UNIVERSITI PUTRA MALAYSIA

FLUORIDE EXPOSURE AND THE PREVALENCE OF DENTAL FLUOROSIS AMONG 12-YEARS OLD STUDENTS IN SEPANG, SELANGOR

BY:
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ABSTRACT

Fluoride has been associated with remineralisation of skeletal tissues. However, excess consumption of fluoride may lead to malformation of the skeletal tissues; namely skeletal and dental fluorosis. Exposure to fluoride mainly comes from drinking water and it is excreted mainly through urine. Therefore, the aim of this study was to study the exposure to fluoride in drinking water and the prevalence of dental fluorosis among 12-years old students in a rural area of Sepang, Selangor. Selected students (N=41) were asked about their past and current exposure information. Three days sample of urine and drinking water were collected to find the mean of current exposure to fluoride. The severity of dental fluorosis was determined using Total Score Index of Fluorosis (TSIF). It was found that the mean of urinary fluoride was 1.49±0.320 while the mean of fluoride in drinking water was 0.51±0.099. The prevalence of dental fluorosis was 51.3%; which consists of score 0 with 48.8%, score 1 and 2 with 22% respectively, score 3 with 2.4% and score 4 with 4.9%. The mean of dental fluorosis score was 0.93±1.13. The mean score for respondents who were breastfed for less than 12 months was 1.21±1.04 while for the respondents who were breastfed for more than 12 months was 2.72±2.78. There was no significant relationship between fluoride in drinking water and the score of dental fluorosis ($r=-0.329$, $p<0.05$ and also there was no significant relationship between urinary fluoride and dental fluorosis score ($r=-0.060$, $p>0.05$). It can be concluded that fluoride exposure through drinking water was not the major factor of causing dental fluorosis in this study. Breastfeeding could not be seen as a protective factor against the occurrence of dental fluorosis in this study.

Keywords: Fluoride, Dental Fluorosis, urine, drinking water, breastfeeding

PENDEDAHAN TERHADAP FLUORIDA DAN PREVALENS FLUOROSIS GIGI DI KALANGAN PELAJAR 12 TAHUN DI SEPANG, SELANGOR

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ABSTRAK

Fluorida sering kali dikaitkan dengan pemineralan tisu rangka. Namun, pengambilan fluorida yang berlebihan boleh menyebabkan malformasi tisu rangka seperti fluorosis rangka dan fluorosis gigi. Pendedahan terhadap fluorida secara umumnya berasal daripada air minum dan kebanyakannya dikumuhkan melalui urin. Justeru itu, kajian ini bertujuan untuk mengkaji pendedahan terhadap fluorida dalam air minum dan prevalens fluorosis gigi di kalangan pelajar 12 tahun di sebuah kawasan luar bandar di Sepang, Selangor. Pelajar terpilih (N=41) ditanya mengenai maklumat pendedahan lampau dan terkini terhadap fluorida; termasuklah maklumat penyususan badan. Sampel urin dan air minum untuk tiga hari dikumpulkan bagi mendapatkan min pendedahan terkini. Severiti fluorosis gigi ditentukan dengan menggunakan Indeks Keseluruhan Permukaan untuk Fluorosis (TSIF). Didapati bahawa min fluorida urin ialah 1.49±0.320 manakala min fluorida dalam air minum ialah 0.51±0.099. Didapati bahawa prevalens fluorosis gigi dalam kajian ini ialah 51.3% daripada responden mengalami fluorosis gigi; dengan skor 0 sebanyak 48.8%, skor 1 dan 2 sebanyak 22%, skor 3 sebanyak 2.4% dan skor 4 sebanyak 4.9%. Min skor fluorosis gigi ialah 0.93±1.13. Min skor bagi responden yang mengambil susu badan kurang daripada 12 bulan ialah 1.21±1.04 manakala bagi yang mengambil susu badan lebih daripada 12 bulan ialah 2.72±2.78. Didapati tiada perhubungan yang signifikan antara fluorida dalam air minum dengan kejadian fluorosis gigi ($r=-0.329$, $p<0.05$) dan juga tiada perhubungan yang signifikan antara fluorida urin dan kejadian fluorosis gigi ($r=-0.060$, $p>0.05$). Ini dapat disimpulkan bahawa pendedahan terhadap fluorida melalui bekalan air minum bukanlah faktor utama penyebab fluorosis gigi dalam kajian ini. Faktor penyusuan badan juga tidak dapat dilihat sebagai faktor penghalang bagi kejadian fluorosis gigi dalam kajian ini.

Kata kunci : Fluorida, Fluorosis Gigi, urin, air minum dan penyusuan badan

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LIST OF ACRONYMS

ATSDR	Agency for Toxic Substances and Disease Registry
EDTA	Ethylenediaminetetraacetic acid
FDI	Foreign Direct Investment
NIDCR	National Institute of Dental and Craniofacial Research
NIOSH	National Institute of Occupational Safety and Health
NSDWQ	National Standard of Drinking Water Quality
PPD	Pejabat Pendidikan Daerah
SPSS	Statistical Package for Social Sciences
TSIF	Total Surface Index of Fluorosis
US CDC	United States Centers for Disease Control and Prevention
US EPA	United States Environmental Protection Agency
US DHHS	United States Department of Human Health and Human Services
WHO	World Health Organization

CHAPTER 1

INTRODUCTION

1.1 Background

Fluoride is the ionic form of the element fluorine, the thirteenth most abundant element in the crust of the earth (US Public Health Service, 1991). It is classified as halogen compounds in the periodic table of elements. Fluoride is widely used in many products, ranging from fatal toxin such as sarin to life-saving antidote such as efaviranz and from inert gas such as carbon tetrachloride to highly reactive compound sulphur tetrachloride. There are various forms of fluoride; such as fluorspar (calcium fluoride), cryolite (sodium aluminium fluoride), fluoroapatite, fluorocarbonate, etc. Fluoride does exists naturally in certain plants, foods and body tissues (Rahimah, 1989). Besides that, fluoride is also used in manufacturing phosphate fertilisers, bricks and ceramic products (Izam, 2002).

In fact, our water supply is also equipped with certain amount of fluoride. Ministry of Health Malaysia has been supplied fluoridated water to the community since 60 years ago (Khairiyyah, 2011). The provision of fluoride basically is to prevent dental caries among the community. Fluoride is the most effective way to protect dental health as it influences the prevention of dental diseases (Ishii, 1991).

Fluoride is incorporated into the crystal lattice structure of teeth and skeletal tissue by replacing some hydroxyl ions within the unit cells of hydroxyapatite, producing partially fluoridated hydroxyapatite (such as fluorhydroxyapatite) (WHO, 1994). Fluorohydroxyapatite is more resistance to acid. However, this is not necessarily good for the community as people nowadays use fluoridated toothpaste daily in spite of taking foods and beverages that contain fluoride. Excess fluoride does not merely excrete out of the body, however, some amounts of fluoride will be absorbed and retained in the body tissues. Fluoride will be absorbed by the bone and teeth when intake of fluoride is high (Knight, 1994).

This excess fluoride will cause hypomineralisation of the tissues and this is known as fluorosis (Den Besten, 1992). Fluorosis is not an uncommon disease in the community. There are two types of fluorosis; namely dental and skeletal fluorosis. More than half of the 16-years old teenagers have dental fluorosis according to Ministry of Health in 1998. Dental fluorosis is a hypomineralisation of teeth enamel due to chronic ingestion of fluoride (Horowitz, 1986). Furthermore, fluorosis is

rarely known by the community and this causes people to be unaware of the risks and the preventive measures that should be taken.

1.2 Problem Statement

The possible reason for the occurence of fluorosis cases in recent days might be due to excessive consumption of fluoride from various sources; such as drinking water, fluoridated toothpaste, foods and beverages (Mascarenhas, 2000; Levy, 2010).

Although the fluoride concentration supplied in household water is at the optimum level for human consumption, people in recent days have access to other various sources of fluoride, most commonly from toothpaste. To make situation worse, consumption of fluoride in form of solution causes more fluoride ions absorbed into the body (Rahimah, 1989). Other foods and beverages that is high in fluoride such as mackerel, sardines, cabbage and tea are also widely consumed by people (Zubaidah, 1992).

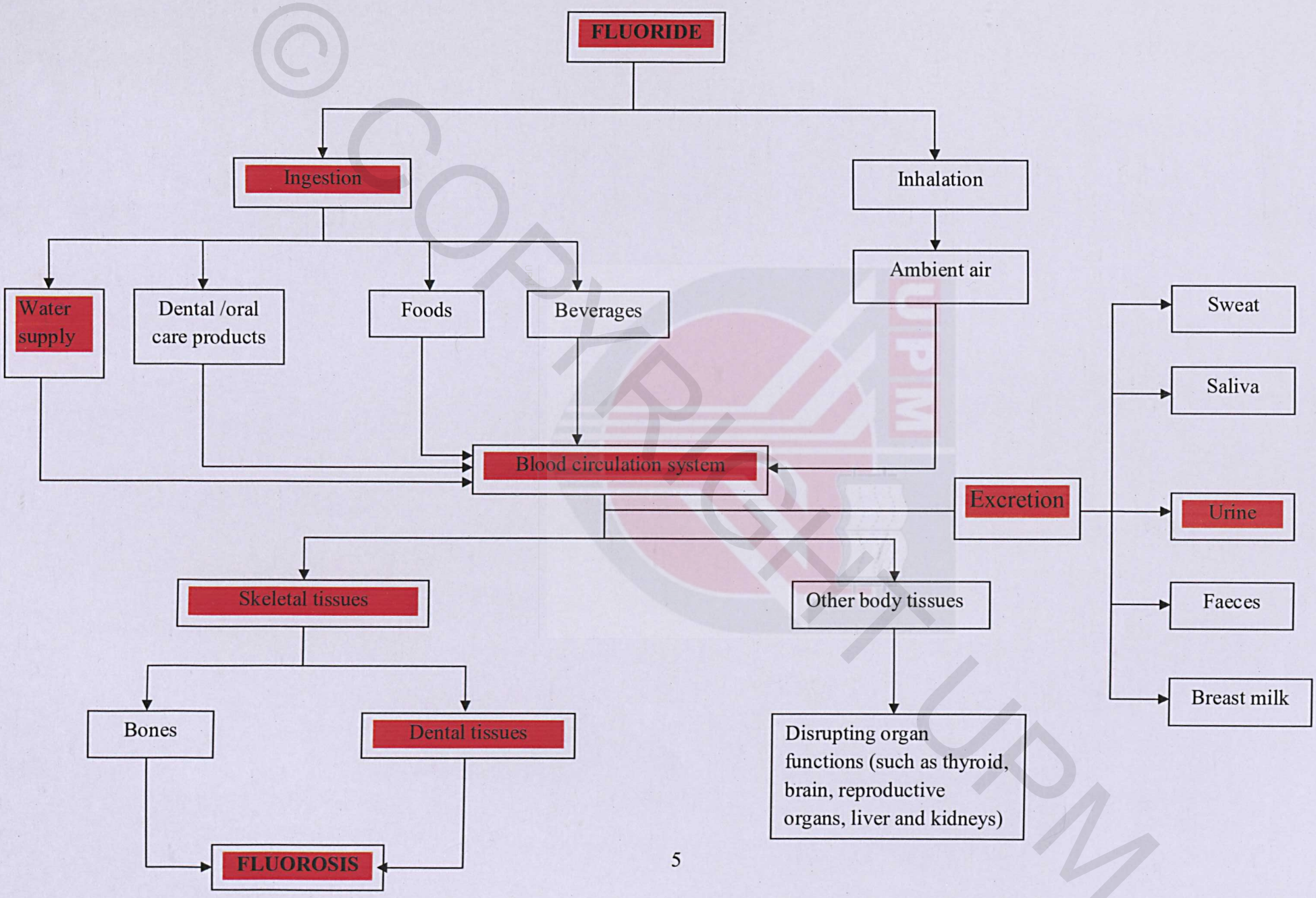
The effectiveness of water fluoridation alone cannot be determined these days (Lewis, 1994). Exposure to all these sources of fluoride actually is already

excessive for our body and excessive fluoride can be related to various diseases. Prevalence of dental fluorosis increased over decades either using fluoridated water or not due to widespread usage of other fluoridated products (Clark, 1997). Furthermore, excess fluoride intake (more than 1 ppm) can cause fluorosis if fluoride is taken during teeth development period (Duxbury, 1982). Chronic intake and topical exposure may cause dental fluorosis, and excess systematic exposure can lead to systemic effects such as skeletal fluorosis (American Dental Association, 2006).

