UNIVERSITI PUTRA MALAYSIA

URINARY FLUORIDE AND ITS RELATIONSHIP WITH FLUORIDE IN DRINKING WATER AMONG SCHOOL CHILDREN IN HULU LANGAT, SELANGOR

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URINARY FLUORIDE AND ITS RELATIONSHIP WITH FLUORIDE IN DRINKING WATER AMONG SCHOOL CHILDREN IN HULU LANGAT, SELANGOR

BY

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Thesis submitted in fulfillment of the requirement for the degree of Bachelor Science (Environmental and Occupational Health) from the Faculty of Medicine and Health Sciences, Universiti Putra Malaysia

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ABSTRACT

URINARY FLUORIDE AND ITS RELATIONSHIP WITH FLUORIDE IN DRINKING WATER AMONG SCHOOL CHILDREN IN HULU LANGAT, SELANGOR

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Objective: This study was undertaken to determine the relationship between fluoride in drinking water and urinary fluoride among school children in Hulu Langat, Selangor. Levels of urinary fluoride between male and female respondents were also compared. Besides, fluoride level in drinking water and urine were compared with the allowable standard. **Method**: Using purposive sampling technique, a total of 46 school children from Sekolah Menengah Kebangsaan Dusun Nanding, Hulu Langat aged 14 years were chosen as respondents. Questionnaires were administered while consent forms were given to both respondents and their parents. Drinking water and urine samples were collected using pre-cleaned high density polyethylene (HDPE) and plastic bottles, respectively, for two consecutive days. Both samples were analysed using a HACH brand direct reading spectrophotometer model DR/1900 and SPADNS reagent was used to detect fluoride. **Result:** A positive correlation ($p < 0.05$) was found between fluoride in drinking water and urinary fluoride. However, there was no significant difference of urinary fluoride levels ($p > 0.05$) between male and female respondents. Fluoride in drinking water and urine both showed significant difference when compared with standard, NDWQS and NIOSH method 8308, respectively. **Conclusion**: Fluoride in drinking water contributed to urinary fluoride among school children in Hulu Langat. However, urinary fluoride levels showed no difference between male and female respondents. Fluoride in drinking water and urine were also found within range allowable by standard.

Keywords: *Fluoride, drinking water, urinary fluoride, school children, Hulu Langat*

ABSTRAK

FLORIDA DALAM AIR KENCING DAN HUBUNGANNYA DENGAN FLORIDA DALAM AIR MINUM DIKALANGAN PELAJAR SEKOLAH DI HULU LANGAT, SELANGOR

NURHANIS BINTI ZAINAL

Objektif: Kajian ini dijalankan bertujuan untuk menentukan hubungan antara florida dalam air minum dan air kencing dikalangan pelajar sekolah di Hulu Langat, Selangor. Tahap florida dalam air kencing antara responden lelaki dan perempuan juga dibandingkan. Selain itu, tahap florida dalam air minum dan air kencing dibandingkan dengan piawai yang dibenarkan. **Method**: Pelajar sekolah daripada Sekolah Menengah Kebangsaan Dusun Nanding berumur 14 tahun sebanyak 46 orang dipilih sebagai responden menggunakan teknik persampelan secara sengaja. Borang soal selidik telah diedarkan manakala borang persetujuan untuk penyertaan diedarkan kepada kedua-dua responden dan penjaga. Sampel air minum dikumpul menggunakan botol polietilena yang mempunyai ketumpatan yang tinggi dan sampel air kencing menggunakan botol plastik sebanyak dua hari berturut-turut. Kedua-dua sampel dianalisis menggunakan spektrofotometer bacaan langsung model DR/1900 berjenama HACH dan reagen SPADNS digunakan untuk mengesan florida. **Keputusan**: Keputusan menunjukkan korelasi positif ($p < 0.05$) antara florida dalam air minum dan air kencing. Walaubagaimanapun, tahap florida dalam air kencing tidak menunjukkan perbezaan yang ketara ($p > 0.05$) antara responden lelaki dan perempuan. Selain itu, florida dalam air minum and air kencing menunjukkan perbezaan yang ketara apabila dibandingkan dengan piawai masing-masing iaitu NDWQS dan NIOSH kaedah 8308. **Konklusi**: Florida dalam air minum menyumbang kepada tahap florida dalam air kencing diantara pelajar sekolah di Hulu Langat. Walaubagaimanapun, tahap florida dalam air kencing tidak menunjukkan perbezaan antara responden lelaki dan perempuan dimana jantina tidak memberi kesan kepada tahap florida dalam air kencing. Florida dalam air minum dan air kencing juga menunjukkan konsentrasi yang dibenarkan oleh piawai masing-masing.

Kata Kunci: *Florida, air minum, florida dalam air kencing, pelajar sekolah, Hulu Langat*

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LIST OF ABBREVIATIONS

NDWQS	National Drinking Water Quality Standard, Malaysia
WHO	World Health Organization
MOH	Ministry of Health, Malaysia
MOE	Ministry of Education, Malaysia
NIOSH	National Institute of Occupational Safety and Health
ADHD	Attention Deficit Hyperactive Disorder
EDTA	Ethylenediaminetetraacetic acid
USA	United States of America
HF	Hydrogen Fluoride
pH	Potential of Hydrogen
IQ	Intelligent Quotient
HDPE	High Density Polyethylene Bottle
USEPA	United States Environmental Protection Agency
SPSS	Statistical Package for Social Sciences

CHAPTER 1

INTRODUCTION

1.1 Research Background

Clean drinking water is important for everyone in this world. Water has been one of the most important element which is needed every single day in each lives. However, insufficient amount of water and the uncertainty of its cleanliness becomes harder for everyone to consume clean drinking water. Water fluoridation in Malaysia which has been accepted as one of government policy in 1972 (Rahim et al., 2014), has been shown to cause significant effects in people (Armfield, 2010). For example, fluoride is effective in reducing tooth decay if taken in optimum level (Rahim et al., 2014) especially among children. Fluoride is also beneficial towards older people where it is able to reduce hardening of arteries and stimulates bones formation as for osteoporosis treatment.

Fluoride is an essential element to human health (Wang et al., 2009). Its effectiveness on health is extensively studied where it is important for bone and teeth development (Karro et al., 2006). However, in the presence of excess fluoride may as well lead to fluorosis which also reduce the quality of human health. In India, fluoride is endemic in approximately 37 000 habitations and people from more than 35 nations across the globe are in the risk of fluoride attack (Gupta and Ayoob, 2006). Thus, fluoride level in water supplies for public need to be monitored and ensured the level consistency in order to minimize adverse health effects (Malaysian Dental Council, 2009).

Water fluoridation is a process where controlled amount of fluoride is added into water containing insufficient amount of naturally-occurring fluoride. This addition is widely known to be able to reduce decayed, missing and filled teeth especially among children (British Fluoridation Society, 2012). This process is also an intervention where it can benefit public health at the population level which involved adjusting fluoride level in public water supplies (Rugg-Gunn et al., 2016).

According to National Drinking Water Quality Standard (NDWQS) (MOH, 2010) fluoride safe level is between 0.4-0.6 mg/L. Besides, World Health Organization (WHO, 2006) also suggests maximum recommended fluoride level is 1.5 mg/L depending on climates. In Malaysia, there are around 20 million of people drinking artificially fluoridated water which makes up 75% of population (British Fluoridation Society, 2012). This have showed fluoridation is important in ensuring drinking water for public uses is in good quality.

1.2 Problem Statement

Fluoride beneficial and detrimental effects has been known since early 1940s (WHO, 2006). Low and high levels of fluoride in drinking water pose risk for human health (Abuzeid and Elhatow, 2007). Fluoride decontaminates water as it kills various bacteria which may be present there (Bashir et al., 2013) as well as helps in preventing dental caries and strengthen bones with low fluoride intake in diet. Meanwhile, high level of fluoride with chronic ingestion can cause several adverse health effects such as skeletal fluorosis, increased rates of kidney stones and lower intelligence in children (Chen et al., 2013).

A study from India reported that excessive intake of fluoride can lead to harmful effects on the developing brain. The results obtained showed lower IQ among children who have been exposed to groundwater with high fluoride in their villages (Trivedi et al., 2012). Potential effects on the neurodevelopment in children also have been explored mainly in China where many urban and rural communities are located in endemic fluorosis areas (Choi et al., 2015). Children are in higher risk compared to adults as 50% of ingested fluoride is deposited in children's bone and teeth while adults only take up to 10%. Parents of children in United States reported their child with higher rates of medically-diagnosed ADHD (Attention-Deficit Hyperactivity Disorder) in which a greater proportion of people receive fluoridated water from public water supplies (Malin and Till, 2015).

