



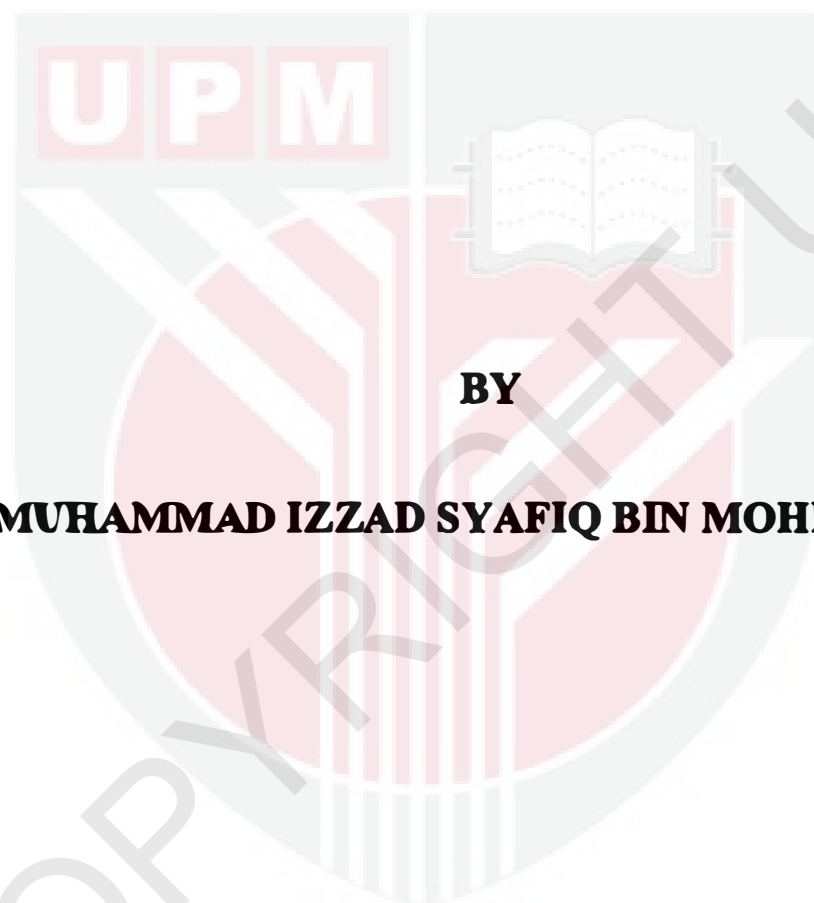
UNIVERSITI PUTRA MALAYSIA

***A CROSS-SECTIONAL STUDY ON FLUORIDE IN DRINKING
WATER AND URINE AMONG SECONDARY SCHOOL CHILDREN
IN WILAYAH PERSEKUTUAN PUTRAJAYA***

MUHAMMAD IZZAD SYAFIQ BIN MOHD FAUZI

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AND URINE AMONG SECONDARY SCHOOL CHILDREN IN WILAYAH
PERSEKUTUAN PUTRAJAYA**



BY

MUHAMMAD IZZAD SYAFIQ BIN MOHD FAUZI

Thesis submitted in fulfilment of the requirement for the degree of Bachelor

Science (Environmental and Occupational Health) from the

Faculty of Medicine and Health Sciences

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With the name of Allah, Most Gracious and Most Merciful. Here, I would like to praise to Allah because for His permission, this thesis could be completed. Without His permission, I would not have the will and bless to run this research and to produce this complete thesis

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ABSTRACT

A CROSS-SECTIONAL STUDY ON FLUORIDE IN DRINKING WATER AND URINE AMONG SECONDARY SCHOOL CHILDREN IN WILAYAH PERSEKUTUAN PUTRAJAYA

MUHAMMAD IZZAD SYAFIQ BIN MOHD FAUZI

Introduction: In Malaysia, fluoridation of water started since 1972 in order to reduce dental caries. In the water treatment process, fluoride will be added before water enters the water storage tank. Fluoride will binds to the tooth enamel and make it more resistant to acid attack mainly from bacteria. **Objectives:** This study aimed at determining the level of fluoride in drinking water and urine among secondary school children in Putrajaya and its relationship between both variables. **Methodology:** A cross-sectional study was conducted on 5th to 8th February 2018 among selected secondary school children. A set of questionnaire was given to the respondents and samples of drinking water used at home and urine have been taken from the respondents. The samples have been taken for 3 consecutive days. The drinking water and urine samples have been analysed using HACH Brand spectrophotometer DR1900 using USEPA Method 8029 within 24 hours. **Result:** A total of 67 respondents were involved in this study and all of the respondents were 14 years old. A total of 36 of the respondents were male (53.7%) and 31 were female (46.7%). Based on the samples obtained, the reading of fluoride in drinking water was 0.423 ± 0.114 mg/L. For level of fluoride in urine, the reading obtained was 1.626 ± 0.222 mg/L. From the findings, there was no significant difference in urinary fluoride between gender as the p-value obtained was larger than 0.05. The National Standard for Drinking Water Quality (NSDWQ) was used in order to compare the level of fluoride in drinking water. The standard was from 0.4 mg/L – 0.6 mg/L. A total of 36 samples (53.73%) were in the optimal range of fluoride in drinking water which was between 0.4 – 0.6 mg/L. About 5 samples (7.46%) exceed the 0.6 mg/L while 26 samples (38.8%) were lower than 0.4 mg/L. While, the National Institute of Occupational Safety and Health (NIOSH) standard was used to compare the level of fluoride in urine. The standard was from 0.2 mg/L – 3.2 mg/L. All samples were in the optimal range of fluoride in urine. Lastly, there was no significant relationship between level of fluoride in drinking water and urinary fluoride, as the p-value obtained was 0.796 (>0.05). **Conclusion:** This study found that the level of fluoride in drinking water for area of Putrajaya, Presint 14 was in optimal range but the authorities should monitor it regularly because there were some readings that lower or higher than the standard. All of the urine samples were in the optimal range as recommended by NIOSH. Next, the level of fluoride in urine was not differ between gender. Besides, this study concluded that there was no association between level of fluoride in drinking water and the level of fluoride in urine.

Keywords: Fluoride, Drinking Water, Urinary Fluoride, Secondary School Children

ABSTRAK

KAJIAN TERHADAP HUBUNG-KAIT ANTARA KANDUNGAN FLUORIDA DI DALAM AIR MINUM DAN AIR KENCING DALAM KALANGAN PELAJAR SEKOLAH MENENGAH DI WILAYAH PERSEKUTUANPUTRAJAYA

MUHAMMAD IZZAD SYAFIQ BIN MOHD FAUZI

Pengenalan: Di Malaysia, fluoridasi air bermula sejak tahun 1972 untuk mengurangkan karies gigi. Dalam proses rawatan air, fluorida akan ditambah sebelum air memasuki tangki simpanan air. Fluorida akan mengikat ke enamel gigi dan menguatkan gigi daripada serangan asid terutamanya dari bakteria. **Objektif:** Kajian ini bertujuan untuk menentukan tahap fluorida dalam air minuman dan air kencing di kalangan pelajar sekolah menengah di Putrajaya dan hubung-kait antara kedua-dua pembolehubah. **Kaedah:** Kajian rentas keratan telah dijalankan pada 5 hingga 8 Februari 2018 di kalangan pelajar sekolah menengah yang terpilih. Satu set soal selidik diberikan kepada responden dan sampel air minum yang digunakan di rumah dan air kencing telah diambil daripada responden. Sampel telah diambil selama 3 hari berturut-turut. Sampel air minum dan air kencing telah dianalisis dengan menggunakan 'spectrophotometer DRCH00 jenama HACH' menggunakan USEPA Method 8029 dalam masa 24 jam. **Keputusan:** Sejumlah 67 responden terlibat dalam kajian ini dan semua responden berusia 14 tahun. Seramai 36 responden adalah lelaki (53.7%) dan 31 adalah perempuan (46.7%). Berdasarkan sampel yang didapati, bacaan fluorida dalam air minuman ialah 0.423 ± 0.114 mg / L. Bagi tahap fluorida dalam air kencing, bacaan yang diperolehi ialah 1.626 ± 0.222 mg / L. Daripada penemuan ini, tidak terdapat perbezaan yang signifikan di antara tahap fluorida dalam air kencing dengan jantina dengan nilai p yang diperolehi lebih besar daripada 0.05. Standard Kebangsaan untuk Kualiti Air Minum (NSDWQ) digunakan untuk membandingkan tahap fluorida dalam air minuman. Standardnya adalah dari 0.4 mg / L - 0.6 mg / L. Sebanyak 36 sampel (53.73%) berada dalam tahap optimum fluorida dalam air minuman di antara 0.4 - 0.6 mg / L. Sekitar 5 sampel (7.46%) melebihi 0.6 mg / L manakala 26 sampel (38.8%) lebih rendah daripada 0.4 mg / L. Seterusnya, standard Institut Keselamatan dan Kesihatan Pekerjaan (NIOSH) digunakan untuk membandingkan tahap fluorida dalam air kencing. Standardnya adalah dari 0.2 mg / L - 3.2 mg / L. Semua sampel berada dalam tahap optimum fluorida dalam air kencing. Akhir sekali, tidak terdapat hubungan yang signifikan antara tahap fluorida dalam air minuman dan air kencing, kerana nilai p diperolehi adalah 0.796 (> 0.05). **Kesimpulan:** Kajian ini mendapati bahawa tahap fluorida dalam air minuman bagi kawasan Putrajaya, Presint 14 berada dalam tahap yang optimum tetapi pihak berkuasa perlu memantaunya dengan kerap kerana terdapat bacaan yang lebih rendah atau lebih tinggi daripada standard. Semua sampel air kencing berada dalam tahap optimum seperti yang disyorkan oleh NIOSH. Seterusnya, tahap fluorida dalam air kencing tidak berbeza di antara jantina. Selain itu, kajian ini menyimpulkan bahawa tiada hubungan antara tahap fluorida dalam air minuman dan tahap fluorida dalam air kencing.