The most serious effect is the skeletal accumulation of fluoride from long-term excessive exposure to fluoride and its effect on non-neoplastic bone disease — specifically, skeletal fluorosis and bone fractures. There is clear evidence from India and China that skeletal fluorosis and an increased risk of bone fractures occur at total intakes of 14 mg fluoride/day and evidence suggestive of an increased risk of bone effects at total intakes above about 6 mg fluoride/day (WHO, 2002). There is only a narrow margin between safe and harmful level of fluoride for human consumption (WHO, 1984).

Excess fluoride intake has been proven to cause dental and skeletal fluorosis (Shani, 2009). Severe dental fluorosis can lead to teeth corrosion, fraction for unsupported enamel and affecting cosmetically aspects (Horowitz, 1986). Excess fluoride intake can also be related to metabolic changes of soft tissues such as thyroid, brain, liver, kidneys and reproductive organs (Ruiz, 2005).

CONCEPTUAL FRAMEWORK



1.3 Study Justification

This study was done to find the relationship between excessive fluoride intake and the occurrence of dental fluorosis. As mentioned before, people in these days get exposed to various sources of fluoride, not just from the tap water. Furthermore, they do not really even know about the effects from excessive consumption of fluoride. The effects may occur in long-term effects; such as osteoporosis and metabolic changes of soft tissues such as thyroid, brain, liver, kidneys and reproductive organs. (Ruiz, 2005). 56% of 16 years old Malaysian students have enamel problems (Ministry of Health Malaysia, 2002). Younger people (including teenagers) tend to absorb fluoride more compared to excrete it (Rahimah, 1989). This study can highlight the effects from the excessive consumption of fluoride in daily life. Furthermore, only few exposures to fluoride studies are available in Malaysia. The findings from the study can be utilised by relevant authorities; such as Ministry of Health Malaysia to instil awareness of fluorosis and reduce fluorosis cases beginning from infancy.

This study also aims to estimate when fluorosis happened by analysing the teeth of the respondents. Past and current exposure can be detected by analysing the teeth. If the occurrence of fluorosis is related to current exposure, some control measures can be done in reducing the exposure to fluoride and this will benefiting the community. 12-years old students is chosen to be the respondents in this study as

at this age, permanent teeth development has already completed; except for the third molar (American Dental Association, 2011). Therefore, a complete conclusion could be drawn from the observation of the permanent teeth and its relationship with the occurrence of dental fluorosis.

1.4 Study Objective

1.4.1 General Objective

To study the exposure to drinking water and the prevalence of dental fluorosis among 12-years old students in Sepang, Selangor.

1.4.2 Specific Objectives

1. To determine the mean concentration of urinary fluoride among the respondents.
2. To determine the mean concentration of fluoride in drinking water used by respondents at home.
3. To determine the prevalence and severity of dental fluorosis among the respondents.

4. To determine the relationship between fluoride concentration in drinking water and dental fluorosis score.

5. To determine the relationship between the concentration of urinary fluoride and dental fluorosis score among the respondents.

6. To determine the breastfeeding duration and its effect on the score of dental fluorosis among the respondents.

7. To determine the difference of the dental fluorosis prevalence among the genders.

1.5 Variables

Independent variable: Fluoride in drinking water

Dependent variable: Concentration of fluoride in urine and dental fluorosis teeth score

1.6 Hypotheses

1) There is a significant relationship between fluoride concentration in drinking water and the occurrence of dental fluorosis.

2) There is a significant relationship between the urinary fluoride and the occurence of dental fluorosis.

3) Respondents with longer breastfeeding duration will have lower prevalence of dental fluorosis.

4) Prevalence of dental fluorosis is higher in girls compared to the boys.

1.7 Study Limitations

There were few limitations in this study. Firstly, measurement of urine was taken only once a day rather than the urine sample should be taken for 24 hours. Secondly, other possible exposure of fluoride, such as dietary intake and toothpaste ingestion was not taken into account in this study. Last but not least, other effects of excessive exposure to fluoride; such as skeletal fluorosis and other metabolic changes were not taken into account in this study.

CHAPTER 2

LITERATURE REVIEW

2.1 Fluoride

Fluoride plays an important role in teeth development especially during teeth calcification process among children among children. Fluoride is also important in preventing dental caries. Fluoridated water is the most effective way to protect dental health. This is because water is an essential nutrient and when fluoride is combined with the water, it can influence the prevention of dental diseases (Ishii,1991).

In 1936, Dean stated at 1.0 ppm concentration of fluoride in water supply will not cause dental fluorosis. Dean also stated that the optimum level of fluoride can reduce the incidence of dental caries (John, 1999).

Fluoride is supplied to the community in two ways; the first one is the systemic therapy, where fluoride is consumed through dietary intake and stored in

the body for dental development. The second way is the topical therapy. Topical therapy means applying fluoride directly onto teeth surface. This is crucial to prevent plaque formation by acting on bacterial enzyme system and protecting teeth root and coronal. Among the examples of topical therapy are fluoridated toothpaste, fluoridated mouth rinse and fluoridated dental floss (American Dental Association, 2005).

The theory of fluoride action was based on the belief that incorporation of fluoride into the hydroxyapatite of developing tooth enamel in the pre-eruptive phase reduced the mineral solubility, thereby increasing enamel resistance as the length of time the tooth is at risk of caries during the post-eruptive phase (Clarkson, 1996). These effects are based on fluoride's role in the aqueous phase around the tooth, both in saliva and in dental biofilm (plaque). Fluoride in plaque contributes to the remineralisation of demineralised enamel when bound fluoride is released during an acid challenge, resulting in a more acid-resistant enamel surface structure. Fluoride also has been shown to inhibit the process of glycolysis by which fermentable carbohydrates are metabolized by cariogenic bacteria to produce acid (National Institute of Dental and Cranofacial Research, 2011).

2.2 Sources of Fluoride

2.2.1 Natural sources

Fluorides are released into the environment naturally through the weathering and dissolution of minerals, in volcano emissions and in marine aerosols. Fluorides are released into the environment via coal combustion, process waters and waste from various industrial processes, including steel manufacturing, metals production, phosphate ore processing and glass manufacturing (WHO, 2002).

2.2.2 Dental care products

There are various types of dental care products nowadays that focus on protecting dental health mainly on preventing dental caries. Among the popular products are fluoridated toothpaste, fluoridated mouth rinse, fluoridated tablet and dental surgery and treatment products; such as gel, varnish and paints.

A study conducted by Rahimah Abdul Kadir and Latifah Abdul Latif (1998) to determine the fluoride level in 20 toothpaste samples in the market. It was found that only two products out of twenty samples comply with the standard. The fluoride level is mainly at 20-1970 ppm. The toothpaste that is used for School Dental Care contains 750 ppm of fluoride. There was a study stated that children aged 2 or below

can increase the risks of getting fluorosis if they use toothpaste that contain 1000 parts per million (ppm) of fluoride. For most people which includes children, adolescents and adults brushing at least twice a day with a fluoride toothpaste (US CDC, 2011).

In United States, it was proposed that toothpastes that contain fluoride more than 1100 ppm should be labelled "not suitable for children below 6 years old (Rahimah, 1998). Below are some of the fluoridated toothpastes that are available in the Malaysian market. It was found that only a few toothpastes do not contain fluoride; such as Sensodyne, Zact and Zaitun (Musa, 1998).

Table 2.1: Few toothpaste brands and the respective fluoride concentration

Toothpastes	Concentration of fluoride (in ppm)
Colgate (Total)	1020
Darlie	320
Sparkle	100
Fresh & White	200
Oral-B	300
Pepsodent	120

Source :Rahimah et.al. (1998)

2.2.3 Drinks and beverages

Tea is one of the most common beverages in the world yet tea is also one of the beverages that high in fluoride, depending on the types. Tea dry leaves contain about 75-100 ppm of fluoride. When the dry leaves immersed in the water, fluoride from the leaves will be extracted out into the water, thus ingested by our body (Rahimah, 1989). Besides that, other fruit juices also contain significant amount of fluoride, such as grape juice, apple juice and cherry juice. Grape juice is one of the juices that contain the highest amount of fluoride, which is 1.45 ppm. Grape juice for example is one of the favourite drinks among children and frequent intake of such drinks might increase the exposure to fluoride (Kiristy, 1996).

2.2.4 Foods

Examples of high-fluoride foods are fishes; especially sardines. (Zubaidah, 1992). Cabbage is the vegetable that has the highest amount of fluoride (more than 40 mg/kg). Vegetables that are processes by using fluoridated water causing the fluoride content to double. Below are some foods with their respective fluoride amount (Table 2.2):

Table 2.2: Certain foods and the respective fluoride concentration

Foods	Fluoride concentration (in ppm)
Beer	0.15 – 0.86
Cereals	0.18 – 2.8
Citrus fruits	0.07 – 0.17
Non-citrus fruits	0.03 – 0.84
Coca cola	0.07
Coffee	0.20 - 1.6
Instant coffee	1.7
Tea	0.1 – 2.0
Instant tea	0.2
Lean fish	1.0
Sardines	8.0 – 40.0
Grape juice	0.0 – 6.3
Vegetables and potato	0.02 – 0.9
Shrimp meat	0.4
Shrimp skin	18.0 -48.0

Source: Rahimah (1989)

2.3 Fluoride usage

The use of fluoride as a preventive measure for dental caries over the latter half of the last century has clearly contributed to the overall reduction in prevalence of dental caries worldwide (Brambilla, 2001; Ellwood, 2003). Most of the improvements in children's dental health are attributable to the widespread availability of fluoride-containing toothpastes since the 1970s (Pizzo, 2007). The joint FDI/WHO working group for Oral Health Research and Epidemiology indicated that the factor common to all countries with substantial reductions in caries prevalence was fluoride, either as fluoridated water or toothpaste (Petinci, 2005).

Fluoride is also widely used in various industries. Cryolite (sodium aluminium fluoride) is used in manufacturing aluminium. Aluminium fluoride is used for making flux for ceramic production. Fluoridated compound is used for gold purification, phosphate and silicate extraction. Fluorocarbon polymer is used in electrical products, insulator, gasket, valve and lubricants. Last but not least, fluoridated compounds such as sodium fluoride and sodium sulphur fluoride are also used in making pesticides (Oon, 2000).

Hydrofluoric acid is one of the acids that is widely used in the industry. It is produced from the reaction between calcium fluoride and sulphuric acid to produce hydrofluoric gas which is cooled and stored as a liquid. It is used in etching and

polishing glass, cleaning stone, brick and marble and in the manufacture of pesticides, plastics and high octane fuels. In home, it is found in rust removers, aluminium brighteners and heavy duty cleaners (Minnesota Poison Control System, 2009).