The purpose of this study is to determine concentration of fluoride in urine and its relationship with fluoride in drinking water among school children in Hulu Langat where they are seen as the vulnerable group. Hulu Langat was chosen as study location as there was no study related to fluoride concentration in drinking water and urine has been done before. The concentration obtained will be used to compare with the standard whether the result exceed the safe level or not. If exceed, possible reasons and health effects can be addressed.

1.3 Research Questions

i. Is there any association between fluoride in drinking water and urinary fluoride of school children?

ii. Is there any significant difference of fluoride concentration in urine between male and female respondents?

iii. Is fluoride in drinking water within the range allowable by NDWQS?

iv. Is urinary fluoride level within the range allowable by NIOSH method 8308?

1.4 Study Justification

Undeniably, there are a lot of previous studies about fluoride and its effect on dental health. Fluoride has shown its effects in preventing both tooth decay and dental fluorosis not only in Malaysia, but in other countries where fluoride in drinking water is implemented. In United States, evidence showed that prevalence of dental caries is lower among communities with community water fluoridation (British Fluoridation Society, 2012). Since fluoride can cause adverse health effects on both low and excessive intake, optimal concentration is very important in making sure the effectiveness of fluoride implementation. Vulnerable group like children poses higher risk of adverse health effects due to fluoride consumption compared to adults.

Thus, it is very important for fluoride concentration in drinking water is addressed towards this vulnerable group as less attention is given to them. By conducting this study, fluoride level in school children's urine can be addressed based on fluoride level in drinking water. Besides, this study will also help increasing knowledge and awareness as well as the potential health effects cause by fluoride.

1.5 Objectives

1.5.1 General Objective

To determine the relationship between fluoride in drinking water and urinary fluoride among school children

1.5.2 Specific Objectives

i. To determine fluoride concentration in drinking water and compare with NDWQS
ii. To determine fluoride concentration in urine of respondents and compare with NIOSH method 8308
iii. To determine the difference of fluoride concentration in urine among male and female respondents
iv. To determine the association between fluoride in drinking water and urinary fluoride among school children

1.6 Hypotheses

i. There is no significant difference of fluoride concentration in urine among male and female respondents

ii. There is no association between fluoride in drinking water and urinary fluoride among school children

iii. Fluoride concentration in drinking water does not exceed the range recommended by NDWQS

iv. Urinary fluoride levels does not exceed the range recommended by NIOSH method 8308

1.7 Variables

1.7.1 Independent Variable

i. Fluoride in drinking water

1.7.2 Dependent Variable

ii. Urinary fluoride level

1.8 Definition of Terms

1.8.1 Conceptual definition

i. Fluoride in Drinking Water

Most of the tap water used to drink contain fluoride. Fluoride is found in it due to the addition during water treatment. If the fluoride is below the recommended level, addition of fluoride is required as to help in preventing dental caries as well as decontaminate the water from any bacteria (Bashir et al., 2013)

ii. Urinary Fluoride

Urine is the main excretion of fluoride in our body (Zohoori et al., 2013). Thus, it is a good tool for studying community exposure to fluoride. (Srikanth et al., 2013) as it is related to fluoride in drinking water (Chen et al., 2013) as well as it is a well-established way to estimate fluoride exposure among general population (Srikanth et al., 2013).

iii. School Children

School children can be divided into two, those in primary and secondary schools. In primary school, the school children's age range from 7 to 12 years old while in secondary school, they are range from 13 to 17 years old. In secondary school, there are two categories of students which are lower and higher secondary education. For lower secondary education, it consists of students aged from 13 to 15 years old while higher secondary education, the students ages are 16 and 17 years old (School Malaysia, 2018).

1.8.2 Operational definition

i. Fluoride in Drinking Water

Drinking water which was used by each student's household for drinking and cooking was required to take as sample. The sample was collected using pre cleaned HDPE bottles for 2 consecutive days and analyzed using SPADNS method on a direct reading spectrophotometer HACH.

ii. Urinary Fluoride

Urine was used as the sample to measure concentration of fluoride in it. Since urine is the main excretion of fluoride from our body, first urine in the morning was required as the sample. The sample was collected in plastic bottle for 2 consecutive days. The urine collected was preserved with Ethylenediaminetetraacetic acid (EDTA) and was measured within 24 hours.

iii. School Children

Secondary school children were used as subject matter. As this was purposive sampling study, exclusive criteria were applied to the students. Students aged 14 years old which have been living in Hulu Langat District for more than 6 years were chosen as respondents as well as used tap water as main source for drinking. Those who have kidney problems were excluded.

1.9 Conceptual Framework

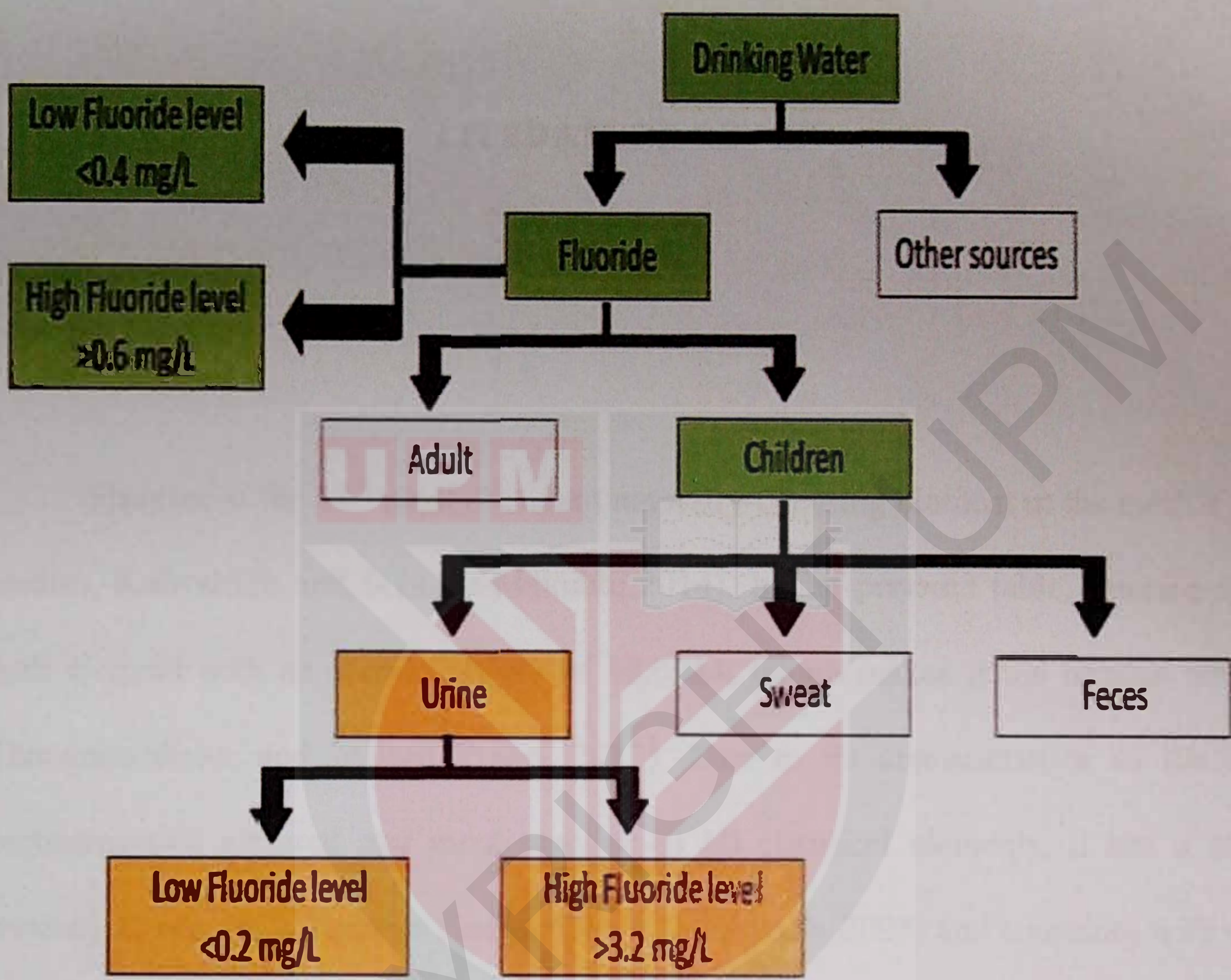

Figure 1. 1 Conceptual Framework

Independent variable Dependent variable

- Ranjan and Ranjan, 2015
- Azlan et al., 2011

CHAPTER 2

LITERATURE REVIEW

2.1 Fluoride

Fluorine is the 13th most abundant naturally-occuring element in the earth's crust (Budisa, Kubyshkin and Schulze-Makuch, 2014). In the periodic table, fluorine is the ninth element with an atomic weight of 18.9984, which makes it the lightest halogen (Thangapandiyan and Milton Prabu, 2013). Due to its characteristics as the most electronegative element and most reactive of all chemical elements, it has a strong tendency to acquire a negative charge (Gupta and Ayoob, 2006) and combines with other elements and molecules in order to form fluorides in the Earth's surface (Chen et al, 2013). Fluoride also accounts for about 0.3 g/kg of the earth's crust and exist in several form in a number of minerals. Some of the most common are fluorspar, cryolite and fluoropatite (WHO, 2006). Fluorine is usually found in soil, air, food and water as fluorides. In industrial settings, fluorine and its compound are used in producing uranium, plastics, ceramics, pesticides and pharmaceuticals. While, fluorochlorohydrocarbons are used in refrigeration and aerosol repellant applications. Although fluoride is widely used, it is a generally unwanted byproduct of aluminium, fertilizer and iron ore manufacture (Peckham and Awofeso, 2014).