Kata Kunci: Fluorida , Air Minum, Air Kencing, Pelajar Sekolah Menengah

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CHAPTER 1

INTRODUCTION

1.1 Research Background

Water is essential for human lives. Human need to drink water in order to keep surviving. Water is needed to make sure all the cell and organs function properly, and also to lubricate the joints as well as protecting the spinal cord (Mcintosh, 2016). Majority of the water that we can obtained are from drinking water, other beverages and also by some food such as tomatoes, soups and oranges. Human are advised to drink at least 8 glasses of water per day (Scott, 2017).

The fluoridation of water is the addition of fluoride into the public water supplies in order to reduce cavities. Fluoride is added into the public water supplies with an average concentration of 1 ppm (part per million) but groundwater may contain much higher levels of fluoride (Main, 2015). The fluoride will binds to the tooth enamel and make it more resistant to acid attack mainly from bacteria. If the cavities that deposited at the tooth is still untreated, it will lead to dental caries. However, too much of fluoride in drinking water may lead to dental fluorosis (Peckham & Awofeso, 2014).

In Malaysia, the fluoridation of water was started in 1972 in order to reduce dental caries. At average, 75.7 percent of our country's population which is around 20.7 million receives fluoridated water. In the water treatment process, fluoride is added before water enters the large finished water storage before being sent to the community (Melbourne Water, 2017).

Based on the National Standard for Drinking Water Quality (NSDWQ), the standard level of fluoride in drinking water in Malaysia is 0.4 – 0.6 mg/L (Engineering Services Division, Ministry of Health Malaysia, 2010). This is lesser than the standard that have been released by World Health Organization (WHO) which is 1.5mg/L. WHO highlights that in setting national standards for fluoride, it is important to consider climatic conditions, volumes of water intake, and intake of fluoride from other sources (Thakre et al., 2009).

But, the source of fluoride are not only from our drinks but also in our foods such as curly kale, fish and tea. For instance, the content of fluoride in curly kale can go up to 40 mg/kg, fish also can go up to 0.1 – 30 mg/kg. Tea may contain high concentration of fluoride that can go up to 3 – 300 mg/kg. This can be caused by the high natural concentrations in tea plants or the use of additives during the growth or fermentation. Based from this, we may know that the fluoride content in food are different from one another. Also, it have been proved that one-third of the fast food wrappers and containers also has fluoride in it (Mercola, 2017).

1.2 Problem Statement

Malaysia is one of the countries currently practising the use of water fluoridation. Since 1972, water fluoridation have been implemented successfully to supply fluoride and also approved as a government policy (Rahim et al., 2013). The most common effects of excessive fluoride ingestion are dental fluorosis (Akpata et al., 2013). Dental fluorosis is the situation where the enamel is formed with decreased mineral content and it increased the porosity of the teeth (Khan et al., 2015). And the

main sources that are responsible to cause this are the increased of fluoride consumption from drinking water and other supplements.

Besides, over consumption of fluoride may even cause kidney toxicity. When the fluoride enter our body, it will undergo four steps which are adsorption, distribution, metabolism and excretion. In the last steps which is excretion, the inorganic fluoride will be eliminated by the kidney (Sauerheber, 2013). When the kidney cells are exposed to high concentration of fluoride, it makes the kidney are vulnerable to fluoride toxicity.

In a meta-analysis of 27 studies, it is linked that fluoride ingestion contributes to IQ deficits in children. Three studies in China showed that increase intake of fluoride especially during pregnancy can causes damage to the brain. From this, we may know that fluoride have their own effects that will interfere the function of the brain and this will lead to lower IQ among children (Michaels, 2017_A).

The overconsumption of fluoride also may cause gastrointestinal side effects. The fluoride and the hydrogen ions may bind together and form hydrogen fluoride in the acidic environment in our stomach. And high concentration of hydrogen fluoride may damage the cell of stomach. These includes the erosion of mucosal lining, ulcers and inflammation of stomach lining (Srivastava, 2017)

The purpose of this study was to determine the fluoride level in drinking water and its relationship with the urinary fluoride. Moreover, this study is conducted to determine whether the levels of fluoride in drinking water complies with the level recommended by the health authorities.

1.3 Research Question

- 1.3.1 What is the level of fluoride among secondary school children in Putrajaya?
- 1.3.2 Is there any significant difference in level of fluoride in urine between gender?
- 1.3.3 Is the level of fluoride in drinking water is within the standard by The National Standard for Drinking Water Quality (NSDWQ)?
- 1.3.4 Is the urinary fluoride level among secondary school children is within the standard by National Institute of Occupational Safety and Health (NIOSH)?
- 1.3.5 Is there any significant association between fluoride level in drinking water and urinary fluoride?

1.4 Study Justification

From the problem statement that have been stated above, it shows that fluoride can give adverse effect to human health such as dental fluorosis, lower IQ level, kidney toxicity and gastrointestinal side effects. By conducting this study, it will help in providing the information of the latest level of fluoride in drinking water as well as in urine. From this, we may know whether the level of fluoride in urine and drinking water are within the optimal range or not. By conducting this study, it also creates awareness and give new knowledge to all especially to the respondents on what is actually fluoride, how are they exposed to it and what is the effects that they faced by overconsumption of it. This will surely give a new pathway to other researchers to conduct further studies regarding fluoride and their effects. This study will give more explanation regarding all issues regarding fluoride association with dental fluorosis.

Besides, this study will give evidence whether fluoride level in drinking water are the most contributor in urinary fluoride level.

1.5 Objectives

1.5.1 General Objective

1.5.1.1 To determine the level of fluoride in drinking water and urine among secondary school children.

1.5.2 Specific Objectives

1.5.2.1 To compare the urinary fluoride level between gender

1.5.2.2 To determine whether the level of fluoride in drinking water is within the standard by National Standard for Drinking Water Quality (NSDWQ)

1.5.2.3 To determine whether the urinary fluoride level among secondary school children is within the standard by National Institute of Occupational Safety and Health (NIOSH)

1.5.2.4 To determine the association between fluoride in drinking water and urinary fluoride

1.6 Hypothesis

1.6.2 There is a significant difference in level of fluoride between gender

1.6.2 There is a significant difference of fluoride levels in drinking water with National Standard for Drinking Water Quality (NSDWQ)

1.6.2 There is a significant difference of fluoride levels in urine with National Institute of Occupational Safety and Health (NIOSH) standard

1.6.2 There is a significant association between fluoride level in drinking water and urinary fluoride

1.7 Variables

1.7.1 Independent Variable

Level of fluoride in drinking water

1.7.2 Dependent Variable

Urinary fluoride

1.8 Definition of Terms

1.8.1 Conceptual Definition

Fluoride

Fluorine is an element that is distributed all around the world and it exists in form of fluorides (World Health Organization, 2011). Fluoride can be found in water, soil, foods and even mineral such as fluorite. Concentration in seawater are about 1.3 ppm while in fresh water is between 0.01 to 0.3 ppm. (Nordqvist, 2016)

School Children

In Malaysia, there are two types of school, which is primary and secondary school. Primary school consists of students from age 6+ to 11+ years old, which is Standard 1 to 6. The secondary school consists of students from age 12+ to 16+ years old, which is Form 1 to Form 5 (Study Malaysia, 2015).

Drinking Water

Drinking water is also known as potable water that is safe to drink without causing any health effects. About 70% our human body is comprised of water and 90% of blood is made up of water. Water is needed to keep us hydrated and maintain

body function. The adequate intake amount of drinking water is around 3 litres or 13 cups per day (Mcintosh, 2016)

Urinary Fluoride

Urinary fluoride level in this study reflects the level of fluoride in the urine of the secondary school children.

1.8.2 Operational Definition

Fluoride

In drinking water, there are a lot of minerals in it includes fluoride. The acceptable range of fluoride in Malaysia is 0.4 – 0.6 mg/L. The sample of drinking water will be collected and will be analysed using spectrophotometer HACH Brand model DR1900 to know the level of fluoride in it.

School Children

In this study, the sample includes the secondary school children aged 14 years old. The school children were from Sekolah Menengah Kebangsaan Putrajaya Presint 14.

Drinking Water

The students that are chosen in this study should only drink water that are not filtered at home. If their houses uses water filter, they are excluded from this study.

Urinary Fluoride

The urine from the students will be collected for 3 consecutive days and will be brought to lab to determine the urinary fluoride level in it. From this, we can know whether the level of fluoride in the urine is in the acceptable range or not.

