cereals, vegetables, potatoes and fruit. The exposure for young children, older children, and adults are 0.042, 0.114 and 0.120 mg/day, respectively while exposure from fruit juice, soft drinks and mineral water are 0.011 mg F/day for younger children while for older children is 0.065 mg F/day (Scientific Committee on Health and Environmental Risks (SCHER), 2011). Exposure to fluoride with other sources including food, dental products and pesticides can cause developmental neurotoxin (Karimzade et al., 2014). Consumption of bottled or carbonated water can influence the absorption and accumulation of fluoride in bones (Kumar et al., 2017).

2.2.4 Other sources

In addition to ingesting fluoride in drinking water, people are exposed to fluoride from a large number of other sources, including toothpastes, mouth rinses, soft drinks, tea, processed foods and vegetables (Fawell & Bailey, 2006). Based on the Council Directive 76/768/EEC related to cosmetic products, twenty (20) fluoride compounds listed which consist of mostly oral hygiene products. The compounds which are usually found in toothpaste are sodium fluoride, sodium monofluoro-phosphate and stannous fluoride. These may contain a maximum of 1500 mg F/kg (0.15% F) (SCHER, 2011). Nowadays, people may be exposed to fluoride in toothpaste, mouth rinse and dietary fluoride supplements or in beverages and foods prepared with fluoridated water thus more 'incidental' ingestion of fluoride exist than was anticipated by the Public Health Services (PHS) and Environmental Protection Agency (EPA) in recommending standards for drinking water (Tiemann, 2013).

Besides, in a study conducted by Garcia-Perez, Irigoyen-Camacho & Borges-Yáñez (2013), it mentioned that salt fluoridation programs are conducted to prevent the development of dental caries as an alternative to water fluoridation. Fluoridated salt also is available in some European countries, including Austria, France, Germany, Hungary, and Switzerland (Tiemann, 2013). Salt fluoridation is able to deliver good oral health to remote locations where no potable municipal water supplies exist. The Pan American Health Organization (PAHO), a regional division of the World Health Organization (WHO), actively developed strategies to implement caries prevention programs in the regions of the Americas using water and salt fluoridation (U.S. Department of Health and Human Services Federal Panel on Community Water Fluoridation, 2015).

2.3 Fluoride and Human Health

Water fluoridation and the use of topical fluoride have played a significant role in improving oral health (American Dental Association, 2005). However, high levels of fluoride in drinking water have been found in several countries around the world (Srikanth et al., 2012). Exposure to high fluoride can lead to several adverse health issues either acute effects such as severe nausea, vomiting, excess saliva production, abdominal pain, and diarrhea, severe exposure result in convulsions, irregular heartbeat, and coma or chronic effects such as dental fluorosis, hip fractures, and skeletal fluorosis (New Hampshire Department of Environmental Services, 2008).

There are several fluorosis cases due to over exposure of fluoride. Fluorosis problems with different intensities ranged from dental fluorosis to deliberating skeletal fluorosis accompanied by non-skeletal manifestations and premature aging has been identified in the areas of the Thar Desert in the south-eastern part of Sindh province, Pakistan where residents consumed high levels of fluoride in groundwater as high as 7 - 32 ppm (Ahmed et al., 2012). A study conducted in 15 villages in Dhar district observed that over 33.5 % of residents were affected by mild fluorosis while 8% and 10% were affected by moderate and severe fluorosis, respectively as there was fewer number of safe water sources, thus higher incidence of dental fluorosis. Kalapani village had high number of dental fluorosis cases (85%) because of less than two safe water sources were available in the village (Srikanth et al., 2012). In Dadanpur village in Jhajjar District, Haryana, India, fluorosis has affected 94.63% of children due to higher levels of fluoride in underground aquifers (Kumar et al., 2017).

Apart from that, excessive exposure to fluoride can also contribute to hypothyroidism. A study conducted by Peckham, Lowery, & Spencer (2015) concluded that a significantly higher prevalence of hypothyroidism occurred in areas with high fluoride (more than 0.7 ppmitre) compared to those with fluoride levels at or below 0.7 ppm. Another study conducted in Azerbaijan Province, Iran found that children living in regions with high levels of fluoride in drinking water had lower IQs compared to children living in areas with low level of fluoride ($p<0.001$). Furthermore, percentages of retarded, borderline, and dull students are higher in regions with high levels of fluoride than in regions with low levels of fluoride. Fluoride affect the activity of thyroid gland thus may give adverse effects to brain development (Karimzade et al., 2014).

2.4 Bioavailability of Fluoride

Fluoride is not possible to generalize on its metabolism since fluoride-containing compounds are extremely diverse. Its metabolism depends on its reactivity and structure, solubility, and ability to release fluoride ions. The ionic form of fluoride which can be generated within body by biochemical modification of variety fluoride-containing compounds or can be directly ingested is metabolized by body in a simple manner (Martinez-Mier, 2011).

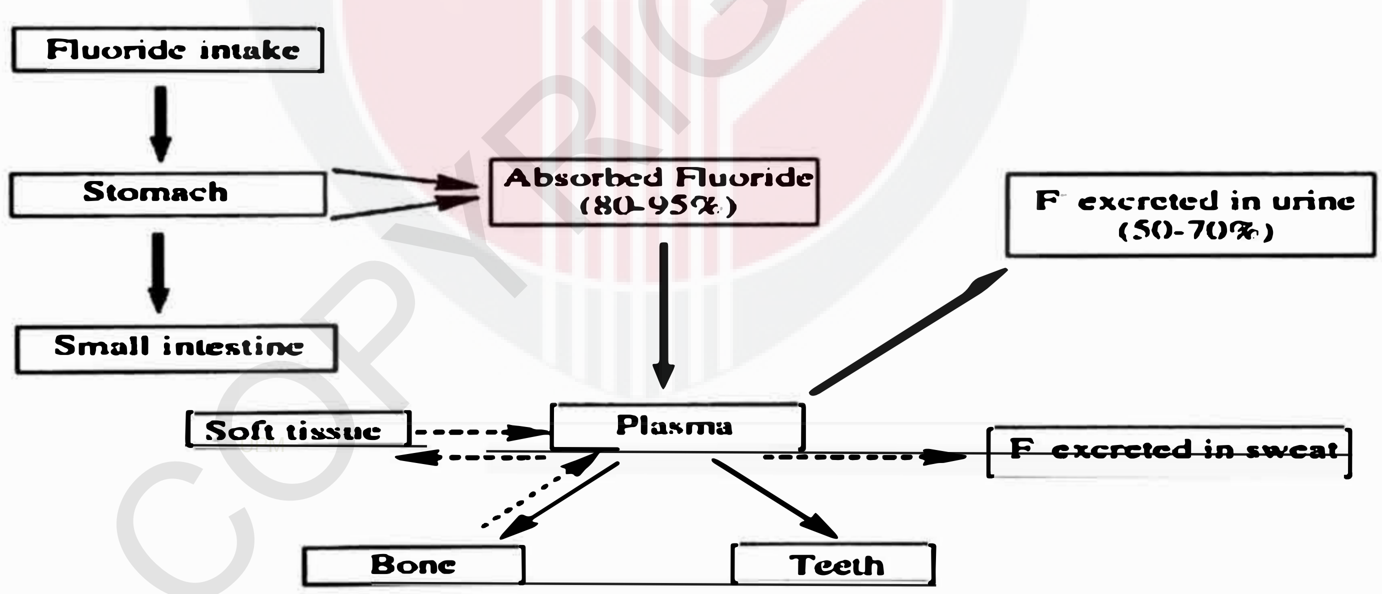

Figure 2. 2 Metabolism of Fluoride in Human Body. (Ghosh et al., 2012)

2.4.1 Absorption

Fluoride is usually ingested in the stomach as hydrogen fluoride (HF), after ingestion, fluoride absorbed effectively from gastrointestinal tract in acidic environment, while most of the remainder is absorbed more slowly from the proximal small intestine. Almost all (99%) of fluoride is then integrated rapidly into calcified tissues. After 30 to 60 minutes, peak plasma levels can be seen (SCHER,2010). Approximately, in healthy adults and under normal conditions, half of the absorbed fluoride binds to calcified tissue such as fluorohydroxyapatite while the remainder is excreted in urine. After fluoride enters the renal tube, 10 - 90 % of ionic fluoride is reabsorbed, then returned to systemic circulation. There are factors that may influence the acid-base status and urinary pH since the mechanism of renal tubular reabsorption of fluoride is pH dependent. Drugs, high altitude, some respiratory diseases, metabolic diseases and physical activity may affect urinary fluoride excretion and fluoride retention (Zohoori et al., 2015).