2.2 Sources Of Fluoride

2.2.1 Naturally-Occuring Fluoride

In the environment, fluoride occurs naturally from the weathering of fluoride-containing rocks and soils as well as leaching from soils into groundwater (Choi et al., 2015). Fluoride also originates from fluoride bearing minerals such as fluorite in rocks. Their presence in the host rocks and interaction with water is said to be the main cause of groundwater fluoride (Singh et al., 2007). Groundwater is the major source for drinking purposes. In fact, in groundwater, the natural concentration of fluoride depends on the geological, chemical and physical characteristics of the aquifer, acidity and porosity of the soil and rocks, the depth of the source and the temperature (Hussain, Arif and Hussain, 2012). Fluoride is frequently found in groundwater at higher concentrations depending on the nature of rocks and nature of fluoride-carrying minerals at certain depths. The concentration ranges from trace quantities to over 25mg/L (Gao, Jin and Wei, 2013).

In India, Sri Lanka, Ghana and Senegal, areas with presence of crystalline igneous and metamorphic rocks along with areas of volcanic and hydrothermal activity contributes to higher fluoride (Gupta and Ayoob, 2006). Meanwhile, 1.3 mg/L of fluoride was reported in seawater while in areas with fluoride bearing minerals, the concentration in well water may contain up to 10 mg/L (WHO, 2006). In USA and Canada, a survey of fluoride in the air of some communities, the concentration ranged from 0.02-2.0 $\mu g/m^3$, while in China, indoor air is also reported to have fluoride due to indoor combustion of high-fluoride coal used for cooking as well as for drying and curing food. The concentration ranged from 16-46 μg/m^3 (WHO, 2006).

2.2.2 Artificial Fluoride

Artificial fluoride is widely used and examples of them include fluoridated drinking water, fluoridated salt and milk, drops, tablets, mouthwashes, toothpastes, gels and varnishes (Garcia-Hoyos, Cardoso and Barberia, 2014). Fluoridation of drinking water is implemented in most countries such as Malaysia, Australia, USA, New Zealand, Singapore and Ireland where more than 50% of water supply artificially fluoridated (Peckham and Awofeso, 2014). Fluoridation to public water supplies is one of the most popular approaches to increase fluoride in drinking water to reduce prevalence of dental caries (Gao, Jin and Wei, 2013). Raw water supply will undergo treatment in water treatment plants where fluoride is added. Fluoride is added in drinking water as many studies showed that it has beneficial effects on teeth especially in preventing tooth decay (Bashir et al, 2013). Besides, greater lifetime exposure to fluoridation of drinking water has been associated with lower level of caries experience (Slade et al., 2013). However, fluoride concentrations in water supplies must be monitored and adjusted as to minimize fluctuations (Malaysian Dental Council, 2009).

Fluoride is also available in toothpaste. At low concentrations, fluoride has an important role in controlling and preventing dental caries. However, excessive intake can lead to dental fluorosis (Amaral et al., 2018). For dental purposes, fluoride concentration may contain 1000-1500 mg/kg of toothpaste; however, the concentration will return to baseline level within 1 to 2 hours (Kohn et al., 2001). Up to 90% of the toothpaste-containing fluoride are available in the market in United States, Canada and other developed countries.

2.3 Fluoride In Humans

Human intake of fluoride comes from a lot of sources. There are two types of sources which are topical and systemic fluorides. The topical sources of fluoride are mouth rinses and toothpaste while systemic sources are drinking water, foods and beverages (Rahim et al, 2013). However, fluoride are mostly ingested from drinking water. After the uptake, fluoride are rapidly absorbed in the gastrointestinal tract. Once absorbed, it will be transported by blood. This makes the concentration of fluoride in drinking water similar with the concentration in blood, in which the validity remains when drinking water has a concentration of 10 mg/L (WHO, 2006).

Distribution of fluoride is also a rapid process. It is deposited in bones and teeth while no storage for fluoride in soft tissue. Except for hydrogen fluoride (HF), it has its way to enter the intracellular fluid of soft tissue. Thus, this may cause a high concentration in kidneys which makes them the most vulnerable sinks of fluoride, making them as the target of acute and chronic fluoride toxicity (Gupta and Ayoob, 2006). Fluoride is excreted via urine, feces and sweat (WHO, 2006). Only low concentrations of fluoride are reported in sweat while renal excretion takes up 35% to 70% of fluoride intake (Gupta and Ayoob, 2006).

2.4 Fluoride Metabolism

2.4.1 Absorption

Almost 75-90% of consumed fluoride is absorbed. Since the stomach has an acidic environment, ingested fluoride is converted into hydrogen fluoride (HF) and almost 40% is absorbed from the stomach as HF (WHO, 2006). Fluoride compounds can be absorbed via several routes which include gastrointestinal tract, respiratory tract as well as skin and mucous membranes (Ranjan and Ranjan, 2015). The gastrointestinal tract is the major route of fluoride intake except for animals. Fluoride permeation through gastric mucosa depends on pH; the higher the acidity of stomach contents, the higher the fluoride absorption. The rate of fluoride absorption also depends on several factors. One of them is inorganic fluoride compounds where they are more soluble and rapidly absorbed from the gastrointestinal tract. However, fluoride absorption decreases up to 20-30% if fluoride is taken along with milk or baby formula (Ranjan and Ranjan, 2015).

About 20 to 25% of total ingested fluoride is absorbed in the stomach while the remainder is absorbed in the proximal small intestine. Its absorption occurs in a half-life of 30 minutes, reaching a peak within 20 to 60 minutes, independently of the amount ingested. After that, fluoride concentrations are rapidly decreased due to uptake of both calcified tissues and renal excretion (Buzalaf, Lima Leite and Buzalaf, 2015). Diet and other foods which contain fluoride also affect fluoride absorption. Sodium fluoride (NaF) in water solutions is 100% absorbed, however when combined with foods or drinks containing calcium, aluminium and magnesium, fluoride will form insoluble complexes that decrease fluoride absorption. This explains the use of calcium-containing solutions in acute fluoride toxicity (Preedy, 2015).

2.4.2 Distribution

Fluoride is readily distributed throughout the body, once it is absorbed into the blood with approximately 99% is retained in calcium rich areas such as bone and teeth. About 80 to 90% of the absorbed fluoride is retained in children but falls to 60% in adults. Blood circulation acts as a transport medium and carries fluoride to different body parts. In blood, 75% of inorganic fluoride remains in plasma while the rest is present in or on erythrocytes (WHO, 2006).

Absorbed fluoride reaches into blood circulation which acts as a transport medium and carries fluoride to different body parts. Fluoride in blood exists in two forms which are organic and inorganic fluorides. (Ranjan and Ranjan, 2015). In plasma, both are found and together they present the total of plasma fluoride. About 75% of inorganic fluoride remains in plasma, about 5% bound with plasma proteins and the rest is present in erythrocytes. After ingestion, plasma fluoride levels rapidly increase until a peak is reached, around 20 to 60 minutes. From then on, the levels will start to decline to baseline levels within 3 to 11 hours, depending on the concentration that is ingested (Buzalaf, Lima Leite and Buzalaf, 2015).

Blood plasma is considered the central compartment from which fluoride is distributed to soft and mineralized tissues and specialized body fluids, followed by its elimination. Velocity of blood flow will determine the rate of fluoride distribution from plasma to soft tissues. Proportion of fluoride levels in plasma or tissue is dependent on the ratio between the extracellular and intracellular pH where fluoride accumulates in more alkaline compartment in response to a pH gradient which makes it reasonable to expect higher concentration in plasma. Intracellular fluoride concentrations are lower, but change proportionately and simultaneously with those in plasma (O Mullane et al., 2015). In human beings, it takes about 30 to 60 minutes to reach peak plasma concentration after ingestion of sodium fluoride with water. From plasma, fluoride migrates across cell concentration ration ranging from 0.5 to 0.9 mg/L. Brain and fat are excluded as they have a considerably lower ratio meanwhile kidneys have a higher ratio because fluoride is concentrated in the renal tubular fluid (Ranjan and Ranjan, 2015).