1.9 Conceptual Framework

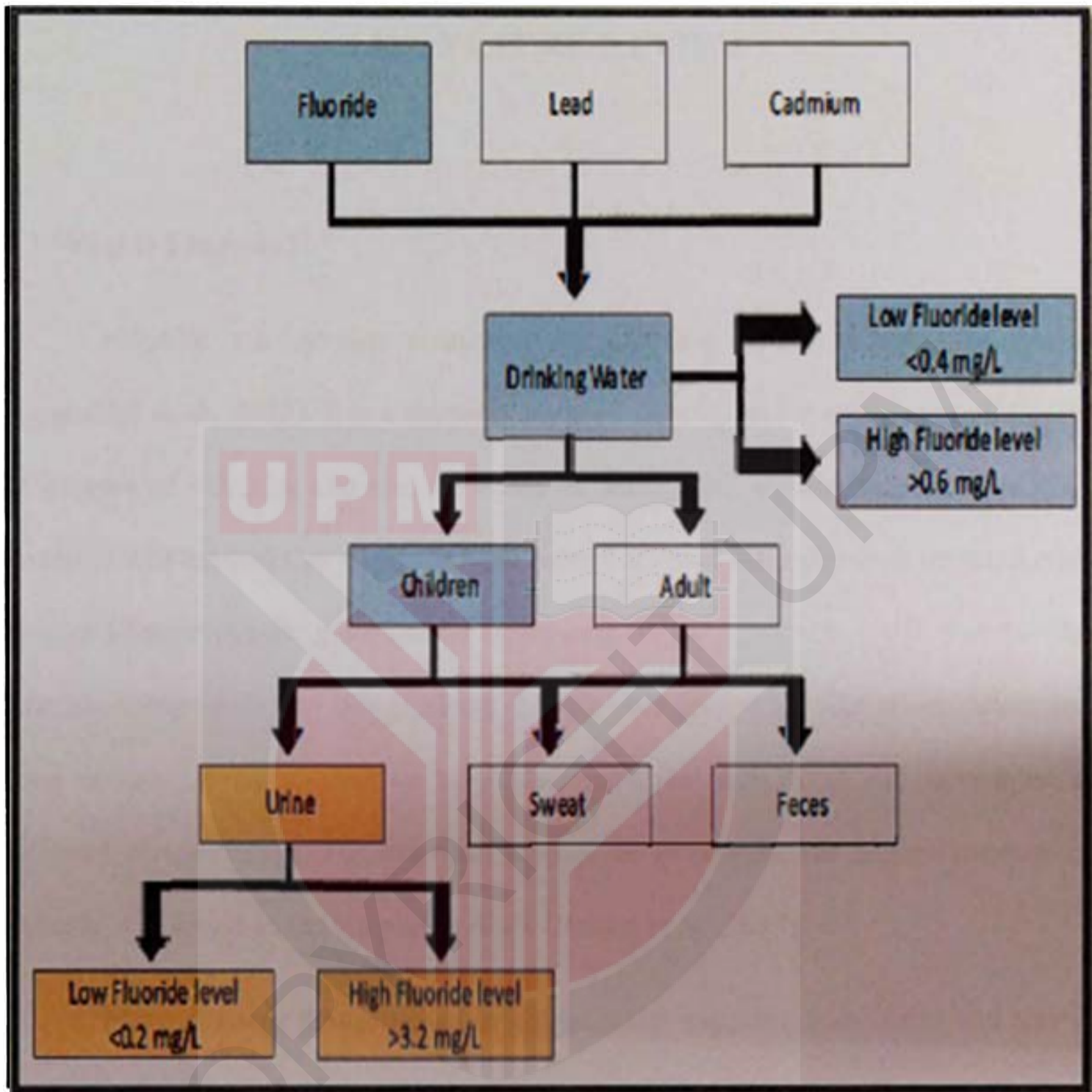


Figure 1.9: Conceptual Framework



• Ranjan & Ranjan, 2015

• Azlan et al., 2011

CHAPTER 2

LITERATURE REVIEW

2.1 What is Fluoride?

Fluoride is a common element in the earth's crust and is highly soluble in water (Hui et al., 2013). It is a simplest anion of fluorine and it exists naturally in lot of sources of water. It can also be found in water, soil, air and even in food. The waters in and around United States have natural level of fluoride range from 0.1 ppm to over 12 ppm. As the groundwater flows over the earth surface, it will dissolve the fluoride compounds and brings along the minerals into water like rivers, lakes and even oceans. Besides, fluoride may also occur in most food and beverages at different concentration. For example, among the beverages, the highest amount of fluoride was found in the tea packet drink (Rahim et al., 2013).

When fluoride that is added to public water supplies, soft drinks and teas is ingested into the body, it is called systemic fluoride. And once it absorbed into the gastrointestinal tract, the blood will flows with it to entire body. The fluoride will be rapidly distributed throughout the body and it is fused into calcified tissues such as teeth and bones (Aweke et al., 2016).

2.2 Source of Fluoride

There are a lot of sources of fluoride nowadays. There are fluoride in water, soil, air and even in food. In this part, it will shows the details of top sources of fluoride.

2.2.1 Tea and Kombucha

There are high content of fluoride in tea and kombucha. Based on the United States Department of Agriculture (USDA), National Fluoride Database of Selected Beverage and Foods, it proved that tea has 5-10 time more fluoride contents than a can of soda. This includes any kind of tea especially in the camellia sinensis family such as oolong, black tea or green tea. Most publish report says that there are 1 to 5 mg of fluoride per litre of black tea, but in recent study, it shows that it can get as high as 9 mg (Michaels, 2017_B).

2.2.2 Teflon and Aluminium cookware

This Teflon or non-stick cookware means that it has some type of fluoride-impregnated coating that gives the slipperiness or non-stick condition. When the food is cook with this type of cookware, it will increase the fluoride in the food. In a study published in the Journal of Dental Research, it will increase the fluoride by three times (Mercola, 2015).

2.2.3 Non-Organic Fruits and Vegetables

Vegetable or fruits, when they are not organic, can pose a threat for our health. This is because it may become one of the biggest source of fluoride in our diet. People thought in order to get healthier, they will eat more salads and juices, however, in the end, they just getting a lot more of fluoride. This situation happens when during the plantation of the fruits and vegetables, the farmers used a fluoride-based pesticides which is cryolite. Non-organic food crops are often sprayed with pesticide that are fluoride based, causing some non-organic crop to contain up to 180 times the amount of fluoride in tap water. This types of pesticides is widely used as a

pesticides to almost of all vegetables and fruits such as orange, grape, cabbage and broccoli (Marilyn, 2016).

2.2.4 Non-Organic Meat, Canned Seafood and Processed Foods

In this part, there are several criteria that makes the food become higher in fluoride. When the animals is fed with non-organic feed that comes from food that have been sprayed with fluoride-based pesticides, it will surely increase the level of fluoride in the food. Furthermore, even though seafood is high in fluoride but the canned fish that includes its bones such as sardines and salmon has higher fluoride in it (Ganta et al., 2015). This includes any processed food. The more processed the food is, the higher the fluoride content. It will make the fluoride become more concentrated because of the processing.

2.2.5 Fluoride in Drinking Water

Water fluoridation is a process where fluoride is added in the public water supplies to prevent any dental caries from happening. This steps is taken in the last step in the process of water treatment. Level of fluoride that reach the household are in the range of 0.5 mg/L to 1.0 mg/L. and this concentration differ from other countries according to the necessity. According to an authoritative reviews of water fluoridation, conducted in Australia, it concluded that water fluoridation is beneficial at reducing dental caries (Rugg-Gunn & Do, 2012)

2.3 Routes of Entry of Fluorides into Body

There are a lot of ways of dissemination of fluoride. It can goes through air, water, agriculture and even in industry sector (Susheela, Mondal & Singh, 2013). In

industry, the cryolite is used as a flux for the conversion of alumina to aluminium. This becomes a major source for fluoride exposure and it is responsible in causing industrial fluorosis (Centers for Disease Control and Prevention, 2015).

If we inhale the air that contains fluoride in it, it will make the fluoride easily enters our body. The most common ways of fluoride entry into our body is through ingestion. Nowadays, almost all types of foods and drinks contain fluorides (Rice, 2017). There are also fluoride in the baby food. Baby that had exposed to excess fluorides may grow white spotted or pitted teeth. There were also fluoride in infant milks, with mean concentration of 0.025 mg/L (Bussell, Nichol, & Toumba, 2016). Last but not least, fluoride may be ingested into our body by drinking fluoridated water supply.

2.4 Absorption and Distribution of Fluorides in Body

About 90% of fluoride ingested will be absorbed into the gastrointestinal tract where up to 25% goes into stomach and around 77% goes into proximal part of the small intestine. The other remaining 10% will be excreted in faeces. After absorption, fluoride is diffused into bloodstream and will be distributed throughout the human body. The mean time of the peak concentration is 20-60 minutes after consumption (Kanduti et al., 2016). This is under ordinary condition. It can be alter by many factors. For example, if the fluoride is ingested with foods contain calcium, magnesium or aluminium, it will make the fluoride absorbed slower. If the persons has stomach ulcers has stomach acid, fluoride absorption will be faster and complete, compare to less acid stomach (Rapp, 2013). And once the fluoride reaches the lower bowels, only little absorption will be takes place. This is because, the condition of

lower bowels is alkaline which is not suitable for fluoride absorption. And also, at there the fluoride leaves the body with faecal material.

If the fluoride enter our body with inhalation which is through air, the respiratory tract is the major route. In the gaseous form which is hydrogen fluoride, the halogen when enters the blood stream it is mainly goes to the upper portion of respiratory tract. The size of particles affects the uptake of the particulate fluoride. The larger ones will stay at the nose, sinuses and pharynx. But the smaller one will goes directly to the alveolar-capillary bed and will be absorbed into the blood stream within minutes. High exposure of hydrogen fluoride may cause severe acute health effects, such as respiratory damage, pulmonary oedema, dermal burns, ocular irritation and hypocalcaemia (Stefano et al., 2016)

2.5 Excretion of Fluoride

There are several ways of excretion of fluoride such as urine, faeces, saliva, milk, and perspiration.

2.5.1 Urine

About 75 to 90% of fluoride that have been absorbed through duodenum and stomach, the fluoride will be excrete through urine. It is a pH-dependent process. When the pH are about 5.0, the ratio of clearance of fluoride and the glomerular filtration rate can become as low as 5% and it also may exceeds 65% when the pH is 6.5. 35-45% of the filtered fluoride will be reabsorbed in the proximal renal tubules. If the kidney have been damage, it will significantly reduce the urinary elimination of fluorides (Maha, Reem, & Mazin, 2015).

2.5.2 Faeces

The unabsorbed fluoride from the gastrointestinal tract will be eliminated through faeces. The maximum faecal elimination can go up until 10% of the ingested fluoride. It has been proved that the fecal fluoride excretion is higher in ruminants. In cattle, the fluoride concentration is usually higher than forage because of the great proportion of the dry matter is absorbed than fluoride. There are also several factors that affect the faecal elimination of fluoride. For instance, the solubility of the fluoride compounds, presence of di-valent cations and concentration of other dietary components (Haftenberger et al., 2001).

2.5.3 Saliva

Fluoride is secreted in saliva which the salivary levels increase as the plasma levels increase. Although the level of fluoride in saliva are only within the range of 0.01 to 0.06 mg/L, they are one of the critical significance for the role of fluoride as a preventive agent for dental caries. Salivary fluorides concentration may increase 10 times from its baseline values when the person is consuming soluble fluoride compounds. After ingestion (1-15 min), the salivary fluoride concentration peaks rapidly. But after that, it return back to its baseline values which are about 20-60 min. Also, it is estimated less than 1% of the ingested fluoride is excreted in human saliva (Martinez-Mier, 2011).