2.4 Fluoride Metabolism

2.4.1 Absorption

There are three routes of entrance for fluoride into the body. The ways are through gastrointestinal tract (by ingestion), lungs (by inhalation) and skin (by direct contact). However, the latter is quite uncommon. The absorption duration is different depending on the solubility of the fluoridated compounds. Almost all water-soluble fluoride will be absorbed by the digestive system rather than the insoluble one (American Dietetic Association, 1994).

The absorption becomes more faster when the fluoride ingested in small dose, ionised and soluble form in water (Rahimah, 1989). Fluoride compounds with low solubility are poorly absorbed. The absorption process occurs mainly by passive

diffusion. It is absorbed principally from both the stomach and the intestine. There is no convincing evidence that active transport processes are involved. The mechanism and the rate of gastric absorption of fluoride are related to gastric acidity. Fluoride compounds that occur naturally or are added to drinking water will yield fluoride ions, which are almost completely absorbed from the gastrointestinal tract. On the other hand, if fluoride is ingested with foods that contain other chemical constituents, the absorption of fluoride is reduced due to binding of fluoride to other chemical constituents (WHO, 2002).

For inhalation, the absorption of fluoride depends on the solubility and the particulate size. As for direct contact, acute absorption to the circulatory system may cause damage to the vascular system (WHO, 2002).

2.4.2 Distribution and storage

Absorbed fluoride will be distributed to the whole body and stored in the tissues. In humans and laboratory animals, approximately 99% of the total body burden of fluoride is retained in bones and teeth (Kaminsky, 1990; Hamilton, 1992), with the remainder distributed in highly vascularized soft tissues and the blood (McIvor, 1990). The ion usually stored in calcified tissues, such as bone and teeth (WHO, 2002). Fluoride does not bind to plasma proteins in the blood (Taves, 1968).

Fluoride will be absorbed by bone and teeth when the intake of fluoride is high and fluoride will be excreted from bone and teeth when amount of fluoride is low in blood. The concentration of fluoride in bone varies with age, sex and the type and specific part of bone and is believed to reflect an individual's long-term exposure to fluoride (WHO, 2002).

When fluoride intake is excessive for continuous period, fluoride will be stored permanently in bone and teeth. At this stage, fluorosis occurs at bone and teeth. On the other hands, if fluoride concentration is very low in the body, fluoride will be excreted from bone and teeth to the blood (Knight, 1994).

Steady-state fluoride concentrations are achieved more rapidly between plasma and well-perfused tissues, such as the heart, lungs and liver, than between plasma and less well-perfused tissues, such as resting skeletal muscle, skin and adipose tissue. For vertical transmission, human studies have shown that the placenta is not any sense of barrier to the passage of fluoride to the foetus (WHO, 2002).

2.4.3 Excretion

Fluoride is excreted out from the body through urine, sweat, saliva, faeces and breast milk. Excretion of fluoride depends on three factors; namely total intake

of fluoride, total exposure of fluoride and the kidney function. (Krishnamachari, 1987). The major route for fluoride excretion is through urine, which constitutes about 90-95% from total excretion of fluoride. Most of the fluoride ingested from drinking water will be excreted through urine at least 3 hours after intake (Rahimah,1989). The excretion of fluoride in urine is reduced in individuals with impaired renal function (Schiffl, 1980; Spak, 1985; Kono, 1986).

Fluoride excretion from faeces usually accounts for less than 10% of the amount ingested each day (Ekstrand, 1984). However, the percentage can rise up to 30% if the total intake of insoluble fluoride is high. Excretion through saliva represents about 0.01-0.05 ppm daily. However, this is not the real amount from the saliva as some of the saliva will be swallowed back into the digestive system and excreted through other media. Excretion of fluoride from sweat is about 0.3-0.4 ppm daily. Fluoride is also excreted through breast milk. The amount is about 0.1 ppm daily. Dabeka (1986) reported that the concentration of fluoride in breast milk was related to the fluoride content of the drinking-water consumed by the women. Besides that, the fluoride content of human breast milk represents the natural daily fluoride intake during the first 6 months of life. This is especially important when comparing the daily fluoride intake by formula-fed and breast-fed infants.

2.5 Health Effects of Fluoride

Fluoride has both positive and negative effects on human health, there is a relatively narrow range between intakes associated with beneficial effects and exposures causing adverse effects compared with many other chemicals. The health effects basically can be divided into two; acute and chronic.

2.5.1 Acute effects

Acute oral exposure to fluoride may produce effects including nausea, vomiting, abdominal pain, diarrhoea, fatigue, drowsiness, coma, convulsions, cardiac arrest and death (Kaminsky, 1990; Whitford, 1990; Augenstein, 1991; ATSDR, 1993). Severe tissue damage, respiratory effects, cardiac arrest and deaths have been recorded in case reports of individuals exposed accidentally to hydrofluoric acid through dermal contact (Buckingham, 1988; Upfal & Doyle, 1990; Bordelon, 1993).

The toxicity of fluoride depends on the type of compound ingested. Generally, the more soluble salts of inorganic fluorides are more toxic that those that are either weakly soluble or insoluble (WHO, 1984). Gastrointestinal effects produced by the acute ingestion of toxic amounts of fluoride likely arise from the

corrosive action of hydrofluoric acid, which is produced within the acidic environment of the stomach (Spak, 1990; Whitford, 1990; Augenstein,1991).

2.5.2 Dental Fluorosis

Dean (1934) has mentioned that the relationship between fluoride intake and dental fluorosis is clear. Dental fluorosis has been recognised when people were exposed to naturally occurring fluoride in drinking water. It has always been more prevalent in fluoridated than non-fluoridated areas. It ranges from very mild symmetrical whitish areas on teeth (very mild dental fluorosis) to pitting of the enamel, frequently associated with brownish discolouration (severe dental fluorosis). The very mild form is barely detectable (US Public Health Service. 1991). Very mild to mild fluorosis has no effects on tooth function and might increase the resistance to decay. Moderate and severe forms of dental fluorosis, considered by some investigators as presenting a cosmetic problem, do not appear to produce adverse dental health effects, such as the loss of tooth function (US Public Health Service, 1991).

Dental fluorosis occurs during enamel formation of permanent teeth (except for third molars) which take place from about the time of birth until approximately five years of age. After the enamel formation is completed, dental fluorosis will not occur even though excessive fluoride is ingested. Therefore, the crucial period for

dental fluorosis development is during the teeth formation under the gums. Teeth that have erupted are not at risk for getting dental fluorosis (American Dental Association, 2005).

Dental fluorosis has been classified in a number of ways. Dean (1934) developed a fluorosis index which classified individuals into 5 categories, depending on the degree of enamel alteration, and which was based on the identification of the 2 most severely affected teeth, giving ordinal numbers as the severity of the enamel alteration increased. This index was later modified by Moller (1982). Thylstrup and Fejerskov (1978) developed an index (T-F) based on the biological aspects of dental fluorosis, classifying individuals into 10 categories characterizing the macroscopic degree of fluorosis in relation to histological aspects. In the original classification, buccal, occlusal and lingual surfaces were examined. Horowitz et al. (1984) developed a fluorosis index based on aesthetic aspects of tooth surface (TSIF) classifying individuals into 8 categories.

2.5.3 Skeletal fluorosis

Skeletal fluorosis is a pathological condition that may arise following long-term exposure (either by inhalation or by ingestion) to elevated levels of fluoride. Although the incorporation of fluoride into bone may increase the stability of the

crystal lattice and render the bone less soluble, this will cause bone mineralization is delayed or inhibited (Grynpas,1990), and consequently the bones may become brittle and their tensile strength may be reduced.

The severity of the effects associated with skeletal fluorosis is related to the amount of fluoride incorporated into bone. An individual's age and stage of skeletal development will affect the rate of fluoride retention. The amount of fluoride taken by bone and retained in the body is inversely related to age. Furthermore, a number of factors, such as age, nutritional status, renal function and calcium intake, in addition to the extent and duration of exposure, can influence the amount of fluoride deposited in bone and consequently the development of skeletal fluorosis (US DHHS, 1991).

Individuals with impaired renal function, such as those with diabetes, may be more prone to developing fluoride-related toxicological effects due to their diminished excretion of fluoride (Kaminsky, 1990; US DHHS, 1991). More fluoride is retained in young bones rather the bones of the older adults (Levy, 1994; Whitford, 1996). A consistent finding in cases of chronically elevated fluoride uptake is an increase in mineralization lag time of bone.

2.5.4 Dental Caries

Fluoride was considered to improve lattice stability and render the enamel less soluble to acid demineralisation incorporation of fluoride into enamel as partially fluoridated hydroxyapatite. However, there is an increasing body of evidence to suggest that a substantial part of the cariostatic activity of fluoride is due to its effects on erupted teeth and the continual presence of fluoride in the saliva and in the fluid phase of dental plaque is critical to its mechanism of action.

Since the introduction of controlled fluoridated drinking-water, efforts to reduce dental caries have been extended to include the use of fluoridated toothpaste, mouth rinses and topically applied dental treatments (e.g., gels, varnishes, solutions), as well as through the use of other fluoride supplements. The use of these products including dentrifices is considered to be one of the major factors responsible for the gradual decline in the prevalence of dental caries in most industrialized countries. In areas where the prevention of dental caries through the widespread use of fluoridated drinking-water, salt or milk may not be feasible, the use of fluoridated toothpastes remains an effective means of improving dental health (WHO, 2002).

2.5.5 Enzyme Inhibition

Fluoride inhibits the enzyme activity by binding to the active site of the enzyme. Fluoride usually competes with metal ions to bind at the active site of the enzyme. If the concentration of fluoride is high, therefore, enzymatic activities will be disrupted due to binding of fluoride to the active site (Rosenstock, 1994).

2.6 Fluoride in Drinking Water

Fluoride is ubiquitous in the environment and it is not impossible that the sources of drinking water are likely to contain at least small amount of fluoride. The amount of fluoride in water bodies are depending on the geological environment from which the water is obtained (WHO, 2002). It is estimated that over 300 million people worldwide have access to fluoridated water (Hamdan, 2003).

Water fluoridation has been introduced in Malaysia as early as 1957 under water fluoridation programme. Fluoridated compounds such as sodium silico fluoride, sodium fluoride, hydrofluorosilic, aluminiumfluorosilic, and calcium fluoride have been used in the programme (Rahimah, 1986). This is one of the examples of systemic therapy for dental caries (Chellapah, 1986; Joyston, 1994).

In determining the standard fluoride content in water supply, there are few factors need to be considered; such as climate, average water intake and fluoride intake from other sources. Optimal fluoride concentration in warm regions should remain below 1 mg/litre (1 ppm) while the concentration can go up to 1.2 mg/litre (1.2 ppm) for temperate regions. The reason is that perspiration occurs more in warm regions thus water intake is also increased to replenish water in the body (WHO, 1984). In Malaysia, the level of 0.7 ppm (parts per million) was recommended in 1971 by a special committee of inquiry appointed to report upon the fluoridation of public water supply (Khairiyyah, 2011).

2.7 Fluoride in Urine

The relationship between fluoride absorption is inversely related to the calcium absorption, which fluoride will be less absorbed when the concentration of calcium is high in the body. Fluoride balance, fluoride tissue concentration and fluorosis risks increase along with the increase of protein nutrients, topological factors of the residential area and metabolism, which all the factors will reduce urine pH value. On the other hands, intake of vegetable nutrients and medical conditions will reduce the balance of fluoride and reduce the risks of fluorosis (Whitford, 1989).

