

ASSOCIATION BETWEEN KNOWLEDGE, ATTITUDE AND PRACTICE (KAP)
TOWARDS SUGAR-SWEETENED BEVERAGE (SSB), BODY MASS INDEX
(BMI) AND SSB INTAKE AMONG UNDERGRADUATES' MEDICAL STUDENTS
IN UNIVERSITY SAINS MALAYSIA HEALTH CAMPUS, KUBANG KERIAN,
KELANTAN

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SCHOOL OF HEALTH SCIENCES
UNIVERSITI SAINS MALAYSIA

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by
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LIST OF ABBREVIATIONS

AGEs	Advanced Glycation End products
BEVQ	Beverage Intake Questionnaire
BMI	Body Mass Index
CARDIA	Coronary Artery Risk Development in Young Adults
CPRD	Commercially Packed Ready-to-Drink
GL	Glycaemic Load
HDL	High-density Lipoprotein
HFCS	High Fructose Corn Syrup
KAP	Knowledge, Attitude and Practice
MANS	Malaysian Adult Nutrition Survey
NCD	Non-communicable Diseases
NHMS	National Health and Morbidity Survey
SSB	Sugar-sweetened Beverages
T2DM	Type II Diabetes Mellitus
UNICEF	The United Nations International Children's Emergency Fund
USDA	United States Department of Agriculture
WHO	World Health Organisation

**HUBUNGAN ANTARA PENGETAHUAN, SIKAP DAN PRAKTIK (KAP)
TERHADAP MINUMAN BERGULA (SSB), INDEKS JISIM TUBUH (IJT) DAN
PENGAMBILAN MINUMAN BERGULA DALAM KALANGAN PELAJAR
SARJANAMUDA SAINS PERUBATAN DI UNIVERSITI SAINS MALAYSIA
KAMPUS KESIHATAN, KUBANG KERIAN, KELANTAN**

ABSTRAK

Minuman bergula (SSB) ialah minuman yang terdiri daripada pemanis yang mengandungi kalori seperti sukrosa, sirap jagung tinggi fruktosa atau jus buah pekat yang ditambahkan ke dalam minuman. Pengambilan minuman bergula telah meningkat dengan pesat di peringkat global. Kajian ini bertujuan untuk mengetahui hubungan antara pengetahuan, sikap dan praktik (KAP) terhadap SSB, indeks jisim tubuh (IJT) dan pengambilan minuman bergula dalam kalangan pelajar sarjanamuda sains perubatan. Kajian rentas keratan telah dijalankan kepada 122 responden daripada pusat pengajian sains perubatan, USM Kampus Kesihatan dari Mac sehingga Mei 2021. Soal selidik telah digunakan untuk mengumpulkan data termasuk sosio-demografi, ukuran antropometri yang dilaporkan oleh subjek sendiri dan pengetahuan, sikap dan praktik terhadap SSB. Pengambilan minuman pada bulan lepas telah diakses menggunakan borang pengambilan minuman (BEVQ). Majoriti subjek adalah berbangsa Melayu dengan usia lebih 21 tahun dan mempunyai pendapatan keluarga bulanan lebih RM 3,000. Kebanyakan subjek mempunyai indeks jisim tubuh yang normal (61.5%) dengan julat $22.33 \pm 3.58 \text{ kg/m}^2$. Hasil kajian menunjukkan bahawa subjek lelaki berusia lebih 21 tahun dan pendapatan keluarga bulanan yang lebih rendah mempunyai IJT yang lebih tinggi. Skor peratusan min tertinggi adalah 95.0% untuk sikap, diikuti oleh peratusan min 59.8% untuk

pengetahuan dan skor min terendah ialah praktik (47.6%). Hasil kajian menunjukkan bahawa subjek lelaki lebih cenderung mempunyai sikap ($t=0.046$, $p=0.006$) dan praktik ($t=0.162$, $p=0.048$) yang lebih baik terhadap SSB daripada subjek perempuan. Hasil kajian menunjukkan prevalens pengambilan minuman bergula yang rendah dengan hanya 9.8% responden mempunyai pengambilan SSB setiap hari, di mana kopi atau teh manis adalah minuman yang paling biasa diminum (18.9%). Kajian mendapati bahawa tiada perkaitan antara KAP pada SSB dengan pengambilan SSB ($p>0.05$). Tiada hubungan antara IJT dengan pengambilan SSB ($p>0.05$) dikesan. Kajian lanjutan perlu dilakukan untuk memahami penentu pengambilan SSB terutamanya semasa pandemik Covid-19.