2.6 Retention of Fluoride in Human Body

Retention of fluoride in human body can be affected by several factors. The factors are the amount of fluoride that is being ingested and the activity of the calcifying tissues.

2.6.1 The Amount of Fluoride Being Ingested

In general, the higher the amount of fluoride ingested, the higher the amount of it will be retained in our body. This will comply the law of mass action. Even though only small amount of fluoride is ingested but in multiple times, it still has more fluoride retained than a fewer number of larger doses (Rapp, 2013).

2.6.2 The Activity of Calcifying Tissue

A storage depot for calcium in our body is called a calcified structure such as bone and tooth. While growing, the fluoride ion will goes into the crystalline structure of the calcified structure and because of that, it will retain more fluoride in the body. This is called an act of calcification. The tissue will bind the fluoride and retain it more than the ones that the calcification process is virtually finished. It have been proved in a study that animals as they grew older, they retained less fluoride than when the animals were young. About 36% of fluoride ingested will be absorbed into the skeleton for adult while for children, the degree of retention is much higher around 55% (Buzalaf & Whitford, 2011). This is due to richer blood supply and larger surface area of bone crystallites.

2.7 Health Effects of Fluorides

There are several health effects of fluoride and this includes dental fluorosis, skeletal fluorosis and lower IQ levels.

2.7.1 Dental Fluorosis

A long-term consumption of drinking water containing high fluoride concentration (more than 1 mg/L) could cause adverse health effects such as dental

fluorosis. Dental fluorosis can be produced by the absorption of excessive fluoride content during the formation of teeth. The crucial period for the formation of permanent teeth begins at start of birth until the age of 12-14 years old. By absorbing too much fluoride will impair the normal development of enamel in teeth and what is making it worse, the symptoms will not be seen until 4-5 years of exposure. The symptoms are like the formation of white streaks on the enamel surface, porous areas of the enamel and discolouration of the tooth surface (Wang et al., 2012).

2.7.2 Skeletal Fluorosis

Fluoride can diffuse into the mineral structure of the bones and if exposed to large amounts, it may lead to a weaker bone matrix. This disease only happen due to long-term exposure of high concentration of fluoride and may causes crippling effects. It can be considered as the immobilization of joints of the axial skeleton and of the major joints of the extremities. There is difficulty in bending, moving, walking and eventually the patient is crippled and incapacitated (Apurva et al., 2011). Also, in Europe, this disease can only be seen in workers that works in the mineral processing industries.

2.7.3 IQ Levels

High consumption of foods or drinks containing fluoride may give effects to lower IQ especially among school children. The fluoride may affect the brain cells that will end up make the IQ become lower. In a systematic review and meta-analysis conducted in 2013, it said that there are high possibility of adverse effect of high fluoride exposure to children cognitive functions (Anna et al., 2012).

CHAPTER 3

METHODOLOGY

3.1 Study Design

The study design for this study was a cross-sectional study where the variables was studied in a specific period of time.

3.2 Study Location

This study was conducted at a school in Wilayah Persekutuan Putrajaya. This was because we want to choose the population that receives water supply from Sungai Semenyih Water Treatment Plant.

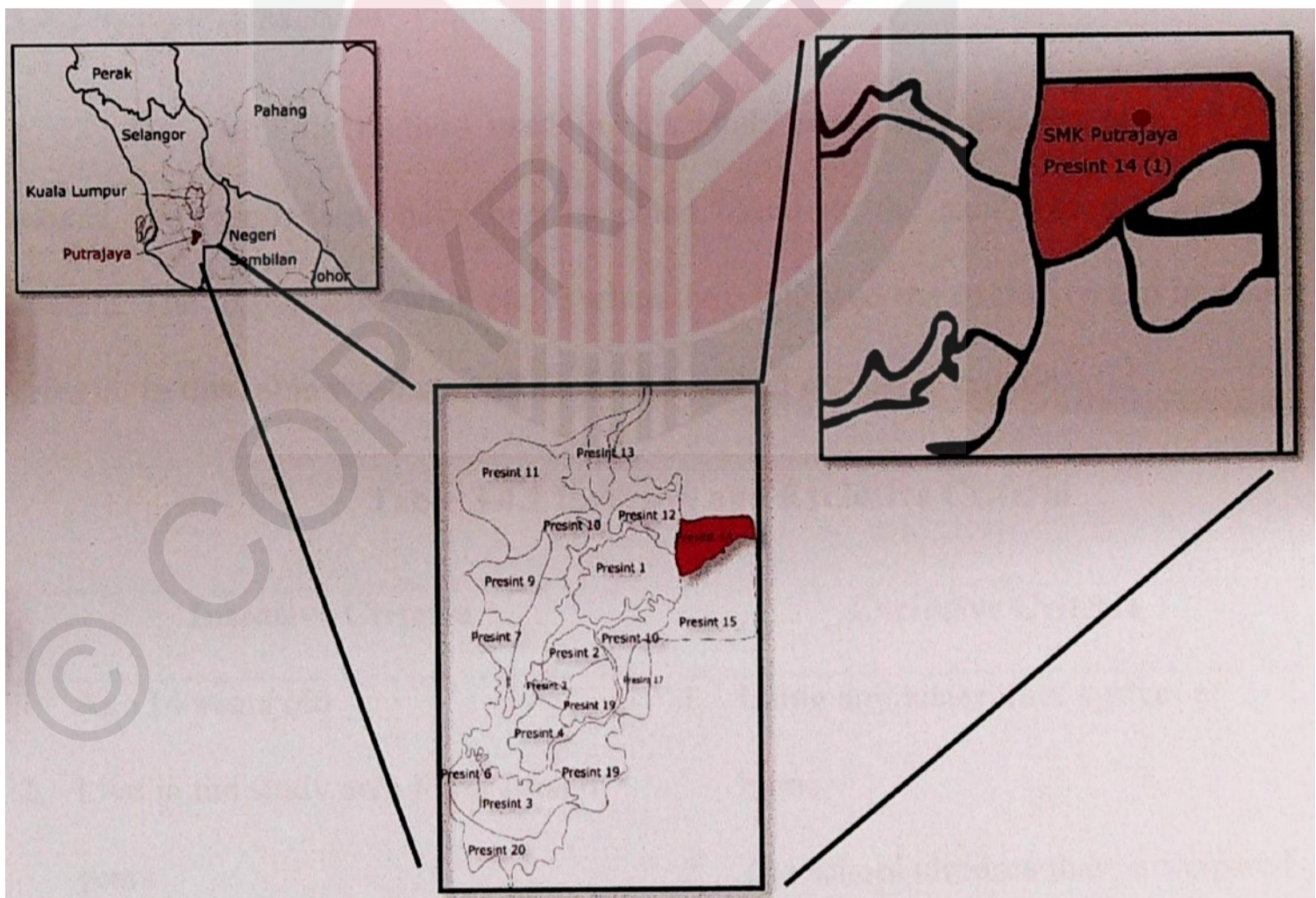


Figure 3.2: Map of Study Location

3.3 Study Population

The study population for this study was the student age 14 years old at the selected school.

3.4 Sampling

3.4.1 Sampling Frame

The study frame for this study were the name list of the student of the school. The name list of the Form 2 students were obtained from the Student Affairs Department. The student will be selected accordingly the exclusive and inclusive criteria.

3.4.2 Sampling Method

The sampling method used in this study was purposive sampling. Which means, the respondents have been selected based on the exclusive and inclusive criteria. The respondents were chose when they followed the exclusive and inclusive criteria. In this table was listed all the inclusive and exclusive criteria:

Table 3.4.2 Inclusive and Exclusive Criteria

Inclusive Criteria	Exclusive Criteria
1. Age 14 years old	1. Using any water filter system at
2. Live in the study area for at least 6 years	home.
3. Using tap water as a source of drinking water	2. The school children that participated during this study are relocated to a new place.
4. Free from any kidney disease	

Before any sample was taken from the students, parent's consent form will be passed to the students to get the parent's permission. If parents did not allow the students to join this study, the students were allowed to withdraw from the study.

3.4.3 Sampling Size

Formula used: 2 sample proportion (Lemeshow et al., 1990)

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

Where;

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

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

$$P_1 = \text{Proportion of fluoride in urine among males}$$

$$P_2 = \text{Proportion of fluoride in urine among females}$$

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

When;

$$P_1 = 0.86 \text{ (Kousik \& Naba, 2016)}$$

$$P_2 = 0.44 \text{ (Chen et al., 2013)}$$

$$n = \frac{\left\{ 1.96 \sqrt{2(0.675)(1-0.675)} + 1.28 \sqrt{0.86(1-0.86) + 0.44(1-0.44)} \right\}^2}{\{0.86 - 0.44\}^2}$$

$$n = 24.4$$

Based on the formula, 24 respondents are needed for one group. The number is increased by 10% to take account for missing respondents and errors. The number is 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 recruited in this study.

3.4.4 Study Instrumentation

For this study, there were 3 instruments used in order to get all the information needed. The instruments were questionnaire, sample of drinking water and urine sample.

3.4.4.1 Questionnaire

A set of questionnaire have been given to the respondents to obtain all the information needed. This questionnaire have been adopted from previous study (Solihin, 2017). The questionnaire consist of the socio-demographic data, socio-economic, health status and type of water supply usage. From this questionnaire, it showed that the respondents were complying the inclusive criteria.

3.4.4.2 Urine

All the respondents have been given a urine container bottle (50 ml) and it filled with the urine sample. The samples have been directly analysed within 24 hours after the collection using spectrophotometer DR1900. The sample of urine need to be taken for three consecutive days.

3.4.4.3 Drinking Water

Water samples have been collected from the tap from the respondent's house for about 250 ml HDPE bottle. The samples were taken for 3 consecutive days and was analysed using USEPA Method 8029 using SPADNS reagent solution. The samples have been directly analysed within 24 hours after the collection. The instrument used was the HACH brand direct reading spectrophotometer DR1900.

3.5 Equipment and Reagent

3.5.1 Questionnaire

The questionnaire have been used to gather information from the respondents such as their socio-demographic data, health status and the water supply types used at home.