2.8 Teeth development

Ingestion of fluoride during critical periods of teeth development may result in a range of visually detectable changes in enamel opacity that are termed enamel fluorosis, a type of hypomineralisation of the enamel (Den Besten, 1992). Dental or enamel fluorosis occurs when excess amounts of fluoride are ingested during tooth development (ATSDR, 2003). Generally, the greater the amount of fluoride intake during tooth development, the greater the prevalence of enamel fluorosis will be.

Tooth development begins from *in utero* stage. For permanent teeth, teeth calcification starts from as early as infancy (3 months of age) until approximately 3 years old; except for the third molar (7-9 years old). Incisors (foremost teeth) begin to calcified starting from 3-4 months of age whilst the second molar (most backwards) begin to calcified starting from 2 ½ years until 3-years old (Ash, 2003). Infant formula processed with fluoridated water may be a significant source of fluoride in infants (Levy 1994; Fomon, 2000). Continue use of liquid or powdered concentrate infant formulas reconstituted with optimally fluoridated drinking water is a potential risk for enamel fluorosis (American Dental Association, 2011). Besides that, usage of fluoridated toothpaste from among young children is also recognised as one of the sources of causing dental fluorosis (CDC, 2011).

CHAPTER 3

METHODOLOGY

3.1 Study location

The study was conducted at SK Sungai Merab Luar (Sungai Merab Luar primary school) which is located in Dengkil, north-east of the Sepang district, Selangor. This school is administered under Sepang District Education Office (PPD Sepang). The location map is attached at the Appendix 8.

3.2 Study design

A cross-sectional study was conducted to study the exposure to fluoride from drinking water and the prevalence and severity of dental fluorosis among 12 years old students. The independent variables (exposure to fluoride from drinking water) and the dependent variables (urinary fluoride and the prevalence

and severity of dental fluorosis) for this study are obtained in a "snapshot" (in one time) period.

3.3 Sampling techniques

The study population consists of 12-years old students. 12-years old students were chosen as the respondents as the growth of permanent teeth is fully completed at this age (except for the third molar) (American Dental Association, 2011). Name list of students from the required ages was obtained from the school. The sampling technique that was used is purposive sampling. Students that met with the inclusive criteria were selected to become the respondents while students that had the exclusive criteria were excluded from the study. Below are the inclusive and exclusive criteria:

Table 3.1: Study inclusive and exclusive criteria

Inclusive Criteria	Exclusive Criteria
Age 12 years old	Below 12 years old and above 12 years old
Free from kidney and nephrological disorders/diseases	Have kidney and nephrological disorders/diseases
Free from diabetes mellitus	Have diabetes mellitus
Has been living in the same housing area for past 6 years	Has been living in the same housing area for less than 6 years

Selected students were asked for their consent and parental consent for participating in this study. Students were free to withdraw from the study if they feel uncomfortable and intrusive. This study was subjected to ethical values stated by the Ethical Committee of the faculty.

3.4 Sample size

The sample size of the study was determined as stated below:

Variation estimation in the population; with standard deviation : ð = 2e

Errors allowed = 5% (0.05)

Sample size determination formula:

$N = p(100-p)/e^2$

$N = 0.316(1-0.316)/0.05^2$

$= 0./0.0025$

$= 86.4$

(equivalent to 86)

From the calculation, the minimum sample size for this study is 75. The prevalence (p value) is determined by a recent study by Shaharuddin (2010), which stated the prevalence of dental fluorosis among 12-years old children was at 31.6%. The number of respondents joined the study was fewer from the minimum number required from the sample size calculation. This was due to high

refusal rate, dropout rate and some of the respondents did not obtain consent from their parents. All in all, there were 41 respondents in the study.

3.5 Reliability Test

The reliability of the study was ensured in few ways. Firstly, the questionnaire used in this study was administered to 10% of the required sample size population. This was to ensure the questionnaire is effective and can be understood by the respondents. Besides that, spectrophotometer DR2800 was calibrated prior to the start of the study. 10% from the test sample (urine and drinking water) were analysed first to ensure the validity of the instrument used.

3.6 Data collection

3.6.1 Urine

Three urine samples were collected for three consecutive days (each sample a day) for analysing the present concentration of fluoride in urine. Urine is one of the biomarkers of fluoride exposure as pointed by World Health Organization. First urine of the day was chosen as the sample. This is because

fluoride consumed night before will be excreted and this gave a rough idea of the amount consumed. Urine was collected in 50 ml container bottle. Urine was preserved by adding 0.2g EDTA to avoid fluoride in the urine binds with other cation, such as calcium. Urine samples then were stored in cool container in the lab.

3.6.2 Drinking water

Three drinking water samples were collected for three consecutive days (each sample a day) for analysing the concentration of fluoride in drinking water. The water sample was collected from the tap water that is used for drinking purposes. Water samples were collected in 250 ml container bottle. No preservation is needed according to United States Environmental Protection Agency (US EPA) as the holding time for the sample is 28 days from the sampling date.

3.6.3 Questionnaire

A questionnaire was used in eliciting important information regarding this study. The questionnaire is divided into few parts; Part A (students background), Part B (students' dental health quality) and Part C (fluoride exposure

information), Part D (family information), Part E (Breastfeeding information) and Part F (Dental Fluorosis score). For Part B, the questionnaire was adopted from National Oral Health Survey (under Ministry of Health Malaysia) questionnaire. Among important points in the questionnaire were oral health status, frequency of using toothpaste daily, drinking habits, daily intake of drinking water and toothpaste used. Additional questions such as breastfeeding period and intake of formulated milk were added to enrich the questionnaire and to find the relationship between breastfeeding period and the occurrence of dental fluorosis (Appendix 6).

3.6.4 Dental Fluorosis Score Index

Dental fluorosis score index was determined by using Total Surface Index of Fluorosis (TSIF) by Horowitz in 1984. The score was determined by a competent dentist from University Health Centre by examining the teeth surface. Findings were recorded on the dental inspection card (Appendix 7) and the result was interpreted by the dentist according to TSIF.

3.7 Equipments and reagents

Below are the equipments and reagents that were used in this study:

- Spectrophotometer DR2800 with SPADNS method - to analyse the concentration of fluoride in urine and drinking water
- Questionnaire – to obtain information regarding exposure to fluoride
- Tooth Surface Index of Fluorosis (TSIF) score card – to record the occurrence of dental fluorosis and to analyse the severity of dental fluorosis
- EDTA (Ethylenediaminetetraacetic acid)
- Sample bottle (50 ml sample container for urine collection and 250 ml sample bottle for drinking water collection)

3.8 Measurement

3.8.1 Urine

Before sampling, 0.2g EDTA was prepared in the container sample. The function of EDTA is to prevent fluoride from binding to other cations; such as

calcium which will impair the result. Before analysing the samples, each sample was shook for few times. This is to dissolve any precipitation that might be existing in the solution. Besides that, bacterial growth can be avoided by shaking the sample.

3.8.2 Fluoride concentration analysis

Fluoride concentration in urine and drinking water were analysed using a Spectrophotometer DR2800 by using SPADNS method. The method was approved by United States Environmental Protection Agency (US EPA). SPADNS method works by the reaction of fluoride with a zirconium dipper. The reaction will form a clear solution. The wavelength was set at 580 nm. 10 ml of urine was pipetted with 2 ml SPADNS into the dry sample cell before obtaining the reading. Urine must be at the room temperature before analysis.

3.9 Total Surface Index of Fluorosis (TSIF)

Total Surface Index of Fluorosis is a method of analysing the severity of dental fluorosis. The score was improvised by Horowitz, et. al. in 1984. The index

Table 3.2: Total Surface Index of Fluorosis scores and its respective description

Scores	Description
0	Enamel shows no evidence of fluorosis
1	Enamel shows definite evidence of fluorosis, namely areas which parchment-white colour that total less than one-third of the visible enamel surface.
2	Parchment-white fluorosis totals at least one-third of the visible surface, but less than two-thirds
3	Parchment-white fluorosis totals at least two-thirds of the visible surface
4	Enamel shows staining in conjunction with any of the preceding levels of fluorosis. Staining is the definite discoloration of teeth ranging from light to very dark brown
5	Discrete pitting of enamel exists, unaccompanied by evidence of staining of intact enamel.
6	Both discrete pitting and staining of the intact enamel exist
7	Confluent pitting of the enamel surface exists. Dark brown stain usually present. Anatomy of tooth might be altered and large portion of enamel might be lost.

3.10 Quality control

All sample containers and bottles were washed using deionised water and detergent before taking for sampling. Deionised water was used as there is no possible cross-contamination between the ionic compounds in the water with the sample. Dry sample cells for spectrophotometer analysis were handled carefully by not touching on its tips. Gloves were worn when handling the dry sample cell to avoid the reading errors due to fingerprints. A blank media was used for every 10 samples analysis. This was to ensure the validity and reliability of the data. The method used for analysis urine and drinking water was strictly adhered to SPADNS method which is certified by US Environmental Protection Agency (US EPA).

3.11 Data Analysis

All data were analysed using the Statistical Package for Social Science (SPSS) Version 15.0. Table 3.3 shows the statistical analyses that were used for each specific objective:

Table 3.3: Statistical tests used for analysing the objectives

Specific Objectives	Statistical Test	
	Parametric	**Non-parametric**
1) To determine the mean concentration of fluoride in drinking water among respondents.	Descriptive statistics (mean, minimum and maximum value and standard deviation)	
2) To determine the mean concentration of urinary fluoride among the respondents.	Descriptive statistics(mean, minimum and maximum value, and standard deviation)	
3) To determine the prevalence and severity of dental fluorosis among the respondents.	Descriptive statistics(mean, percentage, minimum and maximum value, and standard deviation)	
4) To determine the relationship between the concentration of fluoride in drinking water and the score of dental fluorosis.	Pearson's correlation test	Spearman-rho correlation
5) To determine the relationship between the concentration of urinary fluoride and the score of dental fluorosis among the respondents.	Pearson's correlation test	Spearman-rho correlation
6) To determine the breastfeeding duration and its effect on the score of dental fluorosis among the respondents.	Descriptive statistics (percentage and mean)	
7) To determine the difference of dental fluorosis prevalence among the genders.	Descriptive statistics (percentage) and Mann-Whitney test	

3.12 Ethical consideration

The study was conducted only after ethical clearance has been obtained from Ethical Committee, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia. Below are the ethical considerations that are involved in this study:

i) The respondents were being given ample explanation regarding the objectives of the study.

ii) The respondents were briefly explained about their rights' prior to the study.

iii) The respondents were given explanation on the purpose of taking samples; such as urine and drinking water samples.

iv) The respondents were given explanation on the purpose of obtaining the information through the questionnaire.

v) All information collected from the study were remained confidential.

CHAPTER 4

RESULTS

4.1 Socio – demographic Data

The respondents consist of 12-years old students in Sungai Merab Luar Primary School (SK Sungai Merab Luar) which is located in a rural area in Dengkil sub-district (*mukim*). Dengkil sub-district is located north-east of Sepang district, Selangor. There were 118 students overall which can be divided into 4 classes. However, only 42 students joined this study due to refusal by some students. Besides that, a number of students did not get the parental consent from their parents and a few of the respondents withdrew during the study was conducted.