Approximately 99% of the body burden of fluoride is associated with calcified tissues. Almost 55% of fluoride ingested will be retained by children and approximately 36% by adults and the remainder of the absorbed fluoride will be excreted in urine. This will make children retain a higher proportion of ingested fluoride compared to adults (O Mullane et al., 2015). Fluoride concentrations were screened and compared among tissues and organs and the result reveals that kidney presents the greatest ratio in fluoride concentration, followed by liver, lung, spleen and others. This explains why these organs are targets for fluoride toxicity (Buzalaf, Lima Leite and Buzalaf, 2015).

2.4.3 Excretion

About 10% of the daily intake of fluoride is not absorbed and is excreted in the feces, except in subjects with high calcium diets when up to 25% can be excreted by this route (O Mullane et al., 2015). The elimination of absorbed fluoride occurs mostly via the kidney as it is the main vehicle for fluoride excretion from the body (Palmer and Gilbert, 2012). Urinary fluoride clearance will increases with urine pH due to HF concentration decrement. In adults and children, urinary excretion, just like fluoride absorption, is influenced by pH. Diets with high proportion of vegetable and fruit intake lead to urinary pH on the alkaline side, whereas protein rich-diets lead to acidification of urine. These changes in urinary pH modify urinary fluoride excretion (Martinez-Mier, 2012). Some dietary factors can increase or reduce urine pH which can affect the excretion of fluoride. The factors may include diet and drugs (WHO, 2006).

Fluoride renal excretion is one of the most important mechanisms for the regulation of fluoride levels in the body. About 60% and 45% of the daily ingested fluoride is excreted in urine of health adults and children, respectively (Buzalaf, Lima Leite and Buzalaf, 2015). Plasma and the kidney excretion rate determined by fluoride intake, uptake to and removal from bone and the capacity of fluoride clearance by the kidney (Preedy, 2015).

Any factor that affects urinary pH will have an impact on the amount of fluoride that is excreted in urine. Urinary fluoride excretion is also influenced by the gromerular filtration rate since its reduction, as occurs in chronic renal dysfunction as well as in the last decades of life, results in lower excretion and increased plasma fluoride levels (Buzalaf, Lima Leite and Buzalaf, 2015).

2.5 Effects On Human Health

Several studies have shown acute and chronic effects of fluoride exposure mainly due to insufficient and overdosing of fluoride. However, the chronic effects due to long-term exposure from drinking water and other environmental sources is the major concern to human health.

2.5.1 Teeth

Beneficial and detrimental effects of fluoride has been well established since early 1940s. Low and high intake of fluoride can cause adverse health effects. Fluoride levels up to 10mg/L were associated with dental fluorosis while low level which is less than 0.1mg/L were associated with high levels of dental decay. Particularly in children, concentrations in drinking water of about 1 mg/L are associated with lower incidence of dental caries whereas the excess intake will cause dental fluorosis (WHO, 2006).

2.5.2 Skeletal Effects

Skeletal fluorosis is widely known to occur in many countries such as India, China as well as Africa. It is mainly associated with consumption of drinking water containing high levels of fluoride which is exceeding the safe level recommended. Other sources of fluoride ingestion which can also become the contributing factors are seafood, toothpastes, infant formulas and fluoride supplements (Enosakhare et al., 2014). Climate also can contribute to higher consumption of fluoride in drinking water. Fluoride ingestion may be higher in winter than in summer which mainly due to higher consumption of hot beverages with high fluoride content (Enosakhare et al., 2014).

2.5.3 Other Possible Health Effects

Several epidemiological studies have been carried out to examine other possible adverse health effects as the consequences of fluoride exposure either low or high. There was a study conducted among pregnant mothers who consumed fluoride in drinking water and the adverse pregnancy outcome. However, there was no increased risk of abortion or congenital malformation (WHO, 2006). Based on studies of occupationally exposed populations primarily from smelting, there have been reports of an increased incidence of lung and bladder cancers. However, the inconsistency of data resulted in no consistent evidence to demonstrate any of the associations mentioned. Meanwhile in one of the meta-analysis studies, it was found that there was lower IQs among children with higher fluoride exposure compared to similar children with lower exposure (Hirzy et al., 2016).

CHAPTER 3

METHODOLOGY

3.1 Study Design

This study was a cross-sectional study where the variables were studied in a single point of time.

3.2 Study Location

This study was conducted in a school at Hulu Langat District, Selangor.

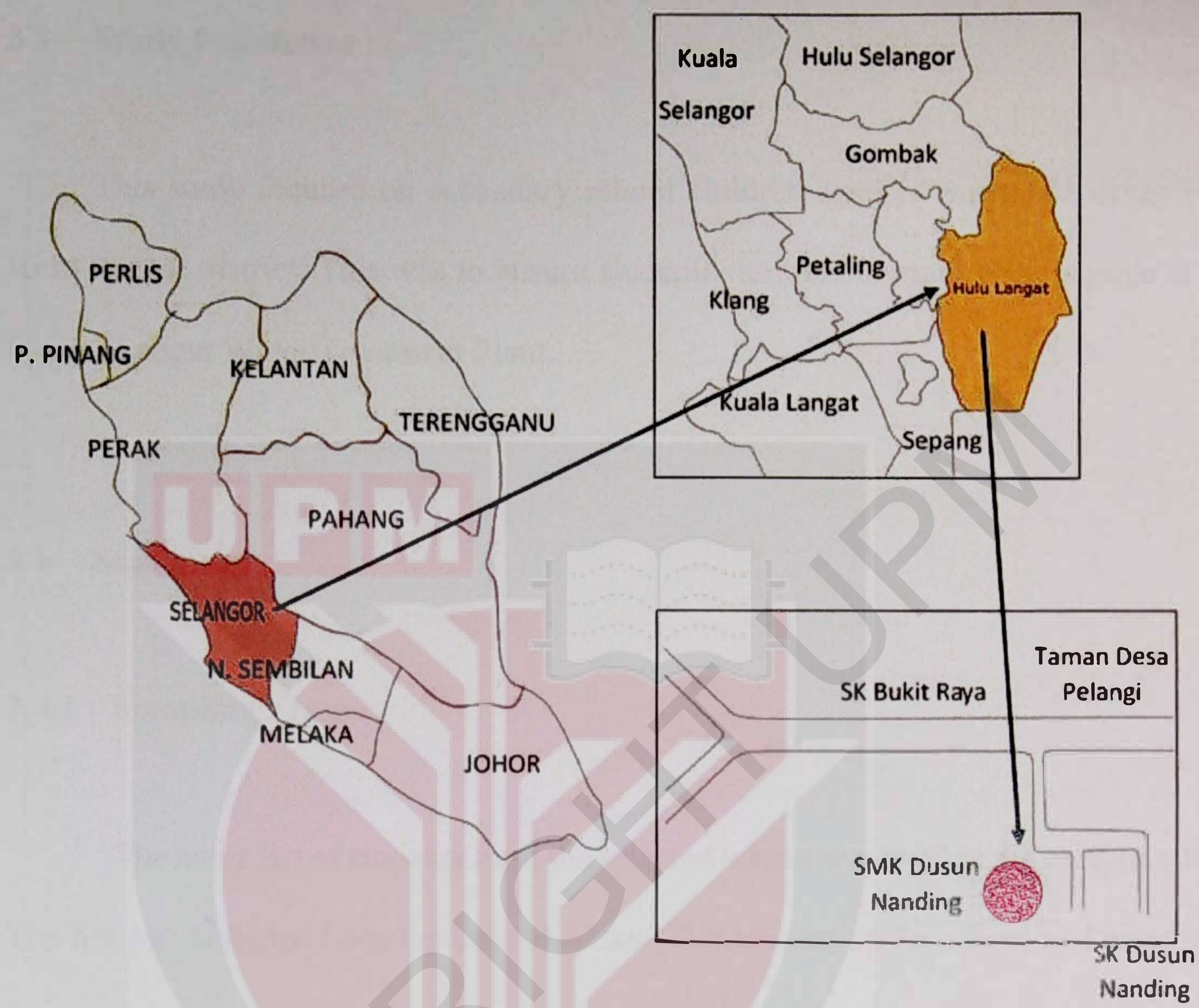

Figure 3. 1 Selangor, Hulu Langat District and SMK Dusun Nanding maps

3.3 Study Population

This study focused on secondary school children aged 14 years old living within Hulu Langat district. This was to ensure students' household main water source is from Sungai Langat Water Treatment Plant.

3.4 Sampling

3.4.1 Sampling Frame

The name list of students from the selected school was used as the sampling frame. The list was obtained from the School Affairs Department of the school and respondents were selected from the list.