2.4.2 Distribution

After absorption, fluoride is then rapidly distributed in body. Most of the fluoride may build up in bones and teeth (dentine and enamel) in the form of crystal lattice, retained approximately 99% of total fluoride burden in the body. In infants, absorbed fluoride retained in body by 80 – 90 % while only 60% of absorbed fluoride retained in adults (Fawell & Bailey, 2006). Plasma has a short term half-life in the range 3 to 10 hours. Fluoride is distributed between plasma and red blood cells but plasma may have twice higher levels than red blood cell while fluoride levels in saliva are approximately 65% of the levels in plasma. Plasma fluoride levels are directly related to exposure of fluoride in a day. For example, mean plasma levels in individuals living in areas with a water fluoride levels of 0.1 ppm or less are normally 9.5 µg /l, compared to a mean plasma fluoride level of 19 - 28.5 µg/l in individuals living in areas with a water fluoride content of 1.0 ppm (SCHER, 2011). Fluoride levels in body fluid and soft tissues such as muscle, skin and tendons as not influenced by homeostatic control and the fluoride levels reflect recent taken of fluoride. Fluoride content in body exist by substitute hydroxyl groups in apatite to form fluoroapatite, more regular and less acidic compared to compound apatite (Kebede et al., 2016).

2.4.3 Metabolism

Metabolism of fluoride has various effects depending on the cell type, concentration and time of exposure to fluoride. Metabolism of fluoride may give positive effects to teeth and bone tissues as promotion of cell proliferation and growth while exposure to high level of fluoride induced apoptosis. Exposure to high levels of fluoride may cause negative effects to various metabolic, structural and functional cellular functions in experimental animals in both *in vivo* and *in vitro* experiments. The toxicity of fluorides may induce inflammatory reactions, response of contraction of cell, inhibit protein synthesis, and DNA damage (Agalakova & Gusev, 2012).

2.4.4 Excretion

After fluoride is absorbed through the stomach, ionic fluoride is mainly eliminated via urination. There are two determining factors in fluoride excretion, which are pH of urine and the volume of urine excreted. Renal excretion occurs rapidly with the total elimination achieved within 12 hours, then maximum excretion can be seen within 1.5 and 3 hours after consumption. Fluoride in urine is considered as an accurate reflection of the amount of fluoride ingested whether in the form of food or from preventive treatment. Both children and adolescents in the growing stage excrete less amount of fluoride via urine due to fluoride accumulation in bones and teeth (Hoyos, Silva, & Barberia, 2015). Approximately 50% of absorbed fluoride occurring in children below 3 years old are excreted via urination while 90% are excreted in adults and children over 3 years old (Ghosh et al., 2012).

CHAPTER 3

METHODOLOGY

3.1 Study Design

A cross-sectional study was used in this study. Cross-sectional study require investigator to measure the outcome and the exposure at the same time. In cross-sectional study, participant selected based on inclusion and exclusion criteria set for the study. (Setia., 2016).

3.2 Study Location

This study was conducted in Sekolah Menengah Kebangsaan Ampang Pecah, Kuala Kubu Bharu, Hulu Selangor, Selangor.

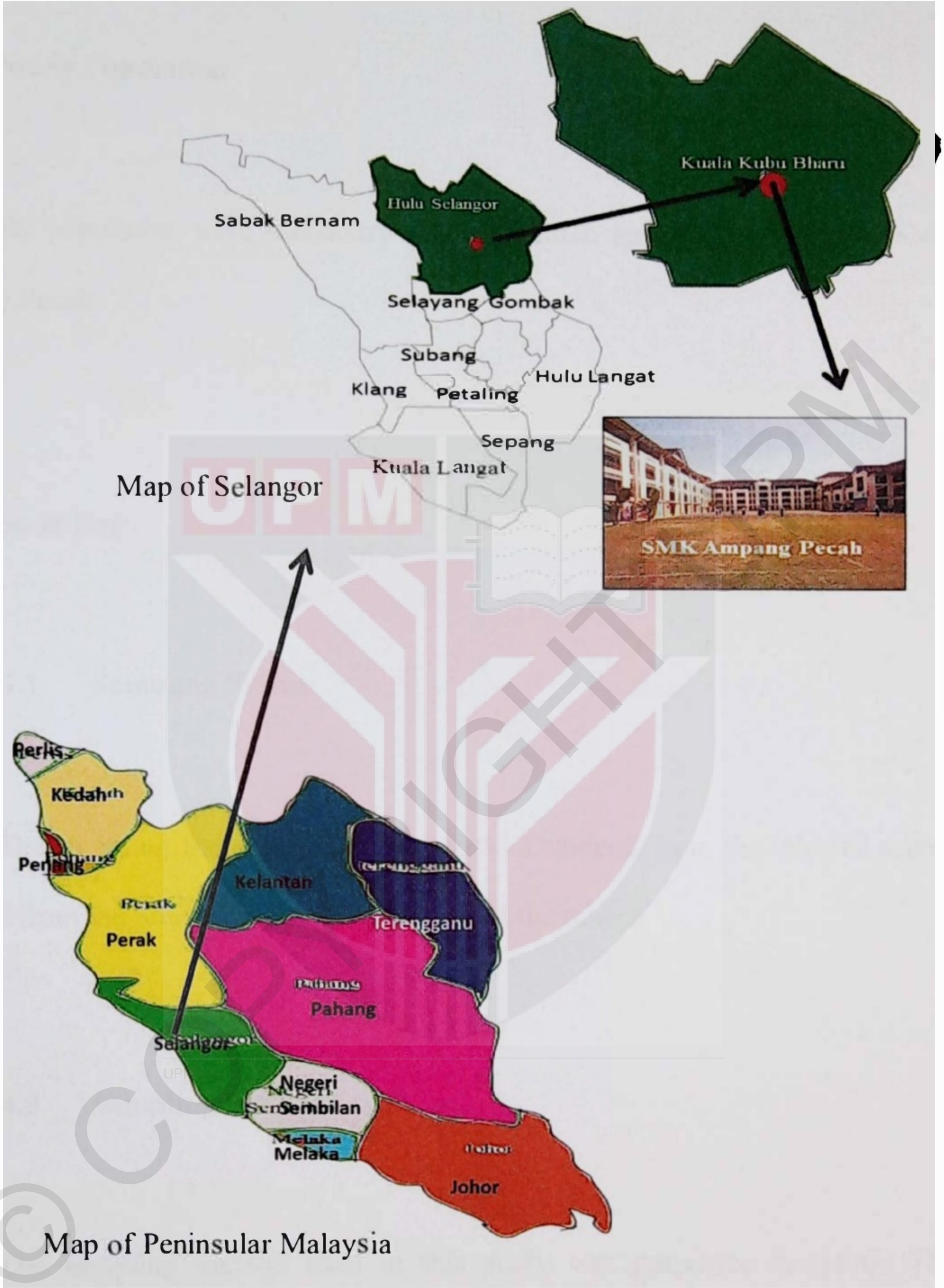

Figure 3. 1 Study Location

3.3 Study Population

The study population were secondary school children aged 14 years old at SMK Ampang Pecah.

3.4 Sampling

3.4.1 Sampling Frame

The sampling frame was the name lists of students from the selected school obtained from the Student Affairs Department of the school.

3.4.2 Sampling Method

The sampling method used in this study was purposive sampling. The respondents were selected based on the inclusion and exclusion criteria listed. School children that had both criteria were selected as respondents in the purpose to achieve the objectives of the study. The inclusion and exclusion criteria were stated as below:

Table 3. 1 Inclusion and Exclusion Criteria

Inclusive Criteria	Exclusive Criteria
a) Aged 14 years old	a) Using filtered water as source of drinking water (Singh, Singh & Singh, 2016),
b) Using tap water as source of drinking water (McLaren, 2016)	b) New students lived less than 6 years and students who did not living in the area of the study location (Garcia-Perez et al., 2017).
c) Have lived in the selected area for more than 6 years (Garcia-Perez et al., 2017).	c) Students who have kidney disease (Khandare, Gourineni & Validandi, 2017).
d) Do not have kidney disease (Khandare, Gourineni & Validandi, 2017).	

Parents' permissions were obtained before the study conducted. Students can withdraw from this study if they feel uncomfortable.

3.4.3 Sampling Size

Sample size was determined by using a formula made by Lameshow et al. (1990):

Sample Size Calculation:

$$n=\{ Z_{(1-\alpha/2)} \sqrt{2P(1-P)} + Z_{(1-\beta)} \sqrt{P_1(1-P_1) + P_2(1-P_2)} \}^2 / \{P_1-P_2\}^2$$

Where;

$Z_{(1-\alpha/2)}$ = Confidence level at 95% (1.96))

$Z_{(1-\beta)}$ = Power of test of 90% (1.28))

P_1 =Proportion of fluoride in urine among males

P_2 =Proportion of fluoride in urine among females

P =Average proportion of fluoride in urine in both groups, $P=(P_1+P_2)/2$

When;

P_1 = 0.86 (Srikanth et al, 2012)

P_2 = 0.44 (Chen et al, 2013)

n={ 1.96 √(2(0.675) (1-0.675))+ 1.28√(0.86(1-0.86)+0.44(1-0.44))}^2/{0.86-0.44}^2

n= 24.4

Based on the formula, 24 respondents are needed for one group. The number was increased by 10% to take account for missing respondents and errors. The number was then multiplied by 1.5 as for the design effect and followed by multiplication of 2 for two group population, male and female. Thus, 78 respondents were needed in this study.