All of the respondents live in nearby villages or housing estates in Sungai Merab. A brief family demographic data was also obtained from this study. Most of the respondents' fathers are self-employed; which constitutes 51.2% from the total paternal occupation. The percentage was followed by working in governmental sectors and uniform bodies (17.1%), private sectors (14.6%), not-working (pensioners) (12.2%) and professional sectors (4.9%). Their education level was mainly up to secondary school level (88%) followed by university level (12%).

Most of the respondents' mothers do not work, which constitutes about 81% from the total occupation, followed by working in governmental sectors (9.8%), private sectors (4.9%) and professional and labourer (2.4% respectively). The education level was mainly at secondary level (92.7%) and followed by university level (7.3%).

Table 4.1: Paternal socio-economics information

Socio-economic information	Percentage (%)
Educational level	
Secondary school	90.3
University	9.7
Occupation	
Professional	4.9
Governmental sectors/uniform bodies	17.1
Private sectors	14.6
Self-employed	51.2
Pensioners	12.2

N=41

Table 4.2: Maternal socio-economics information

Socio-economic information	Percentage (%)
Educational level	
Secondary school	92.7
University	7.3
Occupation	
Professional	2.4
Governmental sectors	9.8
Private sectors	4.9
Housewife	80.5
Labourer	2.4

N=41

4.2 Fluoride Exposure Information

Among the questions that been asked was how long have the respondent lived in Sungai Merab area. 16 of them (39%) reported that they have been living in Sungai Merab since they were born. Half of the total respondents (50%) lived in Sungai Merab during their toddlers and pre-school ages (1-6 years old), while the remaining of the respondents (11%) lived in Sungai Merab only after they were 7 years old. All respondents (100%) reported that they use municipal water supply at their home provided by Syarikat Bekalan Air Selangor Berhad (SYABAS). None of them use water supply from the well or river at their homes.

In terms of general knowledge on dental fluorosis, the respondents were also being asked on whether they know about dental fluorosis and all of them (100%) did not know anything about dental fluorosis.

In terms of drinking water intake, the average of water intake among the respondents were about 2000 ml, which constitutes about 19% from the total respondents. This is followed by 1500 ml (17%), 500 ml and 750 ml (14%), 1250 ml (12%), 1000 ml and 1750 ml (9.5%) and finally 1150 ml and 3750 ml (2%). The amount of water intake initially was measured in the unit of glass, cup and bottle. All these amounts were then converted into a metric unit, millilitre (ml) to find the relative intake among the respondents.

Table 4.3: Respondents' fluoride exposure information

Fluoride Exposure Information	Frequency	Percentage (%)
Living area		
- Rural	41	100
- Urban	0	0
History of living in the area		
	16	39.0
- Since birth	23	56.1
- Since 1 to 6 years old	2	4.9
Water supply		
- Municipal water	41	100
Knowledge on dental fluorosis		
- Have	0	0
- Do not have	41	100
Drinking water intake per day		
- 500 ml	6	14.3
- 750 ml	6	14.3
- 1000 ml	4	9.8
- 1150 ml	1	2.4
- 1250 ml	4	9.8
- 1500 ml	7	17.1
- 1750 ml	4	9.8
- 2000 ml	8	19.5
- 3750 ml	1	2.4

4.3 Fluoride concentration in drinking water

Drinking water samples were taken for three days to find the intake of fluoride through drinking water. The average concentration was obtained from the three days drinking water collection. The mean of drinking water fluoride concentration was 0.51±0.099. In Malaysia, fluoride is supplied into the municipal water supply ranging from 0.4 to 0.6 mg/L according to National Standard for Drinking Water Quality (NSDWQ). Therefore, the mean concentration of fluoride in the drinking water was within the range specified by NSDWQ.

Table 4.4: Drinking water fluoride concentration

Range	Minimum value (mg/L)	Maximum value (mg/L)	Mean (mg/L)	Standard deviation
0.46	0.29	0.75	0.51	0.099

N=41

4.4 Urinary fluoride concentration

Urine samples were taken for three days to obtain the average concentration of urinary fluoride among the respondents. The mean concentration

then was calculated from the three days urinary collection. The mean of urinary fluoride concentration was 1.49±0.320. The mean was within the normal range for urinary fluoride according to National Institute of Occupational Safety and Health (NIOSH) 1997, which is from 0.2 to 3.2 mg/L for non-occupational exposure.

Table 4.5: Urinary fluoride concentration

Range	Minimum value (mg/L)	Maximum value (mg/L)	Mean (mg/L)	Standard deviation
1	1	2	1.49	0.320

N=41

4.5 Dental Fluorosis Score

The dental fluorosis score was classified using Total Surface Index of Fluorosis (TSIF) formulated by Horowitz, et.al. in 1984. The score was given after the inspection of the respondents' teeth by a dentist. It was found that more than half of the respondents (48.8%) did not have dental fluorosis; which the score given was 0. Score 1 and 2 recorded the same perecentage with 21% respectively while score 3 recorded 2%. The highest score obtained was 4 consists of 2 out of the total respondents (5%). In overall, the prevalence of dental fluorosis in this study was 51.3% (n=21).

Table 4.6: Dental fluorosis score distribution

Score	Frequency	Percentage (%)
0	20	48.7
1	9	22.0
2	9	22.0
3	1	2.4
4	2	4.9

N = 41

The mean of dental fluorosis score was 0.93±1.13, with the minimum value was 0 and the maximum was 4. It was found that score 4 was the most severe in the study (Table 7).

Table 4.7: Dental fluorosis score statistical data

Range	Minimum	Maximum	Mean	Standard deviation
4	0	4	0.93	1.13

4.6 Past Exposure Information

Respondents' breastfeeding information was obtained through questionnaire by asking few questions to the respondents' parents. Firstly, the respondents were asked about did their mother breastfed them during infancy. It was found that 100% of the respondents were given the breast milk during the infancy. The second question was "When did the breastfeeding started to be given to the children" and the answer obtained was 95% of the respondents were being given the breast milk started from their birth. 5% of the respondents were given the breast milk only after 6 months and 1 year old (2.4% respectively).

The duration of breastfeeding was also being asked to the parents. It was found that 52% of the respondents were breastfed by their mother for more than 12 months. 23% of the respondents were breastfed for about 6 to 12 months and the remaining 23% answered that their children was breastfed for less than 6 months. Next, parents were also being asked if their children had ever consumed formulated milk during the infancy. The answer obtained was 83% of the respondents were given the formulated milk for more than 12 months. The percentage was followed by 9.5% for the respondents who were never consumed formulate milk and the remaining 7% consumed the formulated milk for less than 12 months. The type of water used to prepare the formulated milk information was also obtained from the questionnaire. More than 60% of the parents answered

that they used tap water to prepare the formulated milk, while the remaining 40% used filtered water to prepare the formulated milk.

Table 4.8: Past fluoride exposure information

Past exposure information	Frequency	Percentage (%)
Breastfed or not		
- Yes	41	100
- No	0	0
Breastfed age		
- Since birth	39	97.6
- After 6 months	1	2.4
Duration of breastfed		
- Less than 6 months	9	23.8
- 6 to 12 months	10	23.8
- More than 12 months	22	52.4
Duration consumption of formulated milk		
- Never	4	9.8
- Less than 12 months	3	7.3
- More than 12 months	34	82.9
Water used for formulated milk preparation		
- Tap water	27	65.9
- Filtered water	14	34.1
- Mineral water	0	0.0
- Well water	0	0.0

N=41

4.7 Relationship between fluoride concentration in drinking water and dental fluorosis score

A correlation test was conducted to determine the relationship of fluoride concentration in drinking water and dental fluorosis score. The correlation test used was Spearman-rho correlation test as both data were not normal. It was found that there was no significant relationship between concentration of urinary fluoride and dental fluorosis score with $p<0.05$ with the correlation coefficient value at -0.329 (Table 4.10). Thus, it can be concluded that there was no significant relationship between fluoride concentration in drinking water and the dental fluorosis score.

Table 4.9: Relationship between fluoride concentration in drinking water and the score of dental fluorosis

Variable	r-value (correlation coefficient)	p-value
Concentration of fluoride in drinking water and dental fluorosis score	-0.329	0.036

4.8 Relationship between concentration of urinary fluoride and dental fluorosis score

A correlation test was conducted to determine the relationship of urinary fluoride (current exposure to fluoride) and dental fluorosis score (past exposure to fluoride). The correlation test used was Spearman-rho correlation test as both data were not normal. It was found that there was no significant relationship between concentration of urinary fluoride and dental fluorosis score with $p>0.05$ with the correlation coefficient value at -0.060 (Table 4.11). Thus, it can be concluded that there was no significant relationship between concentration of urinary fluoride and the dental fluorosis score.

Table 4.10: Relationship between concentration of urinary fluoride and the score of dental fluorosis

Variable	r-value (correlation coefficient)	p-value
Concentration of urinary fluoride and dental fluorosis score	-0.060	0.708

4.9 Determination of the breastfeeding duration and its effect on the score of dental fluorosis

It was found that the percentage of dental fluorosis among respondents who were breastfed for less than 12 months was 47.3% (n=9) while the remaining 45.4% (n=10) were breastfed for more than 12 months. The mean score for the respondents who were breastfed for less than 12 months was 1.21 while the mean score for the respondents who were breastfed for more than 12 months was 2.72 (Table 10). It can be concluded that the breastfeeding duration was inversely proportional to the mean score of dental fluorosis in this study.

Table 4.11: Comparison between breastfeeding period and the mean score of dental fluorosis

Duration of breastfeeding	Prevalence of dental fluorosis	Mean score
<12 months	47.3%	1.21
>12 months	45.4%	2.72

N = 41

4.10 Gender difference in the prevalence of dental fluorosis

The prevalence of dental fluorosis was 52.2% (n=21); which consists of boys with 52.4% (n=11) and girls with 47.6% (n=10). Mann-Whitney test was conducted to find the difference between the genders. The p-value obtained was larger than 0.05 ($p>0.05$). This indicated that there was no significant difference between the genders in terms of the prevalence of dental fluorosis. However, it was found that the prevalence of dental fluorosis was higher among boys compared to the girls.

CHAPTER 5

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

5.1 Socio-demographic background

The study was conducted at Sungai Merab Luar Primary School (SK Sungai Merab Luar) which located at north-east district of Sepang, Selangor. All students were Malay. However, only 12 years-old (Year 6) students were chosen as 12 years old is one of the best ages to study the prevalence of dental fluorosis because permanent teeth begin to grow at this age (WHO, 1997).

One of the selection criteria was the respondents must live in the same area (within Sungai Merab) since they were 6 years old at least. This is because the permanent teeth start to grow from 6 years old of age. Drinking water plays a major effect on developing dental fluorosis. Therefore, respondents must live in the same area for at least 6 years (Kumar, 2004). This is to find the correlation of drinking water and the occurrence of dental fluorosis. Besides that, students with nephrological or kidney problems were excluded from the study as people with

renal insufficiency would have impaired renal clearance of fluoride (Juncos & Donadio, 1972).

Most of the respondents' parents educational level were at secondary level. A few of them were varsity leavers. In terms of occupation, most of the fathers are self-employed while most of the mothers are housewives.

5.2 Concentration of Fluoride in drinking water

The mean concentration of fluoride in drinking water was 0.51±0.099. The mean was still within the range specified for fluoride in the National Standard for Drinking Water Quality (NSDWQ); which ranges from 0.4 to 0.6 mg/L. Fluoride concentration in drinking water was determined by few factors; namely climate, water intake and other sources to fluoride. According to Badson and Bjourton (1998), the fluoride level should not be more than 1.5 mg/L. At concentrations from 0.5 to 1 mg/l in water supply, it reduces dental caries (WHO, 2004). At concentrations of 1.0 to 3.0 mg/L, fluoride may cause dental fluorosis (Meenakshi, 2006). Water is one of the largest contributors to an individual's total exposure to fluoride, although there are other sources of exposure (National Academy of Sciences, 2006).