3.4.2 Sampling Method

Purposive sampling method was used in this study. This method was chosen with the expectation that each of the participant involved will provide rich information and value to the study (Lee et al., 2014). As those information is also held by only certain students (Tongco, 2007), they were selected based on the inclusive and exclusive criteria needed for the study. Students who met the criteria were selected as respondents. Below were those criteria:

Table 3. 1 Inclusive and Exclusive Criteria of Respondents

Inclusive criteria	Exclusive criteria
• Aged 14 years old • Have lived in the residency area within Hulu Langat District for more than 6 years (Ahmed et al., 2012) • Used tap water as main source for drinking	• Aged 13, 15, 16 and 17 years old • Use filtered water system at home • Health problems (eg; kidney problem) (Jarquín-Yañez et al., 2015)

Based on those criteria, purposive sampling was chosen as there was limited number of students nowadays where their household use tap water as their main drinking water source. In Malaysia, the volume of municipal water used for drinking by consumers was low (Azlan et al., 2011) which decreased data validity if random sampling was chosen.

3.4.3 Sampling Size

Sample size was determined by using a formula made by 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;

$Z_{1-\frac{\alpha}{2}}$ = *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., 2013)

P_2 = 0.44 (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 were 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 for the design effect and followed by multiplication of 2 for two group populations, male and female. Thus, 72 respondents were needed in this study.

3.5 Study Instrumentation

3.5.1 Questionnaire

A set of questionnaire was given to respondents to gather information before selecting on the most suitable respondents based on the inclusive and exclusive criteria. The questionnaire contained data on socio-demographic, health status and sources of water for drinking (Ahmad Solihin, 2016)

3.5.2 HACH brand direct reading spectrophotometer model DR/1900

The spectrophotometer was used to determine level of fluoride in both urine and drinking water.

3.6 Data Collection Method

Before sample collection begins, a detailed briefing was conducted to all chosen respondents who participated in this study. This was to ensure that all respondents understand study objectives and sample collection method to be used.

3.6.1 Questionnaire

A set of questionnaire was distributed to each respondent. The questionnaire was used to collect information such as;

I. gender data

II. health status

III. water supply usage

(Ahmad Solihin, 2016)

The information collected above corresponded to the inclusive criteria of the study. The questionnaires were given to respondents before collection of both urine and drinking water samples.

3.6.2 Drinking Water

Tap water from each of the participant's house was used as the sample. Water samples were collected in a pre-cleaned HDPE bottle for 2 consecutive days and analyzed within 48 hours using SPADNS Method 8029 on a direct reading spectrophotometer HACH Brand model DR/1900. Based on the method, it involved the reaction of fluoride with red zirconium dye-solution. Fluoride combined with part of the zirconium to form a colorless zirconium-fluoride complex with the net effect of color bleaching. Measurement of the decrease in color intensity provided an accurate determination of the fluoride concentration. This method was also approved by United States Environmental Health Agency (USEPA) (HACH, 2014).

3.6.3 Urine

Urine sample was collected using plastic bottle (NIOSH, 1994) for 2 consecutive days. First urine in the morning was taken as the sample (Enosakhare et al., 2014). This is because the sample at that time was the most concentrated and acidic as compared with other time (University of Bern, 2008). Student was given the bottle and briefing a day before urine sample was collected. Then, the sample was analyzed using spectrophotometer within 24 hours (Enosakhare et al., 2013). EDTA was added to minimize other interference in the urine such as calcium (NIOSH, 1994).

3.7 Analysis of Fluoride

Fluoride in both urine and drinking water were analysed using SPADNS Method 8029 (HACH, 2014). The steps were started with blank preparation where 10.0 mL of deionised water was added into sample cell using dropper. Then, preparation of sample was done by adding 10.0 mL of sample into sample cell using dropper. After that, 2.0 mL of SPADNS Reagent solution was added into each blank and sample solutions using dropper. Mixtures were then swirled. Instrument timer was set for one minute. When the timer stopped, blank mixture was cleaned and inserted into cell holder. Then, zeroing was done to show 0.00mg/L F^- display by pushing ZERO button. Blank mixture was taken out from cell holder. Sample mixture was cleaned and inserted into the cell holder. Results were then shown by pushing READ button.

3.8 Data Analysis

The data obtained was analyzed using IBM SPSS (Statistical Package for the Social Sciences) version 22. The type of analyses used in this study were shown in Table 3.2, based on the objectives of this study.

Table 3. 2 Type of Data Analysis

No	Objectives	Type of Analysis
1	To determine fluoride concentration in drinking water and compare with NDWQS	Descriptive Analysis
2	To determine urinary fluoride level and compare with NIOSH method 8308	Descriptive Analysis
3	To determine significant difference of fluoride concentration in urine between male and female respondents	Independent sample t-test
4	To determine the correlation between fluoride in drinking and urinary fluoride level among school children.	Spearman-rho correlation test

CHAPTER 4

RESULTS AND DATA ANALYSIS

This study aimed to determine the relationship between fluoride in drinking water and urinary fluoride among school children. Data collection was conducted in Sekolah Menengah Kebangsaan Dusun Nanding, Hulu Langat according to the proposed methodology and objectives. In total, 46 out of 78 respondents were able to participate in this study which resulted in 59% response rate.

4.1 Gender data

Table 4.1 shows the gender data of the respondents. All of the respondents taken were 14 years-old students. From 46 respondents, 15 were male (33%) and 31 were female (67%).

Table 4. 1 Descriptive analysis of respondents

Variables		N = 46	
		Frequency	Percentage (%)
Gender			
	Male	15	33
	Female	31	67

4.2 Fluoride in Drinking Water

Fluoride in drinking water was the first parameter measured in this study. Fluoride in drinking water was not normally distributed, as assessed using Shapiro-Wilk's test ($p < 0.05$). From table 4.2, fluoride in drinking water was analyzed descriptively where it ranged from 0.21 to 0.97 mg/L with a median of 0.43 ± 0.25 mg/L. Figure 4.1 showed overall fluoride concentration in drinking water consumed by respondents.

Table 4. 2 Fluoride Level in Drinking Water

Variable	**n = 46**		
	Range (mg/L)	**Median[a] (mg/L)**	**(±) IQR**
Fluoride in Drinking Water	0.21 - 0.97	0.43	0.25