3.5.2 Sample Bottle

The sample bottle have been used to collect the urine samples (50ml) and drinking water samples (250 ml).

3.5.3 Spectrophotometer

To determine the fluoride level in urine and drinking water.

3.6 Analysis of Fluoride

The method that have been used to analyse the level of fluoride in both drinking water and urine was USEPA method 8029. The SPADNS reagent solution method will also be used in this method. The step as below:

- I. Prepare blank: Pipette was used to add 10.0 mL of deionised water to the sample cell.
- II. Prepare sample: Pipette was used to add 10.0 mL of sample to the sample cell.
- III. Pipette was used to add 2.0 ml of SPADNS Reagent solution into each sale sample solution
- IV. Swirl to mix
- V. The instrument timer was started for one minute
- VI. When the timer expired, the blank sample cell was cleaned.
- VII. The blank was inserted into the cell holder
- VIII. Push ZERO. The displayed showed 0.00 mg/L F
- IX. The prepared sample cell was cleaned
- X. The sample prepare was inserted into the cell holder.
- XI Push READ. The result was shown in mg/L F. _____

3.7 Data Collection

The first steps was to get the letter of approval from the Ministry of Education Malaysia and State of Education Department Putrajaya. The approval letter have been forwarded to the headmaster of the selected school. Before the study was conducted, the students have been given a short briefing regarding the study, why the study was conducted, the objectives of it, benefits for the respondents and a consent form have been given to them to pass it to their parents. After received back the

approved consent form, a set of questionnaire have been distributed to all the respondents.

3.8 Data Collection Method

3.8.1 Questionnaire

Set of questionnaire have been distributed to the respondents. Questionnaire was used to collect information that was needed to assist this study such as

- I. socio-demographic data
- II. health status
- III. types of water supply used

The questionnaires have been given to the respondent before the collection of the sample (Urine sample and drinking water sample).

3.8.2 Sample Collection

Before any samples were taken from the respondents, a detail briefing regarding the study have been to all the chosen respondents. All the respondents must comply the inclusive and exclusive criteria of this study. The most important was, they must make sure at their home, there was no water filtration system used.

3.9 Data Analysis

After all the data have been collected, it will be analysed using the latest IBM SPSS (Statistical Package for the Social Sciences) version 22. Based on the objectives of this study, the type of analysis that have been used were listed bellows in Table 1.

Table 3.9: Type of Data Analysis

Objectives	Type of Analysis
To determine the urinary fluoride level in school children	Descriptive Analysis
To determine fluoride level in drinking water of school children	Descriptive Analysis
To compare the urinary fluoride level between gender.	Parametric: Independent T-test Non-Parametric: Mann Whitney U
To determine whether the level of fluoride in drinking water is differ from the standard by The National Standard for Drinking Water Quality (NSDWQ)	One Sample T-test
To determine whether the urinary fluoride level among secondary school children is differ from the standard by National Institute of Occupational Safety and Health (NIOSH)	One Sample T-test
To determine the association between fluoride in drinking water and urinary fluoride level among school children.	Parametric: Pearson Correlation Non-Parametric: Spearmen Correlation

3.10 Study Ethics

The proposal was submitted to the University Ethics Committee for Researchers Involving Human of Universiti Putra Malaysia. Before the respondents participate in this study, the permission in the written consent needed to be approved first by their parents. And all the privacy of information and confidentiality was protected.

3.11 Ethical Consideration

Approval from Medical Research Committee, Faculty of Medicine and Health Science, University Putra Malaysia was obtained.

- I. The respondents was given some explanation about the whole of the study activities involved.
- II. The respondents were given a detailed briefing about the methodology that involve in term of the purpose of the assessment, the procedure taken, and also respondents' right in this study.
- III. Approval from Ministry of Education were given to school to obtain the consent of the resident involved in this study.

Approval letter were given to the respondents to get their consent to be participant in this study

3.12 Study Limitation

The information given by respondents could not be verified to be 100 % true. In term of this limitation, we assumed the answer and the data given met validity. Recall bias can contribute to this study. The minimum requirement for number of sample size

was unable to achieve due to there were more students that have water filter system at home.



CHAPTER 4

RESULT AND DATA ANALYSIS

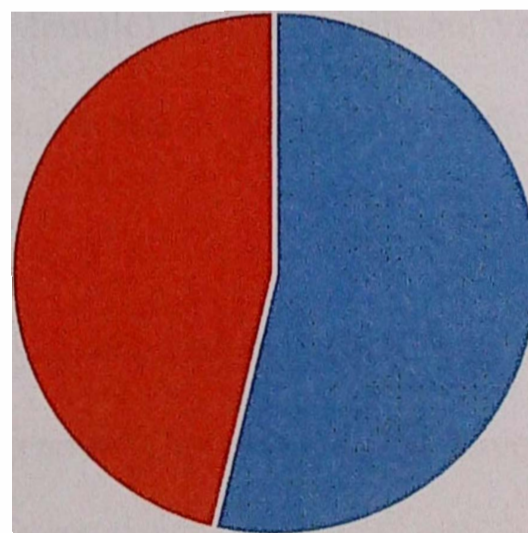
4.1 Socio Demographic Data

This study was conducted on 5th February 2018 until 8th February 2018 at Sekolah Menengah Kebangsaan Putrajaya Presint 14 (1). In Table 4.1 below, this study involved 67 respondents and all of them were Form 2 students (14 years old). Out of this, 36 (53.7%) were male and 31 (46.7%) were female.

Table 4.1 Distribution of respondents by gender

N = 67			
Variable		Frequency	Percentage (%)
Gender	Male	36	53.7
	Female	31	46.3

No. of Respondents



■ Male ■ Female

Figure 4.1 Distribution of respondents by gender

4.2 Fluoride in Drinking Water and Urine

The parameters that were measured in this study were fluoride in drinking water and urine. Based on Table 4.2, the reading ranged was between 0.15 – 0.71 mg/L with a mean of 0.423 and the standard deviation was ± 0.114 . For level of fluoride in urine, the reading ranged from 1.18 – 2.23 mg/L. The mean was 1.626 with standard deviation of ± 0.222 .

Table 4.2: Fluoride Level in Drinking Water and Urine

N = 67			
Parameters	Range	Mean (mg/L)	SD (\pm)
Fluoride in drinking water	0.15 – 0.71	0.423	0.114
Urinary fluoride	1.18 – 2.23	1.626	0.222

4.3 Comparison of Level of Urinary Fluoride between Gender

For this objective, the statistical analysis used were the Independent Sample T Test. This test was used to determine the significant difference in urinary fluoride between gender (male and female). If the significant value of T-test (p-value) was less than the significance value which was set to 0.05, $p < 0.05$, the null hypothesis was rejected.

In Table 4.3 below, it showed that there was no significant difference in urinary fluoride between gender. The p-value that have been obtained for this test was 0.331, thus larger than 0.05.

Table 4.3 Comparison Between Mean Urinary Fluoride Levels Between Gender

Variables	Mean (SD)		Mean difference (95% CI)	t-statistic (df)	p-value
	Male	Female			
Urinary Fluoride Level	1.651 (0.224)	1.598 (0.219)	0.0533 (-0.055, 0.162)	0.979 (65)	0.331

4.4 Comparison of Level of Fluoride in Drinking Water with National Standard for Drinking Water Quality (NSDWQ)

Based on the standard for fluoride in drinking water by National Standard for Drinking Water Quality (NSDWQ), it should be between 0.4 – 0.6 mg/L. Thus, in order to compare the level of fluoride with this standard, the statistical analysis called One-Sample T-test was used. Because there were two value in this range of standards, the lowest and highest range were taken as the known value.

In Table 4.4.1 below, it showed the comparison of level of fluoride in drinking water with the standard of 0.4 mg/L. There was no significant difference between the level of fluoride in drinking water and the standard. The p-value for this test is 0.097, which was larger than 0.05.

Table 4.4.1 Level of Fluoride in Drinking Water with NSDWQ Standards (0.4 mg/L)

Variables	Mean (SD)	Mean difference (95% CI)	t-statistic (df)	p-value

In Table 4.4.1 below, it showed the comparison of level of fluoride in drinking water with the standard of 0.6 mg/L. There was a significant difference between the level of fluoride in drinking water and the standards. The p-value for this test was <0.001, which was lower than 0.05.

Table 4.4.2 Level of Fluoride in Drinking Water with NSDWQ Standards (0.6 mg/L)

Variables	Mean (SD)	Mean difference (95% CI)	t-statistic (df)	p-value
Fluoride in Drinking Water	0.423 (0.114)	-0.1764 (-0.2044, -0.1485)	-12.601 (66)	<0.001

4.5 Comparison of Level of Fluoride in Urine with National Institute of Occupational Safety and Health (NIOSH) Standard

Based on the standard for level of fluoride in urine by National Institute of Occupational Safety and Health, it should be between 0.2 – 3.2 mg/L. Thus, in order to compare the level of fluoride with this standards, the statistical analysis called One-Sample T-test was being used. Because of there is two value in this range of standards, the lowest and highest range were taken as the known value.

In Table 4.5.1 below, it showed the comparison of level of fluoride urine with the standard of 0.2 mg/L. There was a significant difference between the level of fluoride in urine and the standards. The p-value for this test was <0.001, which was lower than 0.05.

Table 4.5.1 Level of Fluoride in Urine with NIOSH Standard (0.2 mg/L)

Variables	Mean (SD)	Mean difference (95% CI)	t-statistic (df)	p-value
Fluoride in Urine	1.626 (0.222)	1.426 (1.372, 1.480)	52.553 (66)	<0.001

In Table 4.5.2 below, it showed the comparison of level of fluoride in urine with the standard of 3.2 mg/L. There was a significant difference between the level of fluoride in urine and the standards. The p-value for this test was <0.001, which was lower than 0.05.