3.4.4 Study Instrumentation

3.4.4.1 Questionnaire

A set of questionnaire were given to respondents in order to gather information. The questionnaire consists of socio-demographic data, health status and drinking water sources to ensure the respondents meet the inclusive criteria.

3.4.4.2 Drinking Water

Water samples collected from tap water used for drinking purposes using HDPE bottles (Shaharuddin et al., 2009). Fluoride was then analysed using SPADNS

Method 8029 and used device HACH Brand Direct Reading Spectrophotometer model DR/ 1900. This method detects levels of fluoride in drinking water which involves the reaction of fluoride with a red zirconium-dye solution to form a colourless complex, bleaching the red colour in the amount proportional to the level of fluoride. Method 8029 was accepted by the EPA for reporting of drinking water and wastewater analysis purposes (HACH Company USA, 2003).

3.4.4.3 Urine

Based on NMAM 8308 (2003), 50 ml of urine collected in clean plastic bottles containing 0.2 g EDTA to be analysed using HACH Brand Direct Reading Spectrophotometer model DR/ 1900 to determine level of fluoride in urine.

3.5 Analysis of Fluoride

Analysis of fluoride in drinking water and urine using USEPA SPADNS Method 8029 by using SPADNS reagent solution as below:

I. Blank was prepared: Pipet was used to add 10.0 mL of deionized water to a sample cell.

II. Sample was prepared: Pipet used to add 10.0 mL of sample to a sample cell.

III. Pipet used to add 2.0 mL of SPADNS Reagent Solution into each sample cell.

IV. Swirled to mix.

V. Instrument timer was start by one minute reaction time starts.

VI. The blank sample then cleaned when the timer expires.

VII. The blank inserted into the cell holder.

VIII. Button "ZERO" was pushed until the display showed 0.00 ppm F–.

IX. The sample cell was cleaned before insert to cell holder.

X. The cleaned sample then inserted into the cell holder.

XI. Button "READ" was pushed. Results showed in ppm F–.

3.6 Data Collection

Before conducting the study, a letter approval from Ministry of Education was submitted with the proposal of the study to the selected school as an evidence for approval to conduct the study in the school. A briefing regarding the purpose and the objectives of the study, the procedures and a consent form were given to all respondents and parents to obtain approval. After that, the questionnaires were given to all respondents. This to ensure the respondents meet the inclusion and exclusion criteria such as using tap water as source of drinking water and did not have kidney disease or disorder.

3.7 Data Collection Method

3.7.1 Questionnaire

In this study, we used validated questionnaire from previous study that was conducted by Solihin (2016). The respondents were given a set of questionnaires prior to data collection. The purpose of the questionnaires was to collect information regarding socio-demographic, health status and sources of drinking water.

3.7.2 Sample Collection

Before conducting sample collection, respondents were asked about their source of drinking water to ensure only those using tap water as source of drinking was included in this study. After obtaining parents' permission, a set of high-density polyethylene bottle (HDPE) and plastic bottle for drinking water and urine samples respectively for 2 consecutive days in morning to respondents. The samples were then analyzed using a HACH Brand Direct Reading Spectrophotometer model DR/ 1900.

3.8 Data Analysis

IBM SPSS (Statistical Package for the Social Sciences) version 22 was used to analyse the data. Based on the objectives of the study, the types of data analysis were determined as below:

Table 3. 2 Types of Data Analysis based on Objectives

Objectives	Type of Data Analysis
To determine level of fluoride in drinking water among respondents	Descriptive Analysis
To determine the urinary fluoride level in respondents	Descriptive Analysis
To determine the significant different in urinary fluoride between male and female respondents	Parametric: Independent T-test Non-Paramteric: Mann-Whitney U
To determine relationship between fluoride levels in drinking water and	Spearman rank-order Correlation

urinary fluoride among respondents	
To compare drinking water fluoride with National Drinking Water Quality Standards (NDWQS)	One sample T-test
Compare urinary fluoride levels with range stated in NIOSH Method 8308	One sample T-test

3.9 Study Ethics

Before conducting study, a proposal was submitted to the University Ethics Committee involving Humans of Universiti Putra Malaysia. Written consents were distributed to all respondents and their parents to obtain permission and to inform the purpose of the study. The information of the respondents kept confidential and protected. Besides, the respondents were given an explanation about the activities of the study, the procedures and methodology used and also the rights of the respondents.

CHAPTER 4

Results and Discussion

4.1 Socio-demographic of Respondents

This study was conducted in Kuala Kubu Bharu region and Sekolah Menengah Kebangsaan Ampang Pecah was selected to be study location. 46 of form 2 students with desired criteria selected as respondents with 21 (45.7%) of respondents were male while 25 (54.3%) of respondents were female.

Table 4. 1 Distribution of Respondents

Variables		N=46	
		Frequencies	Percentage (%)
Gender	Male	21	45.7
	Female	25	54.3

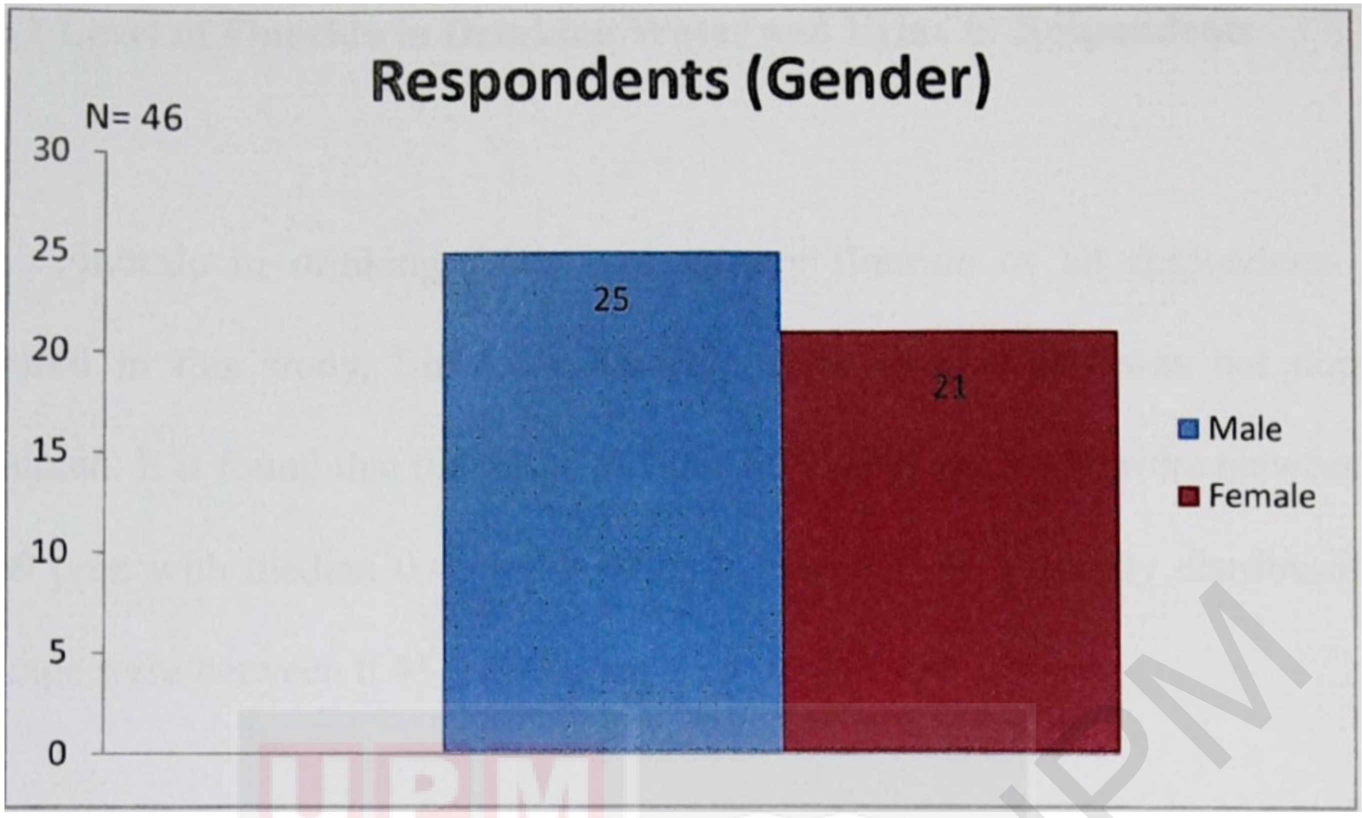

Figure 4. 1 Distribution of Respondents

4.2 Level of Fluoride in Drinking Water and Urine in Respondents

Fluoride in drinking water and urinary fluoride of all respondents were measured in this study. Since the fluoride in drinking water was not normally distributed, It is found that the range of fluoride in drinking water were between 0.41 – 0.59 ppm with median 0.46 while urinary fluoride was normally distributed thus the range were between 0.45 – 2.29 ppm with mean 1.48.