[a]*Descriptive analysis*

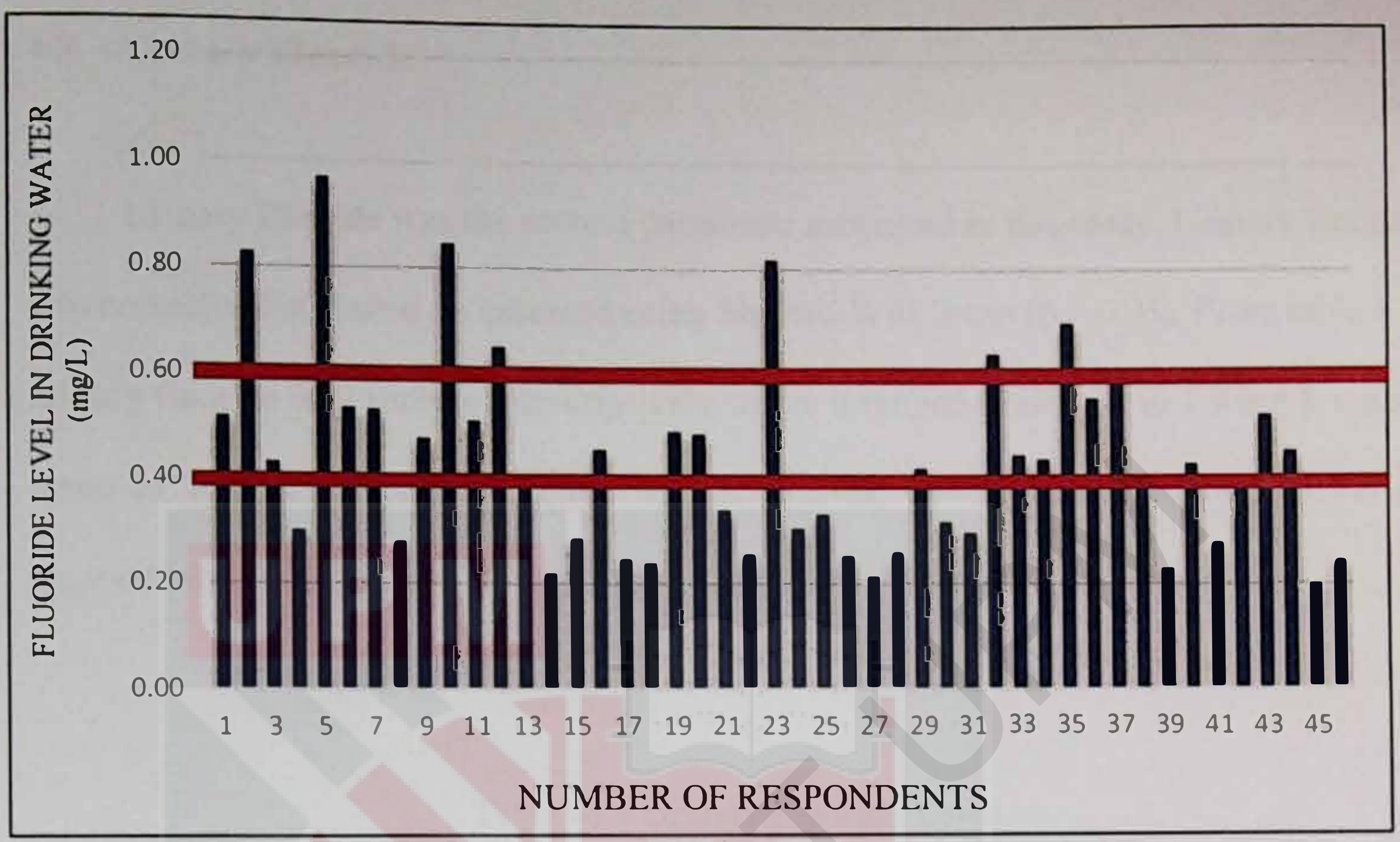

Figure 4. 1 Comparison of Fluoride Level in Drinking Water with NDWQS

4.3 Urinary Fluoride

Urinary fluoride was the second parameter measured in this study. Urinary fluoride was normally distributed, as assessed using Shapiro-Wilk's test ($p > 0.05$). From table 4.3, urinary fluoride was analyzed descriptively where it ranged from 0.82 to 1.9 mg/L with a mean of 1.43 ± 0.29 mg/L. Figure 4.2 showed the overall urinary fluoride level of respondents.

Table 4. 3 Urinary Fluoride Level

Variable	n = 46		
	Range (mg/L)	**Mean[a] (mg/L)**	**(±) SD**
Urinary Fluoride	0. 82 – 1.9	1.43	0.29

[a]*Descriptive analysis*

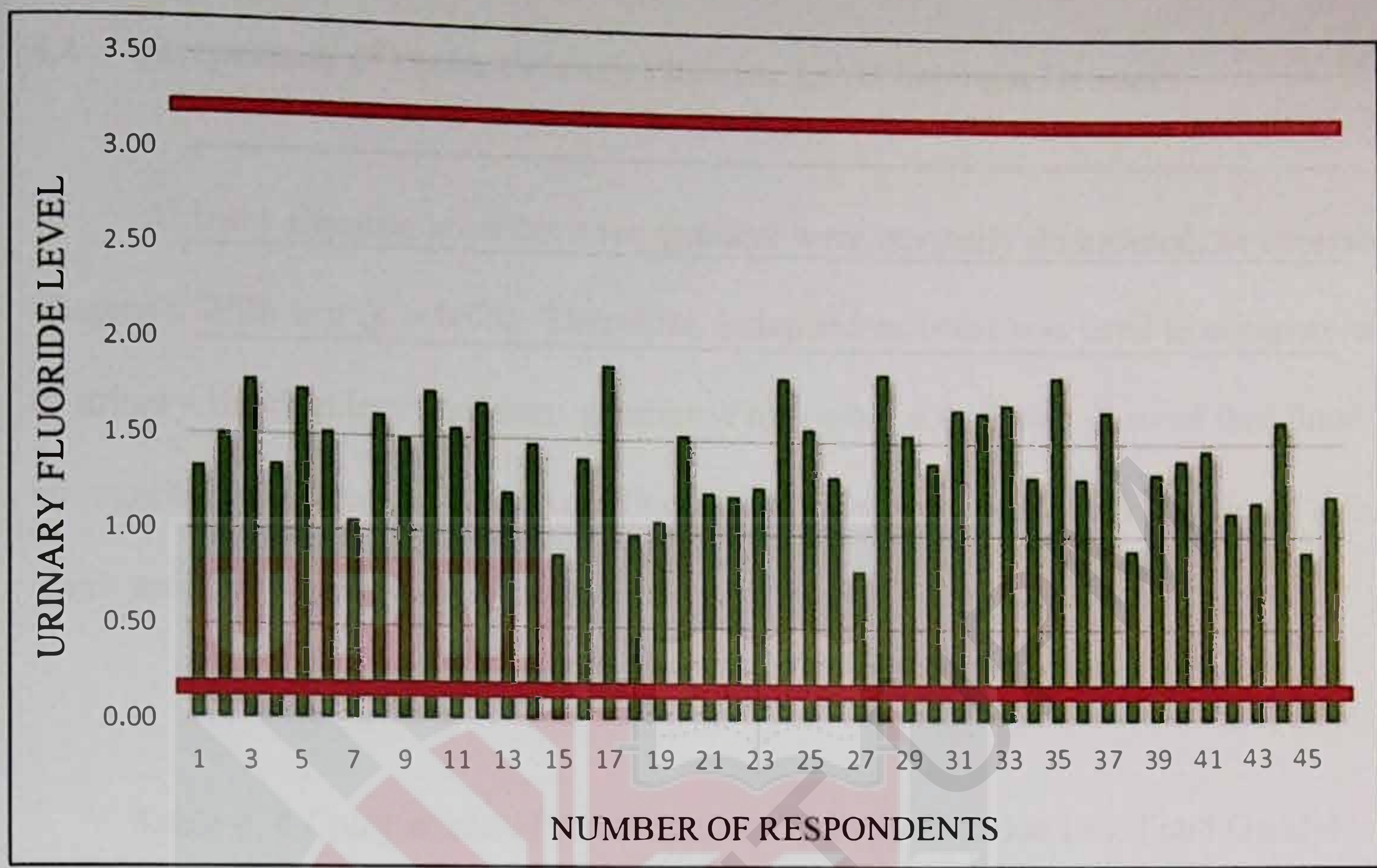

Figure 4. 2 Comparison of Urinary Fluoride Level with NIOSH method 8308

4.4 Comparison of mean Urinary Fluoride Level between Genders

Urinary fluoride level between genders were normally distributed, as assessed in Shapiro's Wilk test ($p > 0.05$). Therefore, independent t-test was used to compare mean of urinary fluoride level between genders. From table 4.4, it was showed that there was no significant difference of urinary fluoride level between male and female ($p > 0.05$). Thus, null hypothesis was accepted.

Table 4. 4 Comparison of mean between Urinary Fluoride Level and Gender

Variable	Mean (SD)		Mean difference (95% CI)	t-statistic[a] (df)	p-value*
	Male	Female			
Urinary fluoride level	1.42 ± 0.27	1.43 ± 0.3	0.01 (0.17, 0.2)	-0.14 (44)	0.887

[a]Independent sample t-test
**p-value significant at 0.05 level*

4.5 Relationship between Fluoride in Drinking Water and Urinary Fluoride

Since fluoride in drinking water and urinary fluoride were not normally distributed, spearman's rho correlation test was used to determine the relationship between the two variables. Table 4.7 showed the significant value indicated in this study was $p = 0.045$ which was ($p < 0.05$). Thus, null hypothesis was accepted. There is a relationship between fluoride in drinking water and urinary fluoride among studied population.

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

Variables	Fluoride in Drinking Water	
	Coefficient[a], (r)	**p-value***
Urinary fluoride	0.29	0.045

[a]Spearman's rho correlation test
**p-value significant at 0.05 level*

CHAPTER 5

DISCUSSION, CONCLUSION, LIMITATIONS AND RECOMMENDATIONS

5.1 DISCUSSION

5.1.1 Fluoride in Drinking Water

As fluoride in drinking water was not normally-distributed, the reading recorded had a median of 0.43 ± 0.25 mg/L. Comparison with recommended range by NDWQS, 0.4 – 0.6 mg/L, fluoride concentration in drinking water was within the range. The range was in optimum amount which can be beneficial to teeth, mostly in helping eliminate teeth decay. Comparison with previous study which stated that Malaysia's fluoride content in tap water has a mean of 0. 39 mg/L and had 0.14 mg/L as the lowest fluoride level (Azlan et al, 2012) which was in optimum amount.

Previous study explored fluoride level in beverages which consisted of tea and juice-flavored drinks. The study found fluoride level in tea and lychee drinks were very high (Rahim et al., 2014). Comparison to this study where fluoride level in drinking water was in optimum amount and safe to consume compared to tea and flavored drinks which had higher content of fluoride.

Drinking water sources in Dhar District, India also showed fluoride concentration was within safe limit as the safe water provision was made through mini water supply schemes from alternative safe sources that had fluoride below permissible level of 1.0 mg/L (Srikanth et al., 2013).