Table 4.5.2 Level of Fluoride in Urine with NIOSH Standards (3.2 mg/L)

Variables	Mean (SD)	Mean difference (95% CI)	t-statistic (df)	p-value
Fluoride in Urine	1.626 (0.222)	-1.573 (-1.627, -1.519)	-57.952 (66)	<0.001

4.6 Relationship between Level of Fluoride in Drinking Water and Urinary Fluoride Level

Since both of the variables, which were the level of fluoride in drinking water and urinary fluoride were normally distributed, the Pearson Correlation Test was selected in order to find the association between these two variables.

The null hypothesis will be rejected when the p-value is less than the significance level which is 0.05 ($p \leq 0.05$). In Table 4.6 below, the significant value

indicate in this study is $p=0.796$ ($p>0.05$) and the null hypothesis was failed to be rejected. This concluded that there was no significant relationship between level of fluoride in drinking water and urinary fluoride.

Table 4.6 Correlation between Level of Fluoride in Drinking Water and Urinary fluoride

	Urinary fluoride	
	Coefficient correlation, r	p-value
Level of Fluoride in Drinking Water	-0.032	0.796

CHAPTER 5

DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

5.1 DISCUSSION

5.1.1 Socio-Demography Background

This study was conducted at Sekolah Menengah Kebangsaan Putrajaya Presint 14 (1) involving 67 school children. All of the respondents were selected based on the inclusive and exclusion criteria that have been stated before. This includes, 14 years old secondary school children, free from any kidney disease and did not use any water filtration system at home.

The inclusive and exclusive criteria were followed when choosing the respondents were in order to minimize the confounding factor and bias. For example, there were several brands of water filter system that able to filter out fluoride from water (Hobson et al., 2007). Thus, in order to investigate the direct exposure of fluoride in drinking water to human, the respondents that used any water filter system at home had to be excluded from this study.

Urinary fluoride have been chosen as an indicator for level of fluoride in the body because it can be considered as the most important metabolic pathway for fluoride elimination from body (Villa et al., 2010). From the level of fluoride in the urine, we were able to determine the level of fluoride in the body.

5.1.2 Level of Fluoride in Drinking Water and Urinary Fluoride

The general objectives in this study were to determine the level of fluoride in drinking water and urinary fluoride among secondary school children. The mean obtained from the level of fluoride in drinking water was 0.423 with standard deviation of ± 0.114 . The highest reading for fluoride in drinking water was 0.71 mg/L and the lowest was 0.15 mg/L. In a study conducted in 2016, where it includes 12 – 14 year old students from Haji Abad, Iran, the mean concentration of fluoride in drinking water was 0.82 mg/L (Dindarloo et al., 2016). It has been proved that drinking water can be considered as one of the sources of fluoride for children. Small concentrations of fluoride are required for natural mineralization of bones and formation of tooth enamel. However, excessive concentrations may be hazardous which result in dental and skeletal fluorosis.

Next, for the urinary fluoride, the mean obtained was 1.626 with standard deviation of ± 0.222 . The highest reading obtained was 2.23 mg/L and the lowest was 1.18 mg/L. These findings are similar with a study that was conducted in India in 2016, where the mean fluoride levels in urine were 0.86 mg/L (Kousik & Naba, 2016). About 80% of fluoride ingested will be excreted mainly through urine, whereas the remainder will be absorbed into body tissue. A study conducted in San Luis Potosi, Mexico that chose 180 school children as respondents. This study was about the association between urine fluoride and dental fluorosis. The researcher concluded that the range of fluoride in urine was 1.1 to 5.9 mg/L, with a mean of 3.14 ± 1.09 mg/L (Lizet et al., 2015). The reasons why the fluoride levels in urine were quite high were because of the community in that area receiving drinking water that had 4.13 mg/L of fluoride levels in it.

5.1.3 Comparison of Level of Urinary Fluoride between Gender

In this part, the level of fluoride in urine between gender was analysed and compared. Based on the statistical analysis that have been conducted, there was no significant difference between male and female urinary fluoride levels. Thus, it failed to reject the null hypothesis. The Thar Desert areas of Sindh province in Pakistan are one of the area of the fluorosis is endemic and the groundwater contains fluoride that can go until 9.76 mg/L. The average values of urinary fluoride for residents in this places are higher from any other parts of the world. Even though, it shows that the urinary fluoride levels of female has slightly higher than male but still, there was no significant difference in fluoride levels of serum, urine and plasma between gender (Rafique et al., 2015). In another study conducted in Texas showed that there was no significant difference when compares between male and females. This study includes respondents from age 0 – 19 years old that lived in sub-optimal, optimal and above-optimal fluoridated area (Natalie, Thomas, & John, 2016).

5.1.4 Comparison of Level of Fluoride in Drinking Water with National Standard for Drinking Water Quality (NSDWQ)

Based on the data analysis, 36 samples (53.73%) had the optimal range of fluoride in drinking water which was between 0.4 – 0.6 mg/L. About 5 samples (7.46%) exceed the maximum allowable range of fluoride which is more than 0.6 mg/L, while 26 samples (38.8%) were lower than minimum allowable range of fluoride which is less than 0.4 mg/L. Figure 5.1.4 showed the graph of level of fluoride in drinking water of respondents.

When One Sample T-test was conducted using 0.4 mg/L as known value, the p-value obtained was 0.097 (>0.05), thus there was no significant difference between level of fluoride in drinking water with National Standard for Drinking Water Quality (NSDWQ). When using 0.6 mg/L as known value, the p-value obtained was <0.001 , thus there was a significant difference between level of fluoride in drinking water with National Standard for Drinking Water Quality (NSDWQ). This happens because most of the samples had the concentration of fluoride in it which was nearer to 0.4 mg/L than 0.6 mg/L.

In a study conducted on 2010 in Malaysia shows that Seri Serdang has the highest mean fluoride levels, at 0.71 mg/L while Kota Kinabalu has the lowest mean fluoride levels, at 0.08 mg/L. This is because of the non-fluoridation of drinking water in Sabah (Shaharuddin et al., 2010). Another study conducted on 2013 in Selangor, Malaysia which showed that the fluoride levels in unfiltered tap water was 0.541 mg/L (Tan & Razak, 2013).

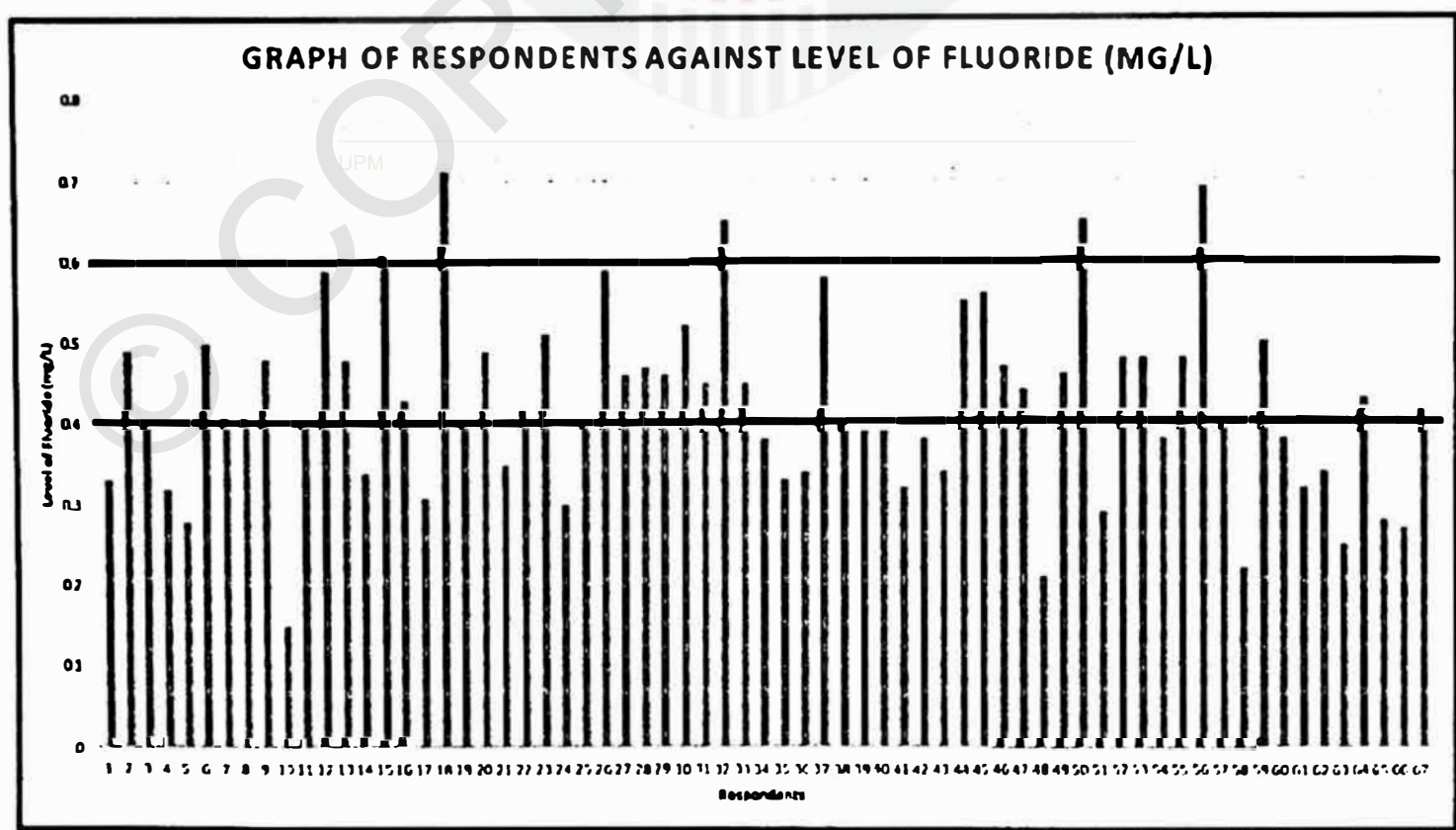


Figure 5.1.4: Graph of Respondents Against Level Of Fluoride in Drinking Water

5.1.5 Comparison of Level of Fluoride in Urine with National Institute of Occupational Safety and Health (NIOSH) Standard

Based on the data analysis, all 67 samples had the optimal range of fluoride in urine which was between 0.2 – 3.2 mg/L. When comparing the level of fluoride in urine with NIOSH standard (0.2 mg/L), the p-value obtained was <0.001 , thus there was a significant difference between level of fluoride in urine with (NIOSH) standard. Next, when compared with 3.2 mg/L, the p-value obtained was <0.001 , thus there was a significant difference. From this data, it showed that all of the samples were not drawn towards 0.2 mg/L and 3.2 mg/L. All of them were in the middle range between 1.18 – 2.23 mg/L. Figure 5.1.5 showed the graph of level of fluoride in urine of respondents.