Table 4. 2 Fluoride Level in Drinking Water in Respondents

Parameters	N=46		
	Range (ppm)	Median (ppm)	(±)Interquartile Range
Fluoride in Drinking Water	0.41-0.59	0.46	0.04

Table 4. 3 Urinary Fluoride in Respondents

	N=46		
Parameters	**Range (ppm)**	**Mean (ppm)**	**SD(±)**
Urinary Fluoride	0.45-2.29	1.48	0.43

4.3 Significant Difference in Urinary Fluoride between Male and Female Respondents

The significant difference in urinary fluoride levels between male and female determined by using independent T-test. There is significant difference if the value less than significant value, 0.05 ($p<0.05$) which means the null hypothesis is rejected.

Based on the test conducted, the significant value was $p=0.468$ which represents $p>0.05$. Therefore, there is no significant difference in urinary fluoride between male and female respondents. The mean value difference between male and female were about equal thus the null hypothesis did not rejected.

Table 4. 4 : Significant Difference in Urinary Fluoride between Male and Female Respondents

Variables	Mean (±SD)		Mean Difference (95%CI)	t-statistics	p-value*
	Male	Female			
Urinary Fluoride Level	0.465 (0.443)	0.455 (0.487)	-0.11 (-0.36,0.15)	0.731	0.468

*Independent t-test

4.4: Relationship between Fluoride Levels in Drinking Water and Urinary Fluoride among Respondents

Correlation test was carried out to determine the relationship between fluoride level in drinking water and urinary fluoride level. Since fluoride in drinking water was not normally distributed, thus spearman correlation was carried out.

The test is significant if the p-value is less than 0.05 ($p<0.05$). From this test, the p-value was 0.367 which was more than 0.05 ($p>0.05$). This showed that there was no significant difference relationship between fluoride levels in drinking water and urinary fluoride levels among respondents. Therefore, the null hypothesis not rejected.

Table 4. 5 Correlation between Fluoride Levels in Drinking Water and Urinary Fluoride among Respondents

Respondents	N=46	
	Coefficient Correlation, r[a]	p-value*
Fluoride in Drinking Water Urinary Fluoride	0.136	0.367

[a] Spearman's rank correlation coefficient

*p- value is significant at 0.05 level

4.5: Comparison Level of Fluoride in Drinking Water with value stated by National Drinking Water Quality Standards (NDWQS).

The mean level of fluoride in drinking water was compared with NDWQS which is ranged from 0.4-0.6 ppm by using one sample T-test. If the significant value is less than 0.05 ($p<0.05$), it means the number of fluoride in drinking water did not have much different compared to the value stated by NDWQS which reject null hypothesis.

Since fluoride in drinking water was not normally distributed, One-Sample Wilcoxon Signed Rank Test (nonparametric one sample T-test) was carried out. It was found that the significant value is less than 0.05 ($p<0.05$), thus there was significant difference between reading of fluoride in drinking water and the range as stated by the NDWQS. The null hypothesis was rejected. The median value obtained was 0.46 which still in the range of NDWQS standards.

Table 4. 6 Comparison Level of Fluoride in Drinking Water with Value stated by National Drinking Water Quality Standards (NDWQS).

Variable	Median (IQR)	Z-statistics	p-value*
Fluoride in Drinking Water	0.46(0.04)	5.848	< 0.05

*One-Sample Wilcoxon Signed Rank Test

4.6: Comparison Urinary Fluoride to NIOSH manual of analytical method 8308 (NMAM) Standards

Urinary fluoride was normally distributed thus the comparison of urinary fluoride to NIOSH Standards carried out by using One Sample T-test.

The test carried out by insert the minimum and maximum value of the standard which are 0.2 and 3.2 ppm respectively. Both of the values were compared to urinary fluoride among respondents.

Significant value obtained were less than 0.05 ($p<0.05$) for both comparison to minimum and maximum value of the standard. However, the t-value for both standard values were different. When compared with minimum standard value, t-value obtained was positive value while when compared with maximum standard value, t-value obtained was negative. This means that urinary fluoride was within the range standard stated by NIOSH.

Table 4. 7 Comparison Urinary Fluoride with Minimum Value (0.2) of Urinary Fluoride based on National Occupational Safety and Health (NIOSH) Standard

Variable	Mean (SD)	Mean Difference (95%CI)	T-statistics (df)	p-value*
Urinary Fluoride	1.477 (0.425)	1.277(1.151,1.404)		< 0.05

*One Sample t test

Table 4. 8 Comparison Urinary Fluoride with Maximum Value (3.2) of Urinary Fluoride based on National Occupational Safety and Health (NIOSH) Standard

Variable	Mean (SD)	Mean Difference (95%CI)	T-statistics (df)	p-value*
Urinary Fluoride	1.477 (0.425)	-1.723(-1.849,-1.596)	-27.486	< 0.05

*One Sample t test

CHAPTER 5

Discussion, Conclusion, Limitation and Recommendation

5.1 Discussion

5.1.1 Level of Fluoride in Drinking Water and Urinary Fluoride in Respondents

Level of fluoride in drinking water and urinary fluoride in respondents are the parameters that measured in this study. Fluoride in drinking water in Malaysia should in the range stated by NDWQS which are 0.4-0.6 ppm to be optimally fluoridated. Urinary fluoride level of each respondent was compared with NIOSH standard which are between values of 0.2-3.2 ppm.

There was study conducted by Azizullah et al. (2011) stated that the issue of fluoride levels in drinking water exceeded the limit stated by Pakistan Environmental Protection Agency (PAK-EPA) wchich is 1.5ppm was not usually happened. Fluoride levels in 84% of water samples throughout the country below the minimum recommended level of 0.7 ppm. In Faisalabad and Kerachi, the fluoride in drinking water also below the standard limit with exceptions from industrial area. Thus, it was recommended to do water fluorination to prevent adverse effects of insufficient of fluoride in drinking water.

From the same study, the author mentioned that there were also issues of excessive fluoride in drinking water above the limit such as in Naranji, fluoride in spring water was 13.52 ppm while in Nagar Parkar Town, mean fluoride level was 3.33 ppm with maximum value was 7.85 ppm. Other than that, Khalanwala, East Punjab had highest fluoride level which was 21.1 pm and 22.8 ppm while in cities such as Kasur, Quetta, and Loralai, there were more than 20% of drinking water contained high levels of fluoride. The sources of high levels of fluoride were from leaching from fluoride-bearing minerals, industrial wastes, agricultural fertilizers, and combustion of coal.

All readings of fluoride levels in drinking water were between minimum and maximum range stated by NDWQS. This showed that all respondents consumed optimally fluoridated average of fluoride from drinking water sources. A safe limit of fluoride level in drinking water can protect community from tooth decay (U.S. Public Health Service Recommendation for Fluoride Concentration in Drinking Water for the Prevention of Dental Caries, 2015).

Fluoride consumption needed to prevent tooth decay (Yeung, Chong, Glenny, 2015) while excessive fluoride levels in drinking may lead to several adverse effects such as skeletal fluorosis, chronic kidney disease, and adverse effects of children neurodevelopment (Walker, 2017). Therefore, it is important to maintain optimally fluoridated drinking water to prevent any tooth-related disease.