5.3 Concentration of urinary fluoride

The mean of urinary fluoride concentration was 1.49±0.320. The mean was within the normal range for urinary fluoride according to National Institute of Occupational Safety and Health (NIOSH) 1997, which is from 0.2 to 3.2 mg/L for non-occupational exposure. Measuring the fluoride excreted in urine is a well-established method of assessing fluoride exposure of a population or of quantifying the daily fluoride intake in children (Rugg-Gunn, 1993). The concentration of urinary fluoride was directly proportional to the concentration of fluoride in drinking water (Chen, 1993). Other factors may involve in the increment of urinary fluoride concentration; such as consumption of high-fluoride foods and accidentally ingestion of toothpaste. However, it was estimated that the fluoride intake in most country was from 0.2 to 2.0 mg/L daily (Sherlock, 1994).

5.4 Prevalence and severity of dental fluorosis

The prevalence of dental fluorosis in this study was 51.3%. The prevalence obtained was much higher compared to the recent related study conducted in Malaysia by Shaharuddin (2010) which reported the prevalence of

dental fluorosis was 31.6%. It can be concluded that other factors might have influenced the intake of fluoride during the respondents' childhood other than drinking water; as the fluoride concentration in drinking water is within the safe limit of National Drinking Water Quality Standard (NDWQS); which is from 0.4 to 0.6 mg/L.

For the severity of dental fluorosis, the mean score for dental flurosis in this study was 0.93±1.13. Most of the respondents had score 1 and 2 with 9 respondents respectively (22.0% respectively). The remaining 2 respondents had score 4 (4.9%) while only 1 respondent had score 3 (2.4%). 20 out of 41 respondents (48.8%) were free from dental fluorosis. Therefore, the most severe score was 4.

Total Surface Index of Fluorosis (TSIF) was chosen to determine the severity of dental fluorosis as drying the teeth prior to determining the score does not required (Rahimah, 1989). According to Horowitz (1984), the prevalence of dental fluorosis was not high when the fluoride concentration in drinking water was at optimum. However, when the concentration of fluoride in the drinking water was above the optimum, the prevalence of dental fluorosis will substantially increase (Heifetz, 1988). All in all, the absorption rate of fluoride is at the highest during childhood (Rahimah, 1989).

5.5 The relationship between fluoride concentration in drinking water and dental fluorosis score

Water is the main source of ingested fluoride for most children. Total fluoride intake from water depends on two factors, the water fluoride concentration and the total water volume consumed. Populations in hot climates and outdoor labourers generally have a greater daily intake of fluorides because of a larger consumption (WHO, 1984) Water can be consumed either by itself or when incorporated into other foods and beverages. Most of the fluoride in food or water ingested enters the bloodstream quickly through the digestive tract. However, the amount that enters the blood stream also depends on factors such as how much of the fluoride swallowed, how well the fluoride dissolves in water. Traditionally fluorosis has been connected with higher intake of fluoride through drinking water (Kloos, 1993).

All the respondents used municipal water as their drinking water. Municipal water comes from Syarikat Bekalan Air Selangor (SYABAS) Berhad, which supplies water throughout Selangor and Kuala Lumpur area. Fluoride level in the water supply is maintained in a range from 0.4 to 0.6 mg/L at any time. The range was adapted from National Standard for Drinking Water Quality (NSDWQ). It was found that the mean concentration of drinking water was 0.51±0.099 mg/L. Therefore, the fluoride level is within the specified range for safe consumption. There is a striking linear relationship between the concentration

of fluoride in drinking water and in the urine of humans exposed continuously to fluoride (ATSDR, 1993). Urinary fluoride levels are generally around less than 1 mg/L when the water supply contains less than 1ppm (1 mg/L) fluoride (Schamschula, 1985).

This might due to the level of fluoride supplied is within the range and not so high. There was a study conducted in Estonia, the water supplied contain less than 1.0 mg/L fluoride recorded only about 6% of the populations have dental fluorosis. The risk of getting dental fluorosis increased if the exposure to fluoride is more than 1.0 mg/L (Fallon, 2006).

However, it was found that there was no significant relationship exists between drinking water and the occurrence of dental fluorosis. It can be considered that drinking water is not the major factor of causing dental fluorosis in this study. As mentioned before, other factors might play roles in causing dental fluorosis; such as dietary intake and toothpaste usage.

Ingested toothpaste might increase the systemic fluoride intake (Bentkey, 1999). The ingested toothpaste amount can be related to the amount of toothpaste used. The amount of tooth paste applied also may serve as a contributing factor for the occurrence of dental fluorosis. A pea-sized amount of toothpaste on the brush is more than adequate to clean young children's teeth but this amount

(0.25–0.3 g) is often exceeded (CDC, 2011). Some children accidentally swallowed the toothpaste due to lack of supervision and training by their parents; resulting high ingestion of fluoride (Berkowitz, 1992).

5.6 The relationship between concentration of urinary fluoride and dental fluorosis score

Urinary fluoride is the parameter to observe the current intake of fluoride among the respondent as 90 – 95% of fluoride intake will be excreted through urine (Rahimah, 1989). The level of fluoride in urine is one of the best biomarkers of acute exposure (ATSDR, 2003). Dental fluorosis score indicating past exposure to fluoride as dental fluorosis took place during the teeth formation under the gums and did not happen when the tooth emerges. Soft tissues do not accumulate significant levels of fluoride over long periods of time, effects of chronic exposure to fluoride first appear in the musculoskeletal system. Chronic oral fluoride exposure can produce dental fluorosis (Duxbury, 1982). The most sensitive biomarkers of effect for fluoride are alterations in teeth and bones for chronic exposure (Knaus, 1976). Tooth alterations are more sensitive, but this only occurs in childhood (DHHS 1991, Heifetz, 1988). Therefore, throughout the correlation test, the relationship between current and past exposure to fluoride can be

established. If there is a significant relationship, this indicates that the respondents are still highly-exposed to fluoride in spite during their childhood.

There might be other sources; such as food intake that contributes to increment of urinary fluoride. Foods that contain high amount of fluoride; such as sardines and shrimps might contribute to increased intake of fluoride (Rahimah, 1989). Processed foods which used fluoridated water in the production can also contain an increased amount of fluoride (Clovis, 1988; Burt, 1992). Besides that, toothpaste ingestion during brushing teeth could also contribute to high systemic urinary fluoride. Swallowing toothpaste can contribute a substantial amount of systemic fluoride increment especially for children exposure (ATSDR, 1993). This is closely related to fluoride content of the toothpaste and the ingestion dose of toothpaste (Bentkey, 1999). However, it was found that ingestion dose does play more important role in increasing fluoride intake (Rahimah & Latifah, 1998).

However, it was found that there was no significant relationship between concentration of urinary fluoride and dental fluorosis score. The current exposure to fluoride can be considered not high as the mean of concentration of urinary fluoride was within the range according to NIOSH, which is from 0.2 to 3.2 mg/L. In fact, the highest urinary fluoride concentration was at 2.1 mg/L, which was still within the range. Therefore, it can be concluded that respondents were not highly exposed to fluoride currently.

5.7 Determination of the breastfeeding duration and its effect on the score of dental fluorosis

Breastfeeding was said to be a protective factor against dental fluorosis. Besides that, there were some researches that stated that there was a relationship between breastfeeding and the decrement of dental caries (Oulis, 1999). Breast milk has been consistently demonstrated to contain little fluoride regardless of the amount of fluoride ingested by the mother (Ekstrand, 1984). The fluoride content of human milk is very low; just approximately 0·01 mg/L (Esala, 1982). This is because limited transfer of fluoride from plasma to breast milk in the mother (Ekstrand, 1984). Fluoride concentrations are so low that excessive consumption would not provide adequate fluoride to disrupt enamel development. (Marshall, 2004).

During the first one or two years of life, which coincide with the period of most active enamel formation, breastfeeding would seem to provide the ideal prevention of fluorotic damage to teeth (Tinanoff, 2002). Walton and Messer reported that a minimum of three months' duration of breastfeeding was necessary to decrease fluorosis risk in permanent teeth. Supporting long-term lactation could be an important strategy to decrease fluorosis risk of primary teeth and early developing permanent teeth. Infants that are bottle-fed infant formula that has been reconstituted or diluted with fluoride-containing water have been shown to

be at increased risk of dental fluorosis (Brothwell, 2003). There was a study stated that prolonged usage of formulated milk has been shown to be a risk factor for fluorosis (Osuji, 1988).

In this study, there was no significant difference between breastfeeding period and the dental fluorosis score. This might be due to many of the respondents also consumed formulated milk in addition to breast milk. Preparation of formulated milk requires water consumption. Exposure to treated water since infancy may increase the chance of getting dental fluorosis. Furthermore, it was also found that nearly 70% of the respondents consumed formulated milk during childhood from the study.

5.8 The difference of dental fluorosis prevalence among gender

It was found that more boys had dental fluorosis; which constitutes of 52.4% (n=11) from the total prevalence of dental fluorosis. The percentage of girls that having dental fluorosis was 47.6% (n=10). Previous studies showed that the prevalence of dental fluorosis was a higher for girls compared to the boys. However, there was no significant difference of dental fluorosis among the genders.

This might due to higher number of boys compared to the girls in the study and more exposure to fluoride from other sources; such as dietary intake among the respondents during the childhood. It has not been proved that fluorosis is sex-dependent but nutritional habits may play a major role in the prevalence of dental fluorosis. Besides that, boys are usually more active and this resulting in higher water intake to quench their thirst. Toothpaste usage during childhood may also a contributing factor of causing dental fluorosis. Differences between boys and girls in fluorosis prevalence and also fluorosis type in the primary dentition were not statistically significant (Nasser, 2007).

Previous studies showed that the prevalence of dental fluorosis was a higher among girls compared to the boys. A study was conducted among 10 to 17 years old children in Kerala, India found that the prevalence of dental fluorosis was quite high among the girls (39.7%) compared to the boys (31.3%) (Gopalakrishnan, 1999). Besides that, another study conducted in Yemen showed that the prevalence of dental fluorosis was higher among girls with 73% of them had dental fluorosis; whereas the percentage was only 54% among boys (Al-Kholani, 1998).

5.9 CONCLUSION

To conclude, the mean concentration of fluoride in drinking water was 0.51±0.099 which was still within the range specified by National Standard for Drinking Water Quality (NSDWQ) while the mean concentration of urinary fluoride was 1.49±0.320 which was also within the ranges specified by National Institute of Occupational Safety and Health (NIOSH) for non-occupational exposure. The prevalence of dental fluorosis among the respondents was 51.3% with the most severe score was 4. It was found that there was no significant relationship between fluoride in drinking water and the severity of dental fluorosis. Besides that, there was also no significant relationship between urinary fluoride and score of dental fluorosis. Breastfeeding could not be seen as a protective factor against dental fluorosis in this study. Last but not least, there was no significant difference in terms of the prevalence of dental fluorosis among the genders.

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APPENDIX 1
ETHICAL CLEARANCE

APPENDIX 2

APPROVAL FROM THE MINISTRY OF EDUCATION MALAYSIA

APPENDIX 3
APPROVAL FROM SELANGOR EDUCATION DEPARTMENT

APPENDIX 4
RESPONDENT'S INFORMATION SHEET

FAKULTI PERUBATAN DAN SAINS KESIHATAN
FACULTY OF MEDICINE AND HEALTH SCIENCES
UNIVERSITI PUTRA MALAYSIA, 43400 UPM SERDANG,
SELANGOR, MALAYSIA

HELAIAN MAKLUMAT KAJIAN

Sila baca maklumat berikut dengan teliti; sekiranya terdapat sebarang persoalan, sila berhubung dengan penyelidik kajian ini.