Based on a study conducted in China on 2016, it showed that the mean fluoride levels in urine of children were 1.39 mg/L for village Warmiao and 1.30 mg/L for village Xinhuai. This is due to the higher concentration of fluoride in drinking water at village Warmiao than village Xinhuai (Xiang et al., 2016). In a study conducted in Mexico, the mean concentration of fluoride in urine for children was 0.82 mg/L. There were several exposure to fluoride and this includes, fluoridated drinking water, dental products and dietary sources (Morteza et al., 2017).

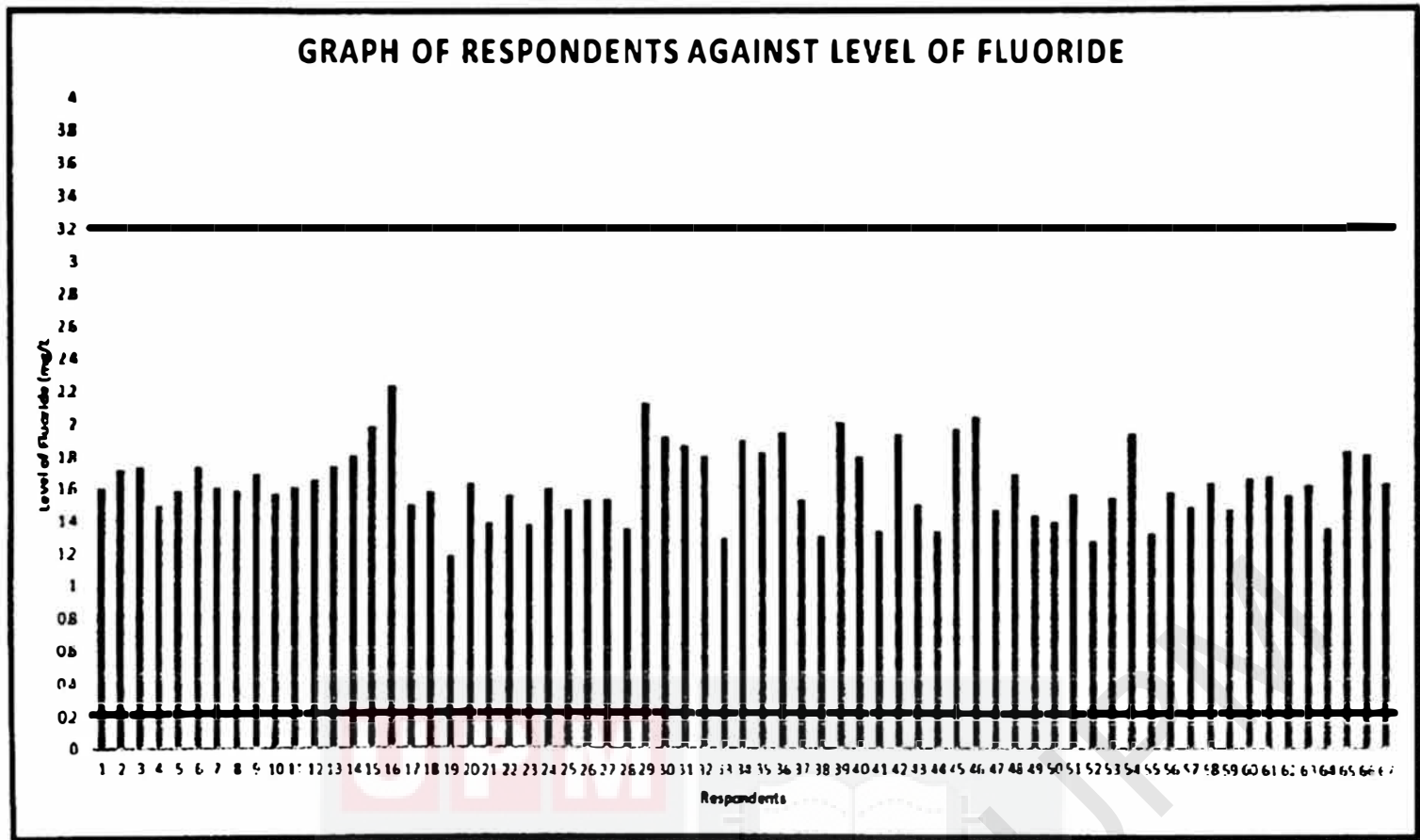


Figure 5.1.5: Graph of Respondents Against Level Of Fluoride In Urine

5.1.6 Relationship between Level of Fluoride in Drinking Water and Urinary Fluoride Level

The statistical analysis used in this study was Pearson Correlation test. Since the p-value obtained was $p=0.796$ ($p>0.05$), there was no significant association between the level of fluoride in drinking water and urinary fluoride. The null hypothesis failed to reject. This findings was consistent with a study conducted in San Luis Potosi. The aim of this study is to study urinary fluoride concentration as a toxicity factor in a rural community (Lizet et al., 2015). In this study location, 83.8% of the population used tap water for drinking and 100% used it for cooking. The average fluoride concentration in drinking water was 4.54 mg/L while in urine was 3.14 mg/L. The researcher concluded that, children has higher urinary fluoride because of longer exposure time and the cumulative effect of fluoride stored in bones

and teeth. Also, there were other resources such as tea, foodstuff and toothpaste can be considered as the most important sources of high fluoride doses

Besides, a study conducted in China on 2015 showed that there was also no significant association between fluoride in urine and in drinking water. In this study, 51 first-grade children aged 6 to 8 years old that lived in Mianning County were being chosen as respondents. This study wanted to study the association of fluoride exposure and cognitive functions. When comparing the level of fluoride in urine and water, there were not significant relationship. They also concluded that the children's urinary fluoride levels may also be affected by the amount of water that the children drank (Anna et al., 2015). In an article written by Ghosh et al. (2013), it said that highest level of fluoride in water were in the groundwater and not in tap water. The respondents in our study only used tap water as source of drinking, thus it may affected the urinary fluoride levels. Others sources of fluoride that may affect the urinary fluoride levels were from therapeutic fluoride products. This includes, dentifrice, fluoride supplements and fluoride mouth rinses. Fluoridated dentifrices have been considered as a risk factor for the development of dental fluorosis (Karina et al., 2016)

5.2 CONCLUSION

This study found that the level of fluoride in drinking water for area of Putrajaya, Presint 14 was still in optimal range but the authorities should monitored it regularly because there were some readings that lower or higher than the standard. All of the urine samples were in the optimal range as recommended by NIOSH. Next, the level of fluoride in urine was not differ between gender. Besides, this study

concluded that level of fluoride in drinking water did not contributed to the level of fluoride in urine. There were other sources of fluoride such as fluoride dentifrice, mouth rinses, foodstuff and tea that were not taking into account in this study. This is because this study focuses on the fluoride exposure through drinking water only.

5.3 RECOMMENDATION

Firstly, the study should be conducted in wider area and not just focus in one area or district. The data obtained can be compared between places and can be used to update available data. Other factor that may affect the level of fluoride in body such as dietary intake and use of fluoride supplements should be also considered.

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**Appendix 1
Informed Consent Form**

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UNIVERSITI PUTRA MALAYSIA

**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

Satu kajian terhadap hubungan di antara kandungan fluorida di dalam air minum dan air kencing dalam kalangan pelajar sekolah menengah di Putrajaya.

2. PENGENALAN

Saya ingin menjemput anda untuk terlibat dalam satu uji kaji berkenaan hubungan kandungan fluorida di dalam air minum dan air kencing. Sebelum anda mengambil keputusan untuk terlibat dalam uji kaji ini, adalah amat penting bagi anda untuk memahami tujuan uji kaji ini dijalankan. Malaysia telah mengamalkan proses fluoridasi air sejak tahun 1972 lagi. Oleh yang demikian, semasa proses rawatan air dijalankan, fluorida akan ditambah pada langkah yang terakhir. Salah satu sebab mengapa fluorida ditambah ke dalam bekalan air awam adalah kerana untuk mencegah penyakit pereputan gigi. Kajian ini akan mengenal pasti kandungan fluorida di dalam air minum untuk mengetahui kandungan fluorida berada di dalam kandungan yang selamat mahupun tidak. Ia juga untuk mengenal pasti samada penduduk yang menggunakan air minum yang mempunyai fluorida ini terdedah kepada pereputan gigi ataupun tidak.

3. APAKAH YANG PERLU ANDA LAKUKAN?

Sekiranya anda bersetuju untuk terlibat dalam kajian ini, saya akan meminta anda untuk menyiapkan borang kaji selidik yang disertakan bersama helaian ini. Responden yang berumur 13 hingga 17 tahun, tinggal di dalam kawasan kajian sekurang-kurangnya 6 tahun dan menggunakan hanya air paip sebagai punca air minum akan dipilih untuk menyertai kajian ini. Borang kaji selidik ini perlu diisi dengan maklumat seperti maklumat diri, maklumat penggunaan air paip, dan maklumat kesihatan. Kesemua maklumat akan diisi sendiri oleh responden. Setelah mengisi borang kaji selidik tersebut, saya akan memberikan kepada anda dua botol sampel untuk anda mengisi sampel air kencing dan sampel air paip daripada rumah anda. Sampel tersebut perlu di ambil selama tiga hari berturut-turut. Setelah saya mengutip kesemua sampel air kencing dan air paip tersebut, saya akan membawa sampel tersebut ke makmal untuk menganalisis kandungan fluorida dalam kedua-dua sampel tersebut. Walaubagaimanapun, penyertaan dalam kajian ini adalah secara sukarela. Penarikan diri daripada kajian ini tidak akan dikenakan sebarang penalti.