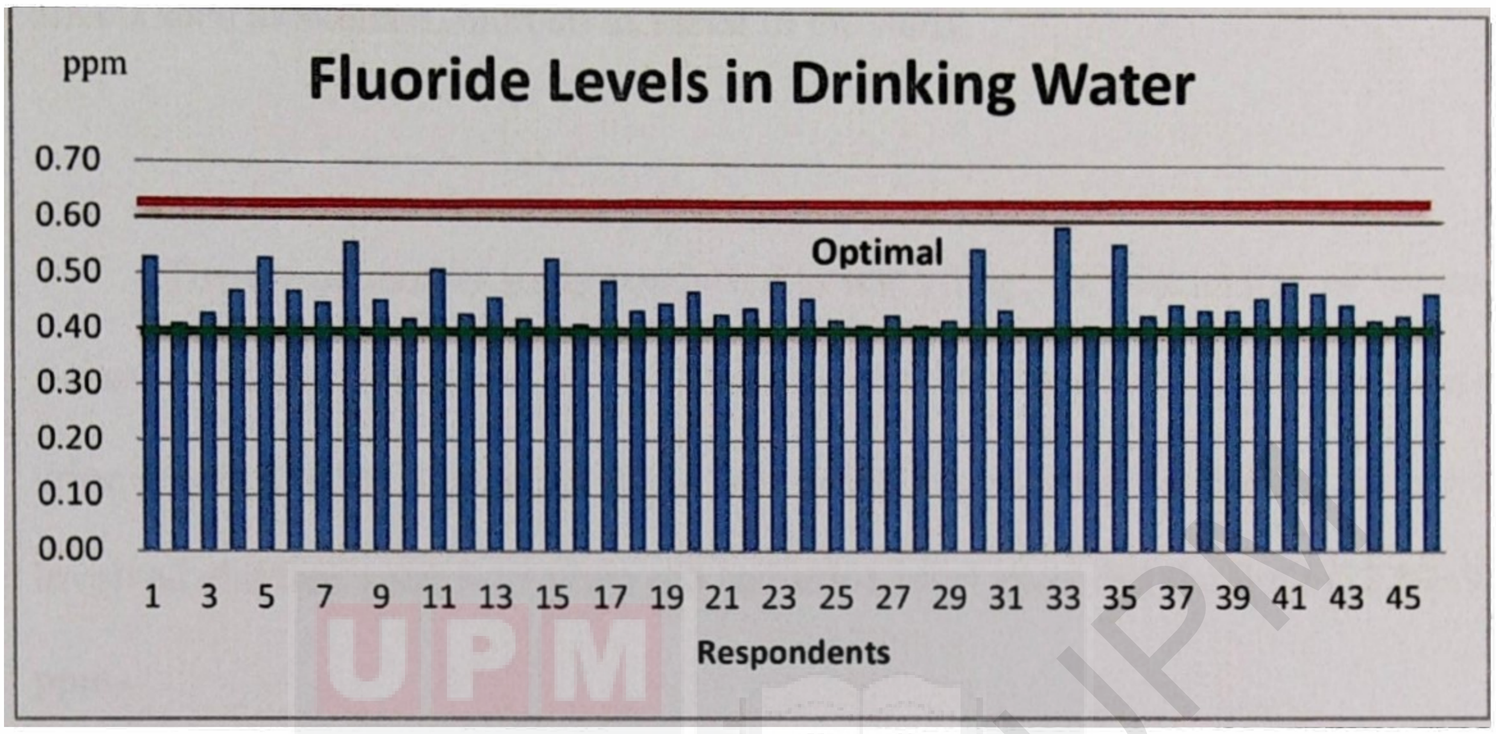

Figure 5. 1 Fluoride Levels in Drinking Water

In this present study, results of urinary fluoride level among respondents in this study were in range stated by NMAM 8308 (0.2 – 3.2 ppm) which are 0.45 – 2.29 ppm with mean 1.48 (±0.43). This means that fluoride consumption was within normal range. This finding may due to fluoride in drinking water within range stated by NDWQS.

There was study conducted in Isparta,Turkey (Tamer et al., 2007) stated that the normal value of urinary fluoride was less than 1.5 ppm (<1.5 ppm) because fluoride content in natural drinking water was high which was more than 1.0 ppm (mean 2.74±0.64). The study found that skeletal fluorosis patients excreted fluoride more than the normal value (range 0.22-3.99 ppm) while in normal people excreted less than 1.5 ppm of fluoride (range 0.18-1.35 ppm). The study showed that people who had urinary fluoride more than normal value in the area might get adverse health effects such as skeletal fluorosis as stated in the study.

There was another study conducted in few villages of district Pali of Western Rajasthan (Kasim & Choudhary, 2017) mentioned that the WHO permissible limit of urine was 0.10 ppm. This study found that dental and skeletal fluorosis patients who involved children aged 5-17 years old had urine level exceeded the limit (22.89±9.9 ppm).

Urinary fluoride is the most reliable indicator for reflecting exposure of fluoride and correlated with amount of fluoride intake (Antonijevic et al., 2015). However, not only fluoride from drinking water will influence the levels of urinary fluoride among respondents, consumption or exposure of other sources of fluoride such as tea, spinach, cabbage (Kheradpisheh et al., 2017) and inhalation of air dust cleaner that contained fluorocarbon (Peicher & Maalouf, 2017) can also influenced the levels of urinary fluoride.

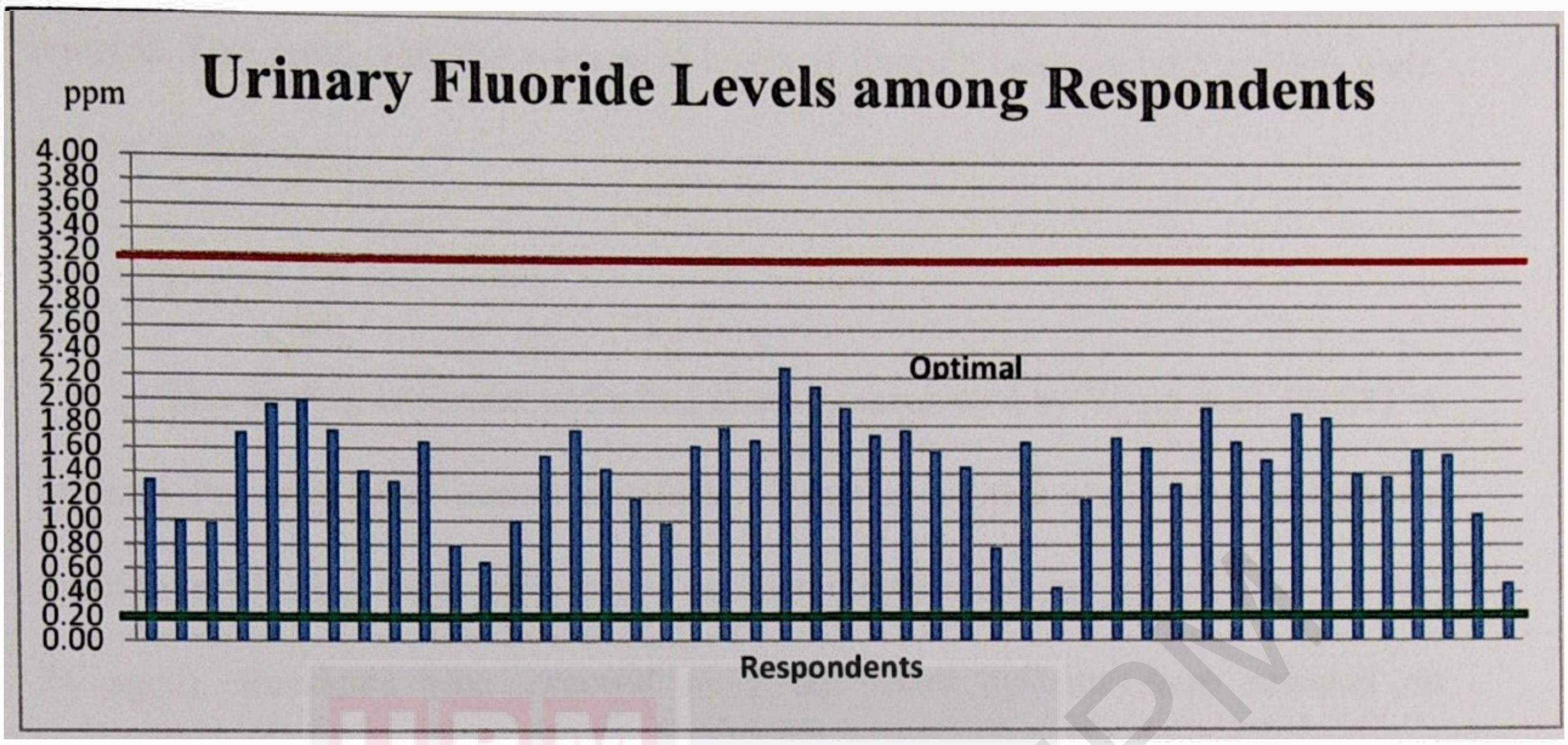

Figure 5. 2 Urinary Fluoride Levels among Respondents

5.1.2 Comparison in Urinary Fluoride between Male and Female Respondents

Monitoring urinary fluoride level can determine fluoride intake by respondents (Mehta, 2013). Generally, men needs more water consumption than women due to their higher average fat-free mas and use more energy than women (Chaplin, 2017). Higher consumption of water may cause higher fluoride content in body (Edmunds & Smedley, 2012). Since fluoride is mainly excreted through urine (Kumar et al., 2016), urinary fluoride between genders was compared to determine the significance difference of urinary fluoride between genders.

After data analysis, it was found that there is no significant difference in urinary fluoride between male and female respondents. The null hypothesis is not rejected. This means that the average of levels of fluoride taken by both genders were not too different.

This finding is similar to finding in study conducted by Wang et al. (2008) in Shaanxi Province and Guansu Province. Objective of this study is to determine fluoride in drinking water and urine of residents in four age groips (5, 12, 35-44, 65-74 aged). Residents who exposed to 7 tap water systems were selected as respondents. It was found that no significant difference was observed in urinary fluoride levels of different genders in every drinking water systems.