Previous study conducted in Malaysia, it was shown that most of the sites which include Kuala Kangsar, Kajang, Bangsar and Masjid Tanah were lower and within the level recommended by the Ministry of Health. Some of the low concentration was due to non-fluoridation of drinking water (Shaharuddin et al., 2009)

A study in Southern China also found that water fluoride levels in villages were within WHO recommended levels. This maybe due to intervention program where residences were supplied with low fluoride public water. In other words, over the years that the high fluoride water was replaced by lower fluoride water, the post-intervention fluoride levels showed declining result (Chen et al., 2013).

From all the related previous study, fluoride in drinking water was within the recommended range as there were difference methods used by the country where most of the efforts were to ensure population receive fluoride in optimal amount. Some may also gain fluoride sources other drinking water which include beverages.

5.1.2 Urinary fluoride

As urinary fluoride was normally distributed, the reading recorded a mean of 1.43 ± 0.29 mg/L and the range has 0.82 mg/L as the lowest and 1.9 mg/L as the highest level where none of the respondents recorded urinary fluoride which exceeded the safe level. Comparison with NIOSH method 8308, urinary fluoride level was within the range.

A previous study in Newcastle also provided urinary fluoride level for children was found to be within the range proposed by the WHO. This might due to altitude of residency which can influenced urine pH. The study showed that residency in high altitudes would reduce urine pH and consequently renal excretion of fluoride (Omid, 2012).

A study in Mexico showed the mean rate of urinary fluoride flow where the value were considered by the WHO to be indicative of optimal fluoride usage. This was because Mexico City has low concentration of fluoride in drinking water which also considered a non-endemic area for dental fluorosis (Jiménez-Farfán et al., 2011).

A previous in Starr County, Texas found that the range of urinary fluoride observed throughout the 24-hour period of the study was within WHO recommended level. This maybe due to school children which selected as respondents had lived in the area as permanent residents for at least the preceding two years. Besides, the water sources also had not changed and fluoride concentration had remained constant for several years (Baez, Baez and Marthaler, 2000).

A study conducted in Seri Serdang, Selangor also showed urinary fluoride was within the range reported by NIOSH method 8308. All of the respondents also showed urinary fluoride levels within the range. This was because most of the respondents received same fluoride sources which is from drinking water (Nurul Shafina, 2017)

5.1.3 Comparison of mean between Urinary Fluoride Level between Genders

Urinary fluoride level between male and female did not significantly differ. Based on data analysis, null hypothesis was rejected which showed that gender did not affect the differences of urinary fluoride level. This was because socio-demographic background of respondents were almost the same. They did not consumed drinking water from water filtration system. Besides, they also received same source of drinking water which was from Sungai Langat Water Treatment Plant.

One study in Pakistan also found that there was no significant difference between male and female respondents might due to life-long residency in Samme Jo Tar Village and Gadap Town with normal urine detailed report (Ahmed et al., 2012).

A study in India showed that there was no statistical significant results between male and female respondents. This was because most of the population consumed sorghum (bread form) which fluoride content was influenced by fluoride content in water. Sorghum in India was one of the most important cereals (Dhanu et al., 2017).

A study in China proved that no significant variation was noticed in urinary fluoride concentrations of different genders in every drinking water system. This might due to population of each age group was large or the fluoride concentrations in drinking water were not high (Wang et al., 2009).

5.1.4 Relationship between Fluoride in Drinking Water and Urinary Fluoride

Urinary fluoride level has been known to be affected by fluoride in drinking water. In this study, fluoride in drinking water was positively correlated ($p < 0.05$) with urinary fluoride which has also been reported in similar studies (Rango et al., 2014; Kumar et al., 2017; Khandare et al., 2018).

The correlation of the variables showed that urinary fluoride was mainly contributed by fluoride in drinking water. Respondents were most probably receive fluoride sources from drinking water supplied to them. As they were residing within Hulu Langat District for more than 6 years, they were exposed to fluoride in drinking water for a longer duration.

A previous study in Gujarat, India revealed a significantly higher fluoride level in drinking water correlated with higher fluoride levels in the urine and vice versa for the lower drinking water and urine samples. The contribution of fluoride to the surface water and groundwater may due to intensive and long term irrigation in the district where it was possibly one of the factors that caused weathering and leaching of fluoride from the soils or weathered rocks (Trivedi et al., 2012).

A study in Haryana, India has stated that the significant positive correlation between fluoride in drinking water and urinary fluoride among the population was mainly due to fluoride in groundwater where it was the main source for drinking (Kumar et al., 2017). The population were also exposed to fluoride in drinking water for a long period as they lived there since birth. Comparing to this study, respondents in Hulu Langat have been exposed to fluoride in drinking water for more than 6 years which has contributed to the correlation.

A study in China showed that urine fluoride was correlated with water fluoride ($p < 0.001$). This was because the studied population had been exposed to stable fluoride concentrations in drinking water where it was a countrywide effort to provide microbiologically safe drinking water in rural communities (Choi et al., 2015).

5.2 CONCLUSION

Results obtained in this study showed that most of the respondents receive fluoride source from drinking water with safe level which indicate that fluoride in drinking water in Hulu Langat is in the allowable range. Urinary fluoride level obtained was also within the safe range. Besides, gender differences give no effect to urinary fluoride level as there is no significant difference found in this study. From the findings, there was positive correlation between fluoride in drinking water and urinary fluoride which also indicate that fluoride intake of populations in Hulu Langat is mostly from drinking water supply.

5.3 LIMITATIONS

There were few limitations in this study. Firstly, the number of respondents recruited was less than the calculated size which was 72 respondents. Only one age of respondents was also recruited which was 14 years old. These were because most of the selected students used water filtration system as drinking water source and parents' disagreement in allowing their children in joining this study. Some of them were initially included in this study, however, they were excluded during data collection process due to absenteeism and failure to bring samples on the following day. The collected samples were also managed to collect for 2 days instead of 3 days. This was because data collection process collided with public holiday where process failed to continue for another one day. Dental fluorosis was also unable to measure due to lack of expert available and budget constraint.

5.4 RECOMMENDATIONS

As no study have been done before in Hulu Langat, further study should go for longer periods of time as to cover a wider study location and a bigger study scope. As respondents' involvement is one of the limitations, a longer time period and different age group will make recruitment of potential respondents increase as there are more respondents to recruit. Besides, other sources of fluoride which include dietary supplement and dental product should be considered as variables since they can be considered as one of the factors affecting fluoride content in urine. Different sources of water should also be considered as to enhance study on human fluoride intake. The sources include drinking water treatment plant, groundwater and bottled water. As drinking water is an important source of fluoride intake, high level of fluoride may pose adverse health effects of humans. By knowing the fluoride concentration on every type of water sources, intervention can be done in order to ensure population consume safe amount of fluoride recommended by health authorities.

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APPENDIX 1:
UNIVERSITY PUTRA MALAIA ETHICAL COMMITTEE APPROVAL

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

Research title	:	**Urinary Fluoride Level and Its Relationship with Fluoride in Drinking Water Among School Children in Hulu Langat, Selangor**
Study Site	:	**Hulu Langat, Selangor**
JKEUPM Ref No.	:	**JKEUPM-2017-191**
Researcher	:	**Nurhanis bt Zainal**
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 1 dated 31/10/2017
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 1 dated 31/10/2017
6. Proposal (English), Version 3 dated 12/3/2018
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 14 MARCH 2019**

APPENDIX 2:
MINISTRY OF EDUCATION APPROVAL

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(65)
Tarikh : 27 Disember 2017

NURHANIS BINTI ZAINAL
NO. KP : 950409025908

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.

" URINARY FLUORIDE LEVEL AND ITS RELATIONSHIP WITH FLUORIDE IN DRINKING WATER AMONG SCHOOL CHILDREN IN HULU LANGAT, 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 **15 Januari 2018** hingga **31 Mei 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 4:
RESPONDENT'S INFORMATION SHEET AND CONSENT FORM (MALAY VERSION)

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

Tahap florida dalam air kencing dan hubungannya dengan florida dalam air minum di antara kanak-kanak sekolah di Hulu Langat, Selangor

2. PENGENALAN

Penggunaan florida di loji rawatan air sudah lama diamalkan di Malaysia. Florida dapat membantu mengurangkan risiko pereputan gigi mengikut kadar florida yang selamat digunakan. Kajian ini akan melibatkan penyelidikan di mana pengambilan sampel air kencing digunakan untuk mengenal pasti tahap florida di dalamnya dan untuk mengenal pasti hubungannya dengan tahap florida dalam air minum. Air kencing dipilih sebagai sampel adalah kerana sistem perkumuhan utama florida dalam badan adalah melalui air kencing. Tahap florida dalam sampel air kencing akan diukur menggunakan alat Spektrofotometer dan mengenal pasti tahap selamat florida dalam sampel tersebut. Penyelidikan ini juga dapat meningkatkan tahap kesedaran masyarakat terhadap pendedahan florida.