4. SIAPA YANG TIDAK BOLEH MENYERTAI KAJIAN INI?

Responden tidak akan dipilih berdasarkan kriteria berikut:

- i. Mempunyai sebarang masalah berkaitan buah pinggang
- ii. Responden ada menggunakan alat penapis air di rumah

5. APAKAH FAEDAH MENYERTAI KAJIAN INI?

a) KEPADA ANDA SEBAGAI PESERTA?

Kajian ini akan memberi maklumat mengenai tahap fluorida di dalam badan anda. Selain itu, kajian ini juga menganalisis samada terdapat kandungan fluorida berlebihan apabila anda menggunakan air paip sebagai punca air minum dan bagaimana ia memberi impak kepada kesihatan anda.

b) KEPADA PENYELIDIK?

Dengan penyertaan anda dalam kajian ini, anda akan membantu saya untuk lebih memahami hubungan diantara kandungan fluorida di dalam air minum dan air kencing di kalangan pelajar sekolah menengah.

6. ADAKAH IA BERISIKO?

Sebelum anda menyertai kajian, adalah penting untuk anda tahu bahawa responden yang mempunyai sebarang masalah berkaitan buah pinggang adalah tidak digalakkan untuk menyertai kajian ini. Ini adalah kerana, ia akan mengganggu dapatan kajian ini. Saya hanya akan menganalisis kandungan fluorida di dalam air minum dan air kencing sahaja, tiada risiko akan terjadi terhadap responden.

7. ADAKAH MAKLUMAT DAN IDENTITI SAYA KEKAL RAHSIA?

Ya, segala maklumat dan identiti responden akan dirahsiakan dan tidak akan disebarikan melalui apa-apa cara sekalipun dan hanya digunakan untuk tujuan kajian sahaja.

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

Responden haruslah memahami setiap maklumat di dalam borang ini sebelum bersetuju untuk menyertai kajian ini. Sekiranya anda mempunyai apa-apa soalan tambahan atau masalah yang berkaitan semasa mengikuti penyelidikan ini, anda boleh hubungi:

Muhammad Izzad Syafiq bin Mohd Fauzi

Pelajar Pasca Siswazah Bac. Sains (Kesihatan Persekitaran dan Pekerjaan)

Fakulti Perubatan dan Sains Kesihatan

Universiti Putra Malaysia

Tel: 019-5465938

Email: izzadsyafiq95@gmail.com

Dr. Shahrudin Mohd Sham (Supervisor)

Jabatan Sains Kesihatan Persekitaran dan Pekerjaan

Fakulti Perubatan dan Sains Kesihatan

Universiti Putra Malaysia

Tel: + 603-8947 2407

Email: shaha@upm.edu.my

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.

Saya bersetuju/tidak bersetuju untuk imej/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:

.....

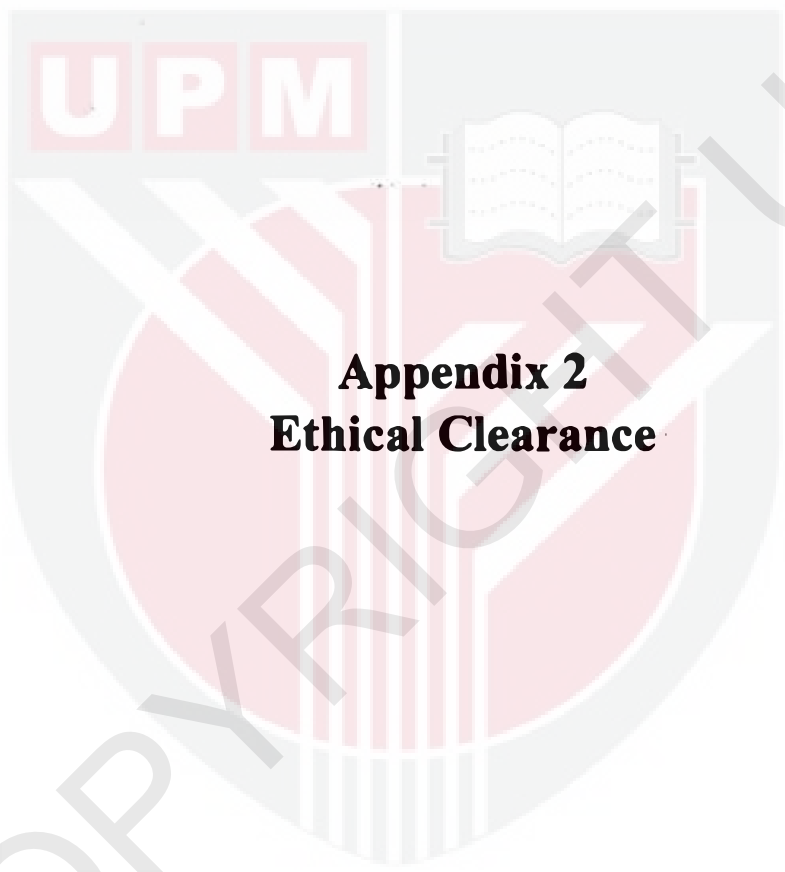
Saya mengesahkan bahawa saya telah menerangkan kepada responden ini sifat dan tujuan penyelidikan yang tersebut di atas.

Tarikh

Tandatangan

.....

(Penyelidik)



Appendix 2
Ethical Clearance

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

Research title	: A Cross-Sectional Study on Fluoride in Drinking Water and Urine Among Secondary School Children in Putrajaya, Selangor
Study Site	: Putrajaya , Selangor
JKEUPM Ref No.	: JKEUPM-2017-194
Researcher	: Muhammad Izzad Syafiq bin Mohd Fauzi
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 2 dated 21/11/2017
3. Respondent Information Sheet & Guardian's/Parent's Consent (Malay), Version 2 dated 21/11/2017
4. Respondent Information Sheet & Consent (English), Version 2 dated 21/11/2017
5. Respondent Information Sheet & Consent (Malay), Version 2 dated 21/11/2017
6. Proposal (English), Version 3 dated 14/3/2018
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:

Approved

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

Disapproved

Please note that the approval is **VALID UNTIL 14 MARCH 2019**



Appendix 3
Approval Letter from Ministry of Education

1/1/2024

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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(66)
Tarikh : 28 Disember 2017

MUHAMMAD IZZAD SYAFIQ BIN MOHD FAUZI
NO. KP : 951030085433

C37, JALAN A5, BUKIT BAYU, SUNGAI LALANG, 08000 SUNGAI PETANI, KEDAH
8000 SUNGAI PETANI
KEDAH

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.

" SATU KAJIAN TERHADAP HUBUNGAN DI ANTARA KANDUNGAN FLUORIDA DI DALAM AIR MINUM DAN AIR KENCING DALAM KALANGAN PELAJAR SEKOLAH MENENGAH DI PUTRAJAYA, 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 **1 Januari 2018** hingga **1 Jun 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:-

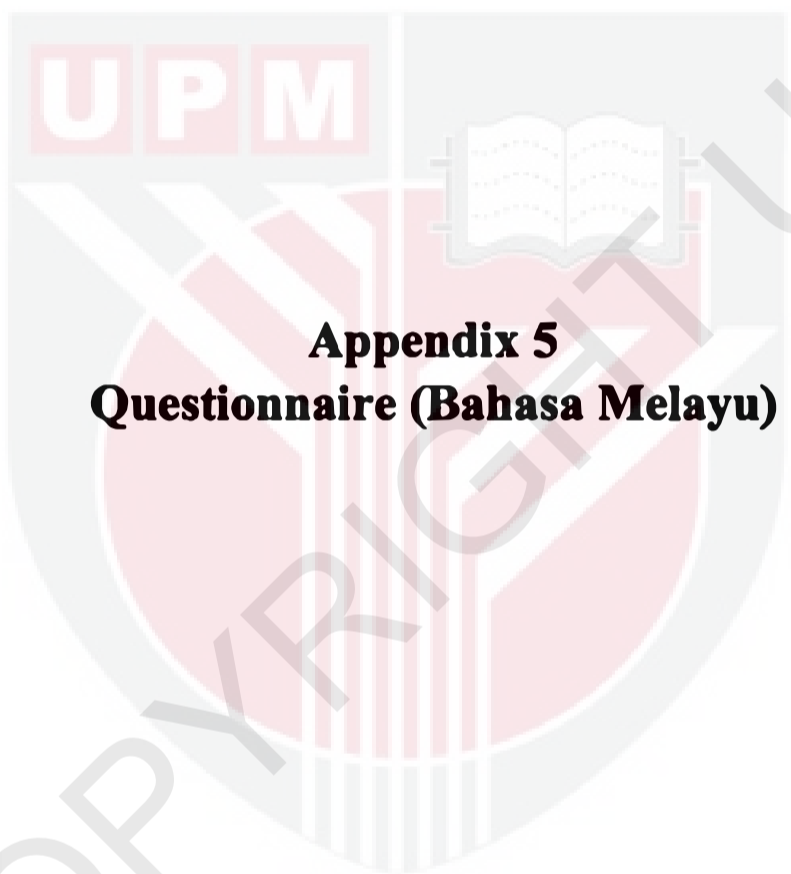
JABATAN PENDIDIKAN WILAYAH PERSEKUTUAN PUTRAJAYA

The logo of Universiti Putra Malaysia (UPM) is a shield-shaped emblem. It features a red and white design with a book in the center, a banner at the top with the letters 'UPM', and a base with vertical stripes. A large, faint watermark of the logo and the text 'COPYRIGHT UPM' is overlaid diagonally across the page.

Appendix 4
Approval Letter from Jabatan Pendidikan Wilayah Persekutuan
Putrajaya



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Appendix 5
Questionnaire (Bahasa Melayu)



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UNIVERSITI PUTRA MALAYSIA
BERILMU BERBAKTI

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

**A CROSS-SECTIONAL STUDY ON FLUORIDE IN DRINKING WATER AND
URINE AMONG SECONDARY SCHOOL CHILDREN IN PUTRAJAYA,
SELANGOR**

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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-