Besides, according to Villa et al. (2008), there was also previous study conducted by same author in 2004 in Santiago found that there was no significant different of total daily fluoride intake excreted in urine (FUFE) between both genders of 61 adults, aged 19-71.

Consuming foods such as black tea contribute to fluoride taken in body (Susheela, Mondal, Singh et al., 2013). Diets such as consuming vegetables can cause urinary pH to be alkaline while protein-rich diets cause acidification of pH. The changes in urinary pH thus modify the fluoride excretion. All respondents might consume similar kind of foods because all lived in same housing areas and came from same school, where foods given to all respondents are same. Age with nocturnal and diurnal patterns influenced urinary fluoride excretion (Martinez-Mier, 2011). In this case, respondents are from same age, thus urinary fluoride excretion did not have significant difference between genders.

5.1.3 Relationship between Level of Fluoride in Drinking Water and Urinary Fluoride among Respondents

Public water system in Malaysia has been fluoridated to protect the health of teeth. This method is most effective as water is the main nutrient for human and fluoride easily dissolves into water (Shaharuddin et al., 2009). However, there are many sources of fluoride that can be taken besides water consumption which are foods including sea foods, wheat, tea and fluoridated toothpaste (Ghosh et al., 2012). Therefore, this study need to determine whether level of fluoride in drinking water contributes to urinary fluoride level among respondents.

However, there was study conducted by Choi et al. (2014) in southern Sichuan, China which involved first-grade children whose drink water from same source by take sample of urine to detect fluoride levels in morning. The result showed that there was significant moderate correlation between urinary fluoride and levels of fluoride in drinking water. This study discussed that urinary fluoride among children reflects the deposits of fluoride from skeletal and might be affected by consumption of bottled water.

Another study conducted by Khandare et al. (2018) in Nalgonda district villages, Telangana, India which the respondents are school children aged 8-14 years old. Respondents selected were resided in the area since birth and categorized based on mean drinking water fluoride consumption. It also was found that a positive correlation between the drinking water and urinary fluoride in different categories.

This result is not similar to previous studies mentioned above as there is no significant difference between level of fluoride in drinking water and urinary fluoride which means that fluoride levels in drinking water is not the major source of urinary fluoride. Mean of urinary fluoride level are higher than mean of fluoride in drinking water.

Fluoride excreted approximately 60% to 45% of daily fluoride taken (Buzalaf et al., 2011). As mentioned earlier, there are other sources that contribute to fluoride taken in body such as consumption of foods (spinach, cabbage, tea), exposure of fluorine such as phosphate fertilizers, and ingestion of toothpaste while brushing teeth, mouth rinses and cosmetics such as talc (Ghosh et al., 2013). All the sources may be inhaled or ingested intentionally or unintentionally in daily life increases fluoride levels in body to be metabolized.

Apart from that, there may be another factor that causes mean of urinary fluoride level are higher than levels of fluoride in drinking water. PH of urine influence fluoride excretion where higher pH causes more fluoride (F^-) that remains in the tubule to be excreted. Low urine pH causes less fluoride (F^-) to be excreted due to high amount of Hydrogen Fluoride (HF), the most permeable form of fluoride to be reabsorbed to systemic circulation (Buzalaf et al., 2011). Consume lots of vegetables diets causes pH of urine to be more alkaline thus more levels of fluoride excreted through urine (O'Mullane et al., 2016).

There was study conducted in Main Ethiopian Rift Valley (Rango et al., 2014) stated that urinary fluoride levels of respondents aged 10-15 years old should take into account from dietary intake such as foods (63%) and beverages (60%). Examples of dietary intake mentioned in the study were agriculture and food from locally grown crops and cows' milk. Another study conducted in Chile involved respondents aged 18-75 years old (Villa et al., 2010) found that there was strong relationship between total daily fluoride intake (TDFI) and daily urinary fluoride excretion (DUFE). The study also stated that vegetarian had more alkaline urine which causes more fluoride excreted than non-vegetarian.

5.1.4 Comparison Level of Fluoride in Drinking Water with value stated by National Drinking Water Quality Standards (NDWQS).

Level of fluoride in drinking water in Kuala Kubu Bharu area was compared with the standard to determine whether the level of fluoride in acceptable limit. After data analysis, it was found that there was no significant difference between the reading of fluoride in drinking water and the range stated by NDWQS. This showed that levels of fluoride in drinking water were within range stated by NDWQS.

High levels of fluoride in drinking water can be a risk factor for dental or skeletal fluorosis and potentially cause high blood pressure (Taghipour et al., 2016). This statement enhanced by previous studies existed in various regions such as China, parts of Africa and India stated that ingestion of high fluoride in water more than 1.5 ppm resulted in endemic fluorosis (Zhang et al., 2017).

There was previous study conducted by Crocombe et al. (2015) located in Australia's capital cities concluded that adults aged 15-46 who exposed longer to fluoridated water (0.3-0.7 ppm) had significantly lower decayed, missing or filled permanent teeth (DMFT) compared to adults who had shorter exposure to fluoridated water.

There was another study conducted in United Kingdom, a study about comparison of DMFT between children living in fluoridated communities (0.5 to 1 ppm) and children lived in non-fluoridated communities (0-0.3 ppm). It was found that children lived in fluoridated communities had significantly less DMFT compared to those lived in non-fluoridated communities (Smith & de Villa, 2016).

Since fluoride in drinking water within standards, respondents are not in high risk to get detrimental effects due to excessive consumption of fluoride. However, maintaining fluoride level in drinking water in safe limit is important as water is main source of fluoride intake and community lived in hot climates increased risk of exposure to fluoride as higher water consumption (Craig, 2015).

5.1.5: Comparison Urinary Fluoride to NIOSH manual of analytical method 8308 (NMAM) Standards

Average of urinary fluoride levels among respondents was compared to the NMAM 8308 standard to determine whether average of urinary fluoride levels followed the standard. After conducting data analysis, it was found that average of urinary fluoride levels was in the range stated by NMAM 8308. This finding may show that respondents have high possibility to not get detrimental effects due to overexposure of fluoride.

There was previous study conducted by Kumar (2010) in different districts of Bihar, India found that levels of fluoride in urine among patients with skeletal fluorosis, non-skeletal fluorosis such as muscle weakness, tingling sensation in hands and feet, feeling bloated and constipation, and dental fluorosis were from 1.6 ppm to 10.65 ppm. The values of fluoride in urine were higher than normal upper permissible limit of fluoride in urine in India.

There was another study conducted on workers and residents of Hindalco Industries Limited (HINDALCO), largest integrated Aluminium plants in Asia that located in Renukoot, India. The plants chosen as study location since it released hazardous waste contained hydrofluoric acid and fluoride may contained in pressurized containers used at some hazardous waste sites. It was stated that urinary fluoride varies between 0.5 ppm to 13.0 ppm for case of skeletal fluorosis (Pandey et al., 2014).

Respondents consumed sufficient fluoride sources from drinking water since level of fluoride in drinking water followed NDWQS standards. However, urinary fluoride levels may also influenced by other sources. Consumption of other fluoride sources such as food and toothpaste that may accidentally swallowed contributed to 30%-40% of fluoride intake in body (Rustagi et al., 2017). This means that respondents also get fluoride in daily diet lifestyle such as from rice, vegetables cooked with fluoridated water (Watts, 2017). Besides, the most widely consumed beverage in the world, tea which made by Camelia sinensis leaves contained 98% of total fluoride of whole plant also increase fluoride levels in body. European Food Safety Authority (EFSA) reported that consuming 2 cups of tea with 5 ppm of fluoride level equivalent to consumed drinking water and foods that prepared using fluoridated tap water (Nagarjuna et al., 2017). However, all respondents consumed the amount of fluoride from diet intake is within safe range.

5.2 Conclusion

In a conclusion, this study generally aimed to determine urinary fluoride in respondents and association with levels of fluoride in drinking water taken by each respondent. Fluoride added in public water system to prevent dental caries but excessive fluoride taken lead to detrimental effects such as skeletal fluorosis and kidney failure. Fluoride in urine of respondents was measured to determine the fluoride intake of respondents. It was found that levels of fluoride in both drinking water and urine were within the safe limit. Fluoride in drinking water consumed by all respondents contained appropriate levels of fluoride following NDWQS standards which may protect from tooth decay, while urinary fluoride of all respondents were considered normal.

5.3 Limitations

There were some limitations in the study. Respondents obtained in this study did not follow the calculations of sample size. This was because the lack of school children from the school who meet the inclusive criteria. Besides, there were no dietary intake in questionnaire to approximate average fluoride taken in a day and there were no clinical information regarding health status of respondents to ensure respondents free from kidney disease/disorder.

5.4 Recommendations

After study conducted, there are some recommendations that might be considered to be applied for future similar studies. It is recommended to include several school children as respondents to represent more kuala kubu bharu area and increase number of respondents for male and female respondents by more than 30 respondents each gender.