3. APAKAH YANG PERLU ANDA LAKUKAN?

Peserta dikehendaki untuk mengambil sampel air kecing yang pertama setiap pagi untuk 3 hari berturut-turut. Peserta juga bertanggungjawab untuk memastikan sampel yang diambil merupakan sampel air kecing yang pertama untuk hari tersebut dan menjaga sampel dengan baik sebelum diserahkan kepada penyelidik.

4. SIAPA YANG TIDAK BOLEH MENYERTAI KAJIAN INI?

a) Peserta yang mengambil peperiksaan PT3 and SPM
b) Peserta yang mempunyai masalah kesihatan. (Cth; masalah buah pinggang)
c) Peserta yang menggunakan sistem penapisan air di rumah
d) Peserta yang menjadi penduduk di kawasan yang berdekatan dengan sekolah untuk jangka masa kurang dari 6 tahun

Kajian ini juga merupakan kajian secara sukarelawan daripada peserta. Peserta boleh menarik diri daripada penyertaan pada bila-bila tanpa sebarang penalti dari pihak penyelidik.Penyertaan juga akan dibatalkan serta merta sekiranya peserta memiliki ciri-ciri di atas semasa sampel sedang diambil.

5. APAKAH FAEDAH MENYERTAI KAJIAN INI?

a) KEPADA ANDA SEBAGAI PESERTA?

Peserta dapat mengetahui tahap florida dalam air kencing mereka and florida dalam air minum. Peserta juga dapat mengetahui tahap selamat florida yang dibenarkan di dalam air minum. Sekiranya peserta atau penjaga ingin mengetahu keputusan sampel air kencing, keputusan akan dimalumkan setelah kajian selesai. Di akhir penyertaan ini, peserta akan menerima hadiah kecil sebagai tanda penghargaan.

b) KEPADA PENYELIDIK?

Penyelidik dapat menyumbang satu penyelidikan yang berguna untuk menentukan hubungan di antara tahap florida dalam air kencing dan tahap florida dalam air minum. Hubungan ini dapat mengaitkan air minum sebagai salah satu sumber utama florida dalam air kencing.

6. ADAKAH IA BERISIKO?

Tidak. Kajian lepas membuktikan kelulusan etika daripada Institusi Ahli Semak dari Duke University bersama kelulusan bertulis dari pihak penjaga dan peserta. (Rango et al., 2014) Sampel yang telah diambil juga akan dihapuskan serta merta setelah kajian selesai.

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?

Nurhanis binti Zainal
(Penyelidik)
Bacelor Sains Kesihatan Persekitaran dan Pekerjaan,
Fakulti Perubatan dan Sains Kesihatan,
Universiti Putra Malaysia.
No Telefon: 017-4774697
Emel: n.hanis0904@gmail.com

Dr. Shaharuddin Bin Mohd Sham
(Penyelaras)
Jabatan Kesihatan Persekitaran dan Pekerjaan,
Fakulti Perubatan dan Sains Kesihatan,
Universiti Putra Malaysia.
Phone No: 012-3387305
Email address: 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 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.

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

*potong yang tidak berkenaan

Tandatangan ………………………………… (*Responden*)

Tandatangan ………………………………… (*Saksi*)

Tarikh :………………………………………

Nama :………………………………………

No. K/P: ………………………………………

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

Tarikh …………………………………

Tandatangan ………………………………… (*Penyelidik*)

APPENDIX 5:
GUARDIAN'S INFORMATION SHEET AND CONSENT FORM (MALAY VERSION)

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

BORANG 2.5: PENERANGAN DAN PERSETUJUAN IBUBAPA/PENJAGA

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

1.TAJUK KAJIAN

Tahap florida dalam air kencing dan hubungannya dengan florida dalam air minum di antara kanak-kanak sekolah di Hulu Langat, Selangor

2. PENGENALAN

Penggunaan florida di loji rawatan air sudah lama diamalkan di Malaysia. Florida dapat membantu mengurangkan risiko pereputan gigi mengikut kadar florida yang selamat digunakan. Kajian ini akan melibatkan penyelidikan di mana pengambilan sampel air kencing digunakan untuk mengenal pasti tahap florida di dalamnya dan untuk mengenal pasti hubungannya dengan tahap florida dalam air minum. Air kencing dipilih sebagai sampel adalah kerana sistem perkumuhan utama florida dalam badan adalah melalui air kencing. Tahap florida dalam sampel air kencing akan diukur menggunakan alat Spektrofotometer dan mengenal pasti tahap selamat florida dalam sampel tersebut. Penyelidikan ini juga dapat meningkatkan tahap kesedaran masyarakat terhadap pendedahan florida.

3. APAKAH YANG PERLU ANDA LAKUKAN?

Peserta dikehendaki untuk mengambil sampel air kecing yang pertama setiap pagi untuk 3 hari berturut-turut. Peserta juga bertanggungjawab untuk memastikan sampel yang diambil merupakan sampel air kecing yang pertama untuk hari tersebut dan menjaga sampel dengan baik sebelum diserahkan kepada penyelidik.

4. SIAPA YANG TIDAK BOLEH MENYERTAI KAJIAN INI?

a) Peserta yang mengambil peperiksaan PT3 and SPM
b) Peserta yang mempunyai masalah kesihatan. (Cth; masalah buah pinggang)
c) Peserta yang menggunakan sistem penapisan air di rumah
d) Peserta yang menjadi penduduk di kawasan yang berdekatan dengan sekolah untuk jangka masa kurang dari 6 tahun

Kajian ini juga merupakan kajian secara sukarelawan daripada peserta. Peserta boleh menarik diri daripada penyertaan pada bila-bila tanpa sebarang penalti dari pihak penyelidik.Penyertaan juga akan dibatalkan serta merta sekiranya peserta memiliki ciri-ciri di atas semasa sampel sedang diambil.

5. APAKAH FAEDAH MENYERTAI KAJIAN INI?

a) KEPADA ANDA SEBAGAI PESERTA?

Peserta dapat mengetahui tahap florida dalam air kencing mereka and florida dalam air minum. Peserta juga dapat mengetahui tahap selamat florida yang dibenarkan di dalam air minum. Sekiranya peserta atau penjaga ingin mengetahu keputusan sampel air kencing, keputusan akan dimalumkan setelah kajian selesai. Di akhir penyertaan ini, peserta akan menerima hadiah kecil sebagai tanda penghargaan.

b) KEPADA PENYELIDIK?

Penyelidik dapat menyumbang satu penyelidikan yang berguna untuk menentukan hubungan di antara tahap florida dalam air kencing dan tahap florida dalam air minum. Hubungan ini dapat mengaitkan air minum sebagai salah satu sumber utama florida dalam air kencing.

6. ADAKAH IA BERISIKO?

Tidak. Kajian lepas membuktikan kelulusan etika daripada Institusi Ahli Semak dari Duke University bersama kelulusan bertulis dari pihak penjaga dan peserta. (Rango et al., 2014) Sampel yang telah diambil juga akan dihapuskan serta merta setelah kajian selesai.

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?

Nurhanis binti Zainal
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Bacelor Sains Kesihatan Persekitaran dan Pekerjaan,
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Fakulti Perubatan dan Sains Kesihatan,
Universiti Putra Malaysia.
Phone No: 012-3387305
Email address: 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 secara sukarela bersetuju membenarkan *anak / jagaan saya .... menyertai **penyelidikan tersebut di atas *(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 yang tercatat dalam Helaian Penerangan). Saya memahami bahawa *anak / jagaan saya berhak menarik diri dari penyelidikan ini pada bila-bila masa tanpa memberi sebarang alasan.Saya juga memahami bahawa sebarang maklumat yang berkaitan identiti *anak / jagaan saya akan dirahsiakan.

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

I setuju/tidak bersetuju untuk imej/gambar/rakaman video/ rakaman suara berkaitan dengan anak/ jagaan saya digunakan dalam apa jua bentuk penerbitan atau pembentangan. (sekiranya berkaitan).

*potong yang tidak berkenaan

Tandatangan ....
(*Ibubapa/ Penjaga*)

Tarikh :..

Tandatangan ....
(*Saksi*)

Nama :..

No. K/P: ....

Saya mengesahkan bahawa saya telah menerangkan kepada ibubapa/penjaga responden mengenai sifat dan tujuan penyelidikan tersebut di atas.

Tarikh ....

Tandatangan ....
(*Penyelidik*)

APPENDIX 6:
QUESTIONNAIRE

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

BACHELOR SCIENCE (ENVIRONMENTAL AND OCCUPATIONAL HEALTH)
FACULTY OF MEDICINE AND HEALTH SCIENCES

QUESTIONNAIRE

URINARY FLUORIDE LEVEL AND ITS RELATIONSHIP
WITH FLUORIDE IN DRINKING WATER AMONG
SCHOOL CHILDREN IN HULU LANGAT, SELANGOR

NAME : NURHANIS BINTI ZAINAL

MATRIC NUMBER : 178012

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-