TAJUK KAJIAN

Pendedahan Terhadap Fluorida dan Prevalens Fluorosis Gigi di Kalangan Pelajar 12 Tahun di Sepang, Selangor.

PENGENALAN

Fluorida kini digunakan secara meluas, umumnya bertujuan untuk mengurangkan karies gigi di kalangan masyarakat. Fluorida dibekalkan melalui sistem bekalan air di Malaysia. Selain itu, terdapat banyak produk penjagaan mulut dan gigi yang mengandungi fluorida di pasaran. Pendedahan terhadap fluorida yang berlebihan dapat menyebabkan fluorosis gigi. Fluorosis gigi mengakibatkan kesan buruk pada rupa gigi dan boleh mengganggu fungsi normal gigi pada keadaan yang serius.

APA YANG PERLU DILAKUKAN OLEH RESPONDEN?

Responden perlu mengumpulkan 3 sampel urin (air kencing) (urin pertama dalam sehari) untuk 3 hari berturut bagi analisis kepekatan fluorida dalam tubuh. Responden juga perlu mengumpulkan 3 sampel air minum untuk 3 hari berturut dari air paip. Ini bertujuan untuk menganalisis kepekatan fluorida dalam bekalan air. Gigi responden akan diperiksa oleh doktor gigi yang bertauliah bagi menentukan prevalens dan keterukan fluorosis gigi. Responden juga perlu menjawab soal selidik yang dikemukakan bagi memperolehi maklumat-maklumat penting yang berkaitan dengan sosio-demografi dan pendedahan terhadap fluorida.

SIAPA YANG TIDAK PERLU MENYERTAI KAJIAN INI?

Pelajar sekolah menengah yang mempunyai masalah ginjal dan nefrologikal (perkumuhan) dan juga diabetes melitus (kencing manis). Pelajar yang pernah berpindah kediaman dalam tempoh 6 tahun juga dikecualikan daripada menyertai kajian ini. Selain itu, pelajar yang berumur bawah dan melebihi 12 tahun turut dikecualikan.

APAKAH FAEDAH DARIPADA KAJIAN INI:

(a) KEPADA ANDA SEBAGAI RESPONDEN?

Kajian ini dapat meningkatkan pengetahuan dan kesedaran mengenai penyakit fluorosis gigi.

b) KEPADA PENYELIDIK?

Kajian ini dapat memberi maklumat rawak mengenai pendedahan terhadap fluorida dan fluorosis gigi; di mana maklumat yang diperolehi dapat digunakan oleh badan-badan tertentu seperti Kementerian Kesihatan Malaysia, Kementerian Pelajaran Malaysia dan Persatuan Pergigian Malaysia bagi melaksanakan langkah proaktif dalam menangani fluorosis gigi dan meningkatkan kesedaran mengenai fluorosis gigi di kalangan pelajar sekolah.

ADAKAH TERDAPAT SEBARANG RISIKO?

Tiada risiko yang signifikan (nyata) daripada kajian ini.

APAKAH HAK ANDA SEBAGAI RESPONDEN?

Responden boleh menarik diri daripada menyertai kajian ini pada bila-bila masa sekiranya berasa tidak selesa untuk mengikuti kajian ini.

ADAKAH MAKLUMAT DAN IDENTITI ANDA DIJAMIN RAHSIA DAN SULIT?

Ya, segala maklumat dan identiti responden yang diperolehi dijamin rahsia dan sulit pada dan selepas kajian dijalankan.

SIAPA YANG PERLU DIHUBUNGI SEKIRANYA TERDAPAT SEBARANG PERSOALAN MENGENAI KAJIAN INI?

Sekiranya anda mempunyai sebarang persoalan, sila hubungi penyelidik kajian ini:

MUHAMMAD NOORHAFIZ BIN NOORDIN
PELAJAR TAHUN AKHIR,
B. SC. (KESIHATAN PERSEKITARAN DAN PEKERJAAN),
FAKULTI PERUBATAN DAN SAINS KESIHATAN,
UNIVERSITI PUTRA MALAYSIA.

H/P : 013 – 341 5961
Emel : noorhafiz_mail@yahoo.com

APPENDIX 5
CONSENT FORMS

FAKULTI PERUBATAN DAN SAINS KESIHATAN
FACULTY OF MEDICINE AND HEALTH SCIENCES
UNIVERSITI PUTRA MALAYSIA, 43400 UPM SERDANG,
SELANGOR, MALAYSIA

BORANG PERSETUJUAN (RESPONDEN)

TAJUK KAJIAN : PENDEDAHAN TERHADAP FLUORIDA DAN PREVALENS FLUOROSIS GIGI DI KALANGAN PELAJAR 12 TAHUN DI SEPANG, SELANGOR

PENYELIDIK : MUHAMMAD NOORHAFIZ BIN NOORDIN

Saya ..... No. Kad Pengenalan ..... yang beralamat di.....
..... dengan ini secara sukarela bersetuju mengambil bahagian dalam penyelidikan klinikal (kajian sampel biologi, kajian soal selidik) yang dinyatakan di atas.

Saya telah dimaklumkan tentang sifat penyelidikan klinikal dari segi kaedah, kemungkinan kesan buruk dan komplikasi (rujuk Helaian Maklumat). Saya faham bahawa saya mempunyai hak untuk menarik diri dari kajian ini klinikal pada bila-bila masa tanpa memberikan apa jua sebab. Saya juga faham bahawa kajian ini adalah sulit dan semua maklumat yang diberikan mengenai identiti saya akan kekal sulit dan persendirian.

Saya *ingin / tidak ingin mengetahui keputusan ujian yang dilakukan ke atas sampel saya.

* potong yang mana perlu

Tandatangan .....
(*Responden*)

Tarikh : .....

Tandatangan .....
(*Saksi*)

Nama : .....

No. K/P. : .....

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

Tarikh : .....

Tandatangan .....
(*Penyelidik*)

FAKULTI PERUBATAN DAN SAINS KESIHATAN
FACULTY OF MEDICINE AND HEALTH SCIENCES
UNIVERSITI PUTRA MALAYSIA, 43400 UPM SERDANG,
SELANGOR, MALAYSIA

BORANG PERSETUJUAN (IBU BAPA/PENJAGA)

TAJUK KAJIAN : PENDEDAHAN TERHADAP FLUORIDA DAN PREVALENS FLUOROSIS GIGI DI KALANGAN PELAJAR 12 TAHUN DI SEPANG, SELANGOR

PENYELIDIK : MUHAMMAD NOORHAFIZ BIN NOORDIN

Saya ..... No. Kad Pengenalan ..... yang beralamat di.....
..... dengan ini secara sukarela bersetuju membenarkan anak/ jagaan saya mengambil bahagian dalam penyelidikan klinikal (kajian sampel biologi, kajian soal selidik) yang dinyatakan di atas.

Saya telah dimaklumkan tentang sifat penyelidikan klinikal dari segi kaedah, kemungkinan kesan buruk dan komplikasi (rujuk Helaian Maklumat). Saya faham bahawa anak/jagaan saya mempunyai hak untuk menarik diri dari kajian ini klinikal pada bila-bila masa tanpa memberikan apa jua sebab. Saya juga faham bahawa kajian ini adalah sulit dan semua maklumat yang diberikan mengenai identiti anak/jagaan saya akan kekal sulit dan persendirian.

Saya *ingin / tidak ingin mengetahui keputusan ujian yang dilakukan ke atas sampel anak/jagaan saya.

* potong yang mana perlu

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

Tarikh : .....

Tandatangan .....
(*Saksi*)

Nama : .....

No. K/P. : .....

Saya mengesahkan bahawa saya telah menjelaskan kepada ibu bapa/penjaga responden sifat dan tujuan penyelidikan klinikal yang tersebut di atas.

Tarikh : .....

Tandatangan .....
(*Penyelidik*)

APPENDIX 6
QUESTIONNAIRE

No Siri:

UNIT KESIHATAN PERSEKITARAN DAN PEKERJAAN
JABATAN KESIHATAN KOMUNITI
FAKULTI PERUBATAN DAN SAINS KESIHATAN
UNIVERSITI PUTRA MALAYSIA

PENDEDAHAN TERHADAP FLUORIDA DAN PREVALENS FLUOROSIS GIGI DI KALANGAN PELAJAR 12 TAHUN DI SEPANG, SELANGOR

Adalah dimaklumkan bahawa satu kajian tentang kesihatan akibat pendedahan fluorida sedang dijalankan di tempat kerja anda. Sehubungan dengan itu, sukacita dimaklumkan bahawa anda telah terpilih untuk menjadi salah seorang responden kajian ini. Oleh demikian, anda diminta menjawab semua soalan yang dikemukakan dengan mengikut arahan yang telah diberikan. Segala maklumat berkenaan responden akan dirahsiakan dan hanya akan digunakan untuk kajian ini.

ID Responden: | | | | | | | | | | |

Tarikh kajian: ……..

No Kad Pengenalan: | | | | | | | | | | | | |

No Telefon: **(R)** | | | | - | | | | | | | |

(Hp) | | | | - | | | | | | | |

ARAHAN SOALAN:

1. Kertas soalan ini mengandungi enam (6) bahagian iaitu:

   Bahagian A: Latar belakang responden
   Bahagian B: Maklumat Kesihatan Pergigian Murid
   Bahagian C: Maklumat pendedahan Fluorida
   Bahagian D: Maklumat Keluarga
   Bahagian E: Skor Fluorosis
   Bahagian F: Lain-lain perkara

2. Anda diminta menjawab semua soalan yang ada dalam buku soalan ini.

3. Untuk menjawab, anda perlulah menandakan (√) pada ruangan kotak yang disediakan. Contoh yang terbaik ialah seperti berikut:

   [√]

4. Buku soalan ini hendaklah diserahkan semula kepada pengkaji setelah selesai menjawab semua soalan yang ada dalam buku soalan ini.

Bahagian A (Latar Belakang Murid)

1. Tarikh :……..

2. Nama Murid :……..

3. Tarikh Lahir :……

4. Umur :……

5. Bangsa :……

6. Kelas :……..

7. Nama Sekolah :……..

8. Alamat Rumah:……..

9. Maklumat Sekolah Menengah – daripada Darjah 1 hingga kini

Bil	Nama Sekolah Rendah	Kelas

<u>Bahagian B</u> (Maklumat Tentang Kesihatan Pergigian Murid)

10. Sejauh manakah anda berpuas hati dengan keadaan gigi anda sendiri?

Tandakan (/) pada jawapan yang paling tepat

a. Sangat memuaskan …terus ke soalan 11 ☐

b. Memuaskan …terus ke soalan 11 ☐

c. Tidak Memuaskan …terus ke soalan 12A ☐

11. Berapa kerapkah anda berjumpa doktor gigi?

a. 3 bulan sekali ☐

b. 6 bulan sekali ☐

c. 12 bulan sekali ☐

d. Tidak pernah

12. Sejauh manakah anda berpuas hati dengan warna gigi hadapan anda?

Tandakan(/) pada jawapan yang paling tepat

a. Sangat memuaskan ☐
b. Memuaskan ☐
c. Tidak memuaskan ☐

12 A. Jika anda menjawab c= tidak memuaskan, Mengapa?

Untk menjawab soalan ini anda boleh menjawab lebih dari satu jawapan. Sila tandakan (/) pada kotak berkaitan.

a. Kerana gigi saya berjalur/ tompok putih ☐
b. Kerana gigi saya berwarna kuning/coklat/kelabu ☐
c. Sebab- sebab lain ☐

(nyatakan.....)