Since urinary fluoride may influenced by consuming other food sources, dietary intake by respondents can include in questionnaire to approximate average fluoride taken in day. Besides, overexposure of fluoride can be determined if hire some health practitioners to detect dental or skeletal fluorosis of respondents and it is recommended to get clinical information regarding health status of respondents to ensure respondents free from kidney disease/disorder.

Apart from that, questionnaire about awareness and practice can distribute to local authority to determine the level of awareness and practice of local authority about adverse effects by consumption of too low or too much of fluoride by community in particular area especially in drinking water.

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APPENDIX I

PERMISSION LETTER

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

Research title	**:**	**Fluoride in Drinking Water and Urine: A Cross-Sectional Study Among School Children in Kuala Kubu Bharu, Hulu Selangor**
Study Site	**:**	**Kuala Kubu Bharu, Hulu Selangor**
JKEUPM Ref No.	**:**	**JKEUPM-2017-215**
Researcher	**:**	**Khairin Nabila bt Idrus**
Supervisor	**:**	**Dr. Shaharuddin bin Mohd Sham**

Documents received and reviewed with reference to the above study:

1. Ethics Application Form, Version 1 dated 31/10/2017
2. Respondent Information Sheet & Guardian's/Parent's Consent (English), Version 3 dated 5/3/2018
3. Respondent Information Sheet & Guardian's/Parent's Consent (Malay), Version 1 dated 31/10/2017
4. Respondent Information Sheet & Consent (English), Version 1 dated 31/10/2017
5. Respondent Information Sheet & Consent (Malay), Version 2 dated 28/12/2017
6. Proposal (English), Version 3 dated 5/3/2018
7. Questionnaire (Malay), Version 1 dated 31/10/2017
8. Curriculum Vitae of:
   a. Dr. Shaharuddin bin Mohd Sham

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

Decision by JKEUPM:

[X] Approved

[X] **Permission MUST BE OBTAINED from the respective hospitals/ institutions before conducting the research**

[ ] Disapproved

Please note that the approval is **VALID UNTIL 9 MARCH 2019**

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.

KEMENTERIAN PENDIDIKAN MALAYSIA
BAHAGIAN PERANCANGAN DAN PENYELIDIKAN DASAR PENDIDIKAN
ARAS 1-4, BLOK E8
KOMPLEKS KERAJAAN PARCEL E
PUSAT PENTADBIRAN KERAJAAN PERSEKUTUAN
62604 PUTRAJAYA

TEL : 0388846591
FAKS : 0388846579

Ruj. Kami : KPM.600-3/2/3-eras(55)
Tarikh : 27 Disember 2017

KHAIRIN NABILA BINTI IDRUS
NO. KP : 950624145080

NO 28 LORONG CP5/44,
TAMAN CHERAS PERDANA 43200 CHERAS
SELANGOR

Tuan,

KELULUSAN UNTUK MENJALANKAN KAJIAN DI SEKOLAH, INSTITUT PENDIDIKAN GURU, JABATAN PENDIDIKAN NEGERI DAN BAHAGIAN DI BAWAH KEMENTERIAN PENDIDIKAN MALAYSIA

Perkara di atas adalah dirujuk.

2. Sukacita dimaklumkan bahawa permohonan tuan untuk menjalankan kajian seperti di bawah telah diluluskan.

" FLUORIDE IN DRINKING WATER AND URINE: A CROSS-SECTIONAL STUDY AMONG SCHOOL CHILDREN IN KUALA KUBU BHARU, HULU SELANGOR "

3. Kelulusan adalah berdasarkan kepada kertas cadangan penyelidikan dan instrumen kajian yang dikemukakan oleh tuan kepada bahagian ini. Walau bagaimanapun kelulusan ini bergantung kepada kebenaran Jabatan Pendidikan Negeri dan Pengetua / Guru Besar yang berkenaan.

4. Surat kelulusan ini sah digunakan bermula dari **16 Januari 2018** hingga **9 Februari 2018**.

5. Tuan dikehendaki menyerahkan senaskhah laporan akhir kajian dalam bentuk *hardcopy* bersama salinan *softcopy* berformat pdf dalam CD kepada Bahagian ini.Tuan juga diingatkan supaya mendapat kebenaran terlebih dahulu daripada Bahagian ini sekiranya sebahagian atau sepenuhnya dapatan kajian tersebut hendak diterbitkan di mana-mana forum, seminar atau diumumkan kepada media massa.

Sekian untuk makluman dan tindakan tuan selanjutnya. Terima kasih.

"SEHATI SEJIWA"

"BERKHIDMAT UNTUK NEGARA"

Saya yang menurut perintah,

Ketua Sektor
Sektor Penyelidikan dan Penilaian
b.p. Pengarah
Bahagian Perancangan dan Penyelidikan Dasar Pendidikan
Kementerian Pendidikan Malaysia

salinan kepada:-

JABATAN PENDIDIKAN SELANGOR

* SURAT INI DIJANA OLEH KOMPUTER DAN TIADA TANDATANGAN DIPERLUKAN *

APPENDIX 2

CONSENT FORMS

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

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

Fluorida dalam air minuman dan air kencing: kajian keratan rentas di kalangan kanak-kanak sekolah di Hulu Selangor.

2. PENGENALAN

Banyak negara telah menambah fluorida dalam air minuman dengan tujuan utama untuk mengelakkan reput gigi dengan memberikan hubungan berterusan dan konsisten dengan jumlah fluorida yang rendah. Walau bagaimanapun fluorida yang berlebihan yang melebihi Nilai Garis Panduan oleh WHO yang sehingga 1.5 mg / liter berpotensi menyebabkan beberapa kesan buruk kepada kesihatan termasuk *fluorosis (satu keadaan daripada garis putih halus dalam enamel (gigi) hingga putih yang pekat, menyebabkan kerosakan gigi) dan juga boleh menyebabkan Kuasa Pintar yang lebih rendah (IQ) pada kanak-kanak.*

Tujuan kajian ini adalah untuk menentukan tahap fluorida dalam air minuman dan hubungannya dengan fluorida dalam urin, untuk menentukan perbezaan fluorida dalam urin antara responden lelaki dan wanita dan untuk menentukan sama ada fluorida dalam air minuman tidak menepati Standard Kualiti Air Minum Nasional (NDWQS).

Peserta dipilih berdasarkan senarai nama yang diperoleh dari Jabatan Hal Ehwal Pelajar sekolah. Satu token akan diberikan kepada setiap peserta. Tiada paksaan untuk menjadi peserta dalam kajian ini. Peserta boleh menarik diri bila-bila masa dari kajian ini jika merasa tidak selesa.

3. APAKAH YANG PERLU ANDA LAKUKAN?

I.Peserta akan diberi taklimat dari penyiasat mengenai prosedur kajian.

II. Peserta akan diberi tiga (3) botol polietilena berketumpatan tinggi untuk mengumpul air di rumah dan tiga (3) botol polietilena untuk mengumpul sampel air urin di rumah selama 3 hari berturut-turut.

III. Setiap hari, peserta perlu mengumpul satu sampel air minuman dan air urin di rumah kemudian

membawa sampel dalam plastik beg kedap udara ke sekolah yang akan dikumpulkan oleh penyelidik
IV. Peserta perlu mengumpul sampel air di rumah mereka hanya sekali kemudian dibawa ke sekolah untuk dikumpulkan oleh penyiasat.
V. Peserta perlu mengikuti prosedur pengumpulan air urin seperti berikut: -

PROSEDUR UNTUK PENGUMPULAN URIN
1 .. Basuh tangan dengan sabun dan air. Tangan kering.
2 .. Mula buang air kecil ke dalam tandas, memegang lipatan kulit menggunakan jari-jari anda.
3. Setelah aliran air kencing terhasil dengan baik, dan tanpa mengganggu aliran air kencing, gerakkan bekas ke aliran untuk "mengambil" air kencing.
4. Kumpulkan air kencing sehingga bekas hampir separuh penuh (atau sehingga aliran air kencing berkurangan dengan ketara) dan kemudian selesai membuang air kecil ke dalam tandas.

4. SIAPA YANG TIDAK BOLEH MENYERTAI KAJIAN INI?

Individu yang menggunakan sistem penapis air sebagai sumber air minum kerana penapis air boleh menjejaskan kandungan fluorida. Responden yang mempunyai penyakit buah pinggang kerana individu mempunyai sensitiviti yang sangat tinggi terhadap kandungan fluorida kerana tulang dan tisu lain mengumpul fluorida pada tahap jauh lebih tinggi daripada individu yang sihat.

5. APAKAH FAEDAH MENYERTAI KAJIAN INI?

a) KEPADA ANDA SEBAGAI PESERTA?

Peserta dapat mengetahui jumlah fluorida yang terdapat dalam sumber air minuman dan dalam badan serta mengetahui kesan terhadap kesihatan disebabkan pengambilan fluorida yang berlebihan.

b) KEPADA PENYELIDIK?

Penyelidik dapat meyumbang satu penyelidikan mengenai jumlah fluorida dalam loji rawatan air di Kuala Kubu Bharu sama ada masih dalam kawalan atau tidak di samping menimbulkan kesedaran mengenai kesan kesihatan disebabkan kandungan fluorida yang berlebihan dalam loji rawatan air yang menjadi sumber air minuman pelajar di Kuala Kubu Bharu.

6. ADAKAH IA BERISIKO?

Terdapat kemungkinan risiko minimum apabila peserta perlu mengumpul sampel air kencing dengan sendirinya di rumah. Pengawasan ibu bapa diperlukan semasa mengutip sampel.

7. ADAKAH MAKLUMAT DAN IDENTITI SAYA KEKAL RAHSIA?

Ya. Semua maklumat dan identiti peserta akan dirahsiakan.

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

Khairin Nabila Binti Idrus
Jabatan Kesihatan Persekitaran dan Pekerjaan
Fakulti Perubatan dan Sains Kesihatan
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____

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 Helaian 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.

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*potong yang tidak berkenaan

Tandatangan	Tandatangan ....
(*Responden*)	(*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*)

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

BORANG 2.5: PENERANGAN DAN PERSETUJUAN IBU BAPA

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

1.TAJUK KAJIAN

Fluorida dalam air minuman dan air kencing: kajian keratan rentas di kalangan kanak-kanak sekolah di Hulu Selangor.

2. PENGENALAN

Banyak negara telah menambah fluorida dalam air minuman dengan tujuan utama untuk mengelakkan reput gigi dengan memberikan hubungan berterusan dan konsisten dengan jumlah fluorida yang rendah. Walau bagaimanapun fluorida yang berlebihan yang melebihi Nilai Garis Panduan oleh WHO yang sehingga 1.5 mg / liter berpotensi menyebabkan beberapa kesan buruk kepada kesihatan termasuk *fluorosis (satu keadaan daripada garis putih halus dalam enamel (gigi) hingga putih yang pekat, menyebabkan kerosakan gigi) dan juga boleh menyebabkan Kuasa Pintar yang lebih rendah (IQ) pada kanak-kanak.*

Tujuan kajian ini adalah untuk menentukan tahap fluorida dalam air minuman dan hubungannya dengan fluorida dalam urin, untuk menentukan perbezaan fluorida dalam urin antara responden lelaki dan wanita dan untuk menentukan sama ada fluorida dalam air minuman tidak menepati Standard Kualiti Air Minum Nasional (NDWQS).

Peserta dipilih berdasarkan senarai nama yang diperoleh dari Jabatan Hal Ehwal Pelajar sekolah. Satu token akan diberikan kepada setiap peserta. Tiada paksaan untuk menjadi peserta dalam kajian ini. Peserta boleh menarik diri bila-bila masa dari kajian ini jika merasa tidak selesa.

3. APAKAH YANG PERLU PESERTA LAKUKAN?

I.Peserta akan diberi taklimat dari penyiasat mengenai prosedur kajian.

II. Peserta akan diberi tiga (3) botol polietilena berketumpatan tinggi untuk mengumpul air di rumah dan tiga (3) botol polietilena untuk mengumpul sampel air urin di rumah selama 3 hari berturut-turut.

III. Setiap hari, peserta perlu mengumpul satu sampel air minuman dan air urin di rumah kemudian membawa sampel dalam plastik beg kedap udara ke sekolah yang akan dikumpulkan oleh penyelidik

IV. Peserta perlu mengumpul sampel air di rumah mereka hanya sekali kemudian dibawa ke sekolah untuk dikumpulkan oleh penyiasat.

V. Peserta perlu mengikuti prosedur pengumpulan air urin seperti berikut: -

PROSEDUR UNTUK PENGUMPULAN URIN

1 .. Basuh tangan dengan sabun dan air. Tangan kering.

2 .. Mula buang air kecil ke dalam tandas, memegang lipatan kulit menggunakan jari-jari anda.

3. Setelah aliran air kencing terhasil dengan baik, dan tanpa mengganggu aliran air kencing, gerakkan bekas ke aliran untuk "mengambil" air kencing.

4. Kumpulkan air kencing sehingga bekas hampir separuh penuh (atau sehingga aliran air kencing berkurangan dengan ketara) dan kemudian selesai membuang air kecil ke dalam tandas.

4. SIAPA YANG TIDAK BOLEH MENYERTAI KAJIAN INI?

Individu yang menggunakan sistem penapis air sebagai sumber air minum kerana penapis air boleh menjejaskan kandungan fluorida. Responden yang mempunyai penyakit buah pinggang kerana individu mempunyai sensitiviti yang sangat tinggi terhadap kandungan fluorida kerana tulang dan tisu lain mengumpul fluorida pada tahap jauh lebih tinggi daripada individu yang sihat.

5. APAKAH FAEDAH MENYERTAI KAJIAN INI?

a) KEPADA ANDA SEBAGAI PESERTA?

Peserta dapat mengetahui jumlah fluorida yang terdapat dalam sumber air minuman dan dalam badan serta mengetahui kesan terhadap kesihatan disebabkan pengambilan fluorida yang berlebihan.

b) KEPADA PENYELIDIK?

Penyelidik dapat meyumbang satu penyelidikan mengenai jumlah fluorida dalam loji rawatan air di Kuala Kubu Bharu sama ada masih dalam kawalan atau tidak di samping menimbulkan kesedaran mengenai kesan kesihatan disebabkan kandungan fluorida yang berlebihan dalam loji rawatan air yang menjadi sumber air minuman pelajar di Kuala Kubu Bharu.

6. ADAKAH IA BERISIKO?

Terdapat kemungkinan risiko minimum apabila peserta perlu mengumpul sampel air kencing dengan sendirinya di rumah. Pengawasan ibu bapa diperlukan semasa mengutip sampel.

7. ADAKAH MAKLUMAT DAN IDENTITI PESERTA KEKAL RAHSIA?

Ya. Semua maklumat dan identiti peserta akan dirahsiakan.

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

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9. PERSETUJUAN

Saya.. No Kad Pengenalan. .... beralamat...

...................................dengan ini bersetuju untuk membenarkan anak sya mengambil bahagian secara sukarela dalam penyelidikan yang tersebut di atas *(kajian klinikal/percubaan ubat-ubatan/rakaman video/kumpulan sasaran/temuduga/ soal selidik).

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Tandatangan .... Tandatangan ....

(*Responden*) (*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 3

QUESTIONNAIRE

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

BACHELOR SCIENCE (ENVIRONMENTAL AND OCCUPATIONAL HEALTH)

FACULTY OF MEDICINE AND HEALTH SCIENCES

QUESTIONNAIRE

DETERMINATION OF FLUORIDE IN DRINKING WATER AND IN URINE AMONG SECONDARY SCHOOL CHILDREN IN SMK AMPANG PECAH, SELANGOR

NAME : KHAIRIN NABILA BINTI IDRUS

MATRIC NUMBER : 179648

SUPERVISOR : DR. SHAHARUDDIN BIN MOHD SHAM

QUESTIONNAIRE

Semua maklumat adalah untuk kegunaan kajian sahaja dan maklumat ini akan dianggap sulit. Maklumat anda hanya digunakan untuk membahagi responden mengikut kategori yang sama.

Arahan: Sila jawab semua soalan dan tandakan (/) pada ruang yang disediakan.

Bahagian A: Maklumat responden

1. No ID : ☐☐

2. Tarikh lahir : ☐☐ Hr ☐☐ bln ☐☐☐☐ thn

3. Umur : ☐☐ Tahun

4. Jantina : ☐ Lelaki ☐ Perempuan

Bahagian B: Maklumat penggunaan air paip

1. Apakah sumber air di rumah?

   ☐ Paip

   ☐ Telaga

   ☐ Lain-lain, sila nyatakan ....

2. Berapa gelas air yang anda minum setiap hari?

   .... gelas (200 ml)

3. Penggunaan air dari dapur:

☐ Memasak

☐ Minum

☐ Kegunaan domestik

☐ Lain-lain, sila nyatakan ……………………………

4. Adakah anda berpuas hati dengan kualiti air paip yang digunakan?

☐ Ya ☐ Tidak ☐ Tidak pasti

5. Adakah anda menggunakan sistem penapisan air persendirian di rumah?

☐ Ya ☐ Tidak

Jika ya, sila nyatakan jenama yang digunakan: ……………………………………………

Bahagian C: Maklumat kesihatan

6. Adakah anda mempunyai masalah buah pinggang?

☐ Ya ☐ Tidak

7. Adakah anda mengalami masalah kesihatan lain?

☐ Ya ☐ Tidak

Jika ya, sila nyatakan ……………………………

TERIMA KASIH ATAS KERJASAMA ANDA

-TAMAT-