13. Adakah anda melakukan perkara berikut kerana keadaan warna gigi hadapan anda? Untuk menjawab soalan ini anda boleh menjawab lebih dari satu jawapan. Sila tandakan (/) pada kotak berkaitan.

a. Menutup mulut bila senyum dan ketawa ☐
b. Mengelak dari keluar bersama rakan- rakan ☐
c. Menggunakan bahan-bahan pemutih gigi ☐
d. Berjumapa doktor gigi ☐

16. Jenis bekalan air yang anda terima di rumah?

a. Paip JBA ☐

b. Telaga ☐

c. Gabungan mana- mana di atas ☐

d. Lain-lain ☐

(nyatakan:….

17. Apakah jenama ubat gigi yang anda selalu gunakan?

(nyatakan:……)

18. Berapa kerapkah anda menggosok gigi dalam sehari?

……..kali sehari

19. Berapakah kuantiti ubat gigi berfluorida yang anda gunakan setiap kali menggosok gigi? (*Rujuk gambar dan tandakan(/) pada kotak)*

☐

☐

☐

20. Adakah anda mengetahui sama ada ubat gigi yang digunakan menggunakan fluorida atau tidak?

a. Ya ☐

b. Tidak ☐

21. Adakah anda ada menggunakan produk penjagaan gigi yang berfluorida yang lain seperti cecair kumur mulut, varnish gigi?

a. Ya ☐

b. Tidak ☐

22. Adakah anda mengetahui tentang kesan kemudaratan (kesan negatif) daripada fluorida (seperti fluorosis)?

a. Ya ☐

b. Tidak ☐

13 A. Jika anda berjumpa doktor gigi, apakah yang doktor gigi lakukan?

a. Memberikan rawatan ☐

b. Memberikan nasihat ☐

14. Adakah anda pernah mengalami perasaan berikut kerana keadaan gigi hadapan anda?

Untuk menjawab soalan ini anda boleh menjawab lebih dari satu jawapan. Sila tandakan(/) pada kotak berkaitan.

a. Runsing kerana warna gigi ☐

b. Tidak yakin dalam pergaulan ☐

c. Perasaan lain ☐

(nyatakan:……..)

Bahagian C (Maklumat pendedahan fluorida)

15. Jenis kawasan tempat tinggal?

a. Bandar ☐

b. Luar Bandar ☐

23. Berapakah gelas air masak atau air tapisan yang anda minum sehari?

Kuantiti minum:.....

24. Apakah air minuman kegemaran anda dan berapa banyak (kuantiti) anda minum sehari?

Minuman kegemaran:.....

Kuantiti minum:.....

25. Pernahkah anda mengalami penyakit berkaitan buah pinggang/perkumuhan baru- baru ini?

Ya ☐

Tidak ☐

Bahagian D (Maklumat keluarga)

26. Pekerjaan bapa atau penjaga(tandakan (/) pada kotak)

a. Professional ☐
b. Pegawai kerajaan/beruniform ☐
c. Pegawai sektor swasta ☐
d. Pekerja upahan ☐
e. Pesara ☐
f. Bekerja sendiri ☐
g. Lain-lain(nyatakan:.....) ☐

27. Pekerjaan ibu (tandakan(/) pada kotak)

a. Professional ☐
b. Pegawai kerajaan/beruniform ☐
c. Pegawai sektor swssta ☐
d. Pesara ☐
e. Pekerja upahan ☐
f. Suri rumah ☐
g. Lain-lain (nyatakan:.....) ☐

28. Pendapatan ibu-bapa (penjaga) sebanyak RM……

29. Taraf pendidikan ibu-bapa (tandakan (/) pada kotak)

	Bapa	Ibu	Penjaga
Tidak Bersekolah:	☐	☐	☐
Sekolah rendah:	☐	☐	☐
Sekolah menengah:	☐	☐	☐
Universiti:	☐	☐	☐

Lain-lain:……..

30. Bilangan ahli dalam keluarga.

……..orang

Bahagian E (Maklumat untuk diisi oleh ibu-bapa/ penjaga – maklumat penyusuan badan)

31. Adakah anda mengamalkan pemberian susu ibu secara eksklusif kepada anak/jagaan anda?

Ya ☐

Tidak ☐

32. Pada umur berapakah anak/jagaan anda mula diberikan susu ibu?

a. Sejak lahir

b. Selepas umur 6 bulan

c. Selepas umur 1 tahun

33. Berapakah tempoh masa anak/jagaan anda diberikan susu ibu?

a. Kurang dari 6 bulan

b. 6 bulan hingga 1 tahun

c. Lebih dari setahun

34. Berapakah tempoh masa anak/jagaan anda diberikan susu formula?

a. Kurang dari 12 bulan

b. Lebih dari 12 bulan

35. Apakah sumber air yang digunakan untuk penyediaan susu formula yang diberikan kepada anak/jagaan anda.

a. Air paip

b. Air telaga

c. Air mineral

d. Air tapisan

36. Pada umur berapakah anak/jagaan anda mula menggosok gigi menggunakan ubat gigi berfluorida?

Nyatakan.....

Bahagian F (Kegunaan penyelidik)

Skor indeks fluorosis ☐

DMFT ☐

Kandungan urin florida _____ mg/L

APPENDIX 7
DENTAL EXAMINATION CARD

APPENDIX 7
DENTAL EXAMINATION CARD

UPM/PKM/DC

No. Daftar : _____

No. MR : _____

PERKHIDMATAN PERGIGIAN
UNIVERSITI PUTRA MALAYSIA

NAMA: _____
Name

TARIKH LAHIR: _____ JANTINA: _____
Date of Birth *Sex*

NO. KP/NO. PASPOT: _____
NIRC/Passport No.:

NO. MATRIK/NO. STAF: _____ TAHUN: _____
Metric No./Staff No. *Year*

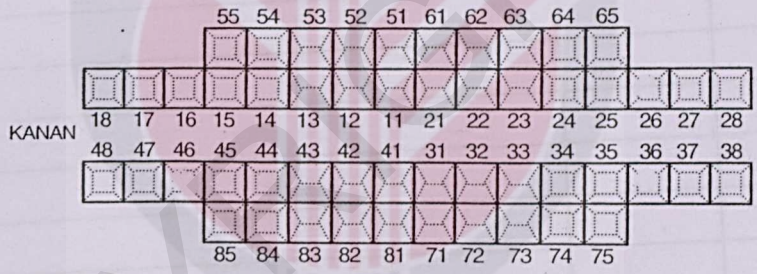
JABATAN/FAKULTI/PROGRAM: _____
Dept./Faculty/Programme

PEKERJAAN: _____ NO. TEL: _____
Occupation *Tel No*

ALAMAT: _____
Addres

Persetujuan Untuk Rawatan
Consent for Treatment

_____
Tandatangan/*Signature*



Perlu Dicabut
Telah Dicabut
Tiada Gigi

Ada Tampalan
Untuk Tampalan
Tampalan Dibuat

R Tunggul

Gigi Buatan Yang Ada	Gigi Buatan Yang Perlu	X-Ray

TANDAKAN ✓ PENYAKIT JIKA ADA

Blood Dyscrasias		Jaundice	
Heart Disease		Hypertension	
Congenital Heart		Toxic Goitre	
Diabetes		Allergic Tendencies	

On Any Drugs:

Sakit-sakit Lain:

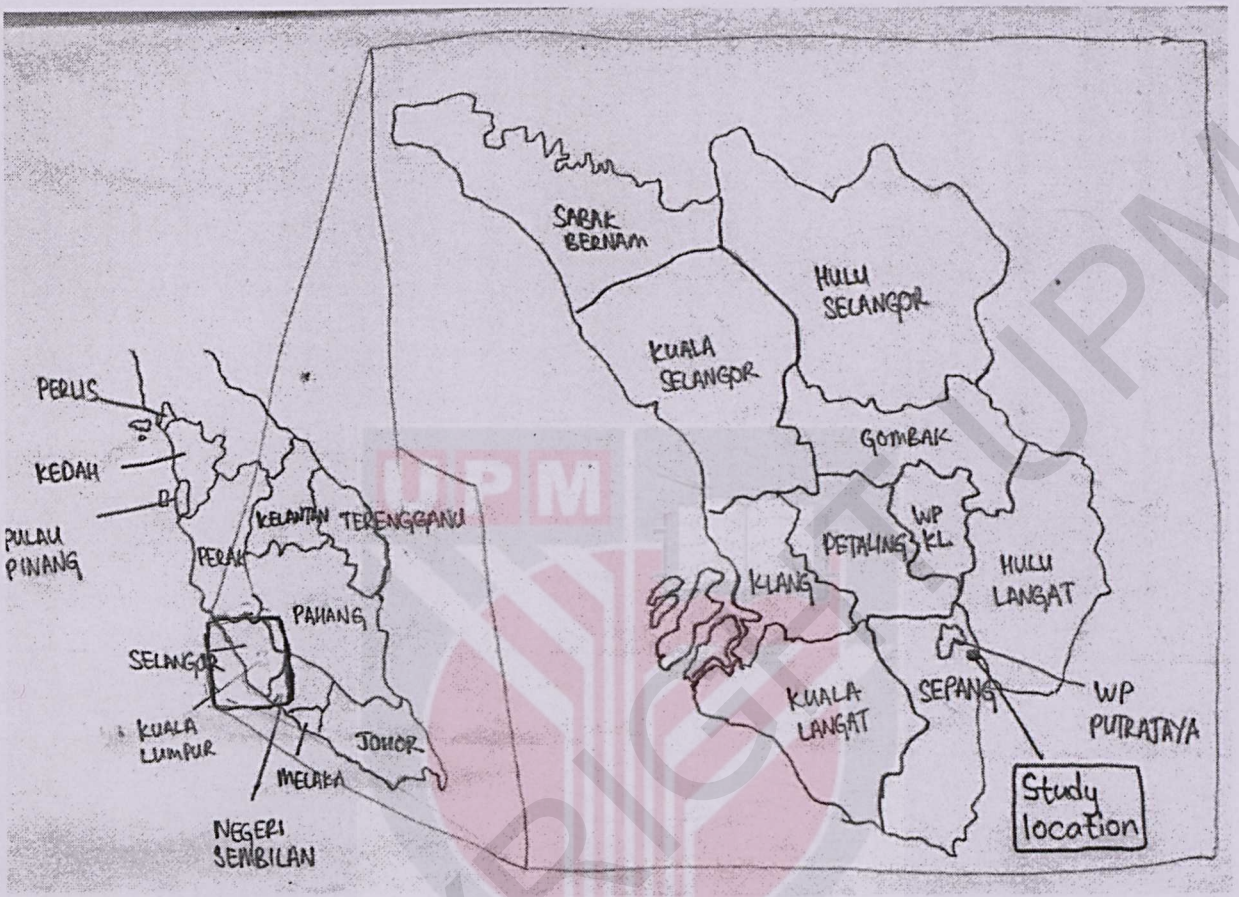
Lain-lain Rawatan

CATITAN PERGIGIAN YANG LAMPAU

UPM/PKM/DC

Tarikh	Tanda Gigi	Rawatan	Tandatangan

APPENDIX 8
STUDY LOCATION MAP



Study Location Map