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ABSTRACT

Sugar-sweetened beverages (SSB) are beverages that composed of caloric-containing sweeteners such as sucrose, high-fructose corn syrup or fruit juice concentrates that are added to the beverages. Globally, the consumption on sugar-sweetened beverages have been increased rapidly. The study aims to determine the association between knowledge, attitude and practice towards SSB, body mass index (BMI) and beverages consumption among undergraduates' medical students. A cross-sectional study was conducted among 122 respondents from school of medical sciences, USM Health Campus from March to May 2021. A set of questionnaires were used to collect the data included socio-demographic background, self-reported anthropometric measurements and KAP towards SSB. The beverages intake in past month was accessed using BEVQ. Most subjects were Malay with age more than 21 years old and had monthly family income of more than RM 3,000. Majority of the respondents fall within normal BMI category (61.5%) with mean BMI at $22.33 \pm 3.58 \text{ kg/m}^2$. The result suggested that male subjects with age more than 21 years old and lower monthly family income were more likely to have higher BMI. The highest mean percentage score was 95.0% for attitude, followed by a mean percentage of 59.8% for knowledge and the lowest mean score of 47.6% was for practice. The results suggested that males were more likely to have better attitude ($t=0.046$, $p=0.006$) and

practice ($t=0.162$, $p=0.048$) towards SSB than females. The finding showed low prevalence of SSBs consumption with only 9.8% has a daily high SSB intake, in which sugar-sweetened coffee or tea (18.9%) was the most common beverages consumed. The study found out that there was no association between KAP on SSB with SSB intake ($p>0.05$). There was also no correlation between BMI with SSB intake ($p>0.05$). Further studies need to be conducted that to understand the determinants of SSB consumption especially during Covid-19 pandemic.

CHAPTER 1

INTRODUCTION

1.1 Background of Study

Sugar also known as simple carbohydrate comprise monosaccharides (glucose, fructose and galactose), disaccharides (sucrose, lactose and maltose) and polyols (sugar alcohols) (Lin Khor, 2016). It can be found naturally in food such as fruit, milk, sugar cane and honey. There is also added sugars which is defined as sugars and syrups that are added to foods or beverages when they are processed or prepared according to American Heart Association. The main function of sugars is to provide sweet taste. Besides, sugars also function in preserving, enhancing the flavour, colour, and texture of the food (Ghanem et al., 2018).

Sugar-sweetened beverages (SSB) are beverages that composed of caloric-containing sweeteners such as sucrose (50% glucose, 50% fructose), high-fructose corn syrup (HFCS: most often 45% glucose and 55% fructose) or fruit juice concentrates that are added to the beverages by manufacturers, establishments or individuals. These beverages usually contain >25 kcal per 8 fluid ounces (approximately 237ml) (Malik et al., 2013). Example of sugar-sweetened beverages include, but not limited to soft drinks, fruit-flavoured drinks, energy drinks, flavoured milk, sweetened teas and coffees and cordials.

Sugar-sweetened beverages (SSB) are the leading source of added sugars. It continues to be the top sources of calories in US diet (Malik et al., 2013). Studies suggested that the beverages such as coffee and tea with sweetened condensed milk and added sugar were the most frequent source of added sugars consumed for both adults and elderly. According to Malaysian Adult Nutrition Survey (MANS) 2003, the estimated

level of added sugar intake by Malaysian adults was about seven teaspoons per day with average consumption of three teaspoons of sweetened condensed milk in drinks and 4 teaspoons of table sugar daily (Lin Khor, 2016).

The intake of added sugar especially in the form of sugar-sweetened beverages has been increasing steadily which exceeded the recommendation. WHO guidelines recommended reducing the intake of sugars to less than 10% of total energy intake, which is then revised and further reduced to less than 5%. These sugars include monosaccharides and disaccharides added to foods and beverages by the manufacturer, cook or consumer and sugars naturally present in food such as honey and fruit (WHO, 2018). The American Heart Association recommended the reduction in the intake of added sugars which for most American women is not exceeding 100 calories per day and for most American men is not exceeding 150 calories per day (Johnson et al., 2009).

1.2 Problem Statement

Globally, consumption on sugar-sweetened beverages have been increased rapidly. The SSB intake among the young adults aged between 20 to 39 years old was the highest (Singh et al., 2015). In a study conducted among the undergraduates students aged between 19 to 26 years in Malaysia, the proportion of consuming at least one SSB in a week and at least one in a day were 96.5% and 89.3%, respectively (National Institute of Health Malaysia, 2019). It can be clearly seen that there is a lack of awareness on limiting the SSB consumption with the high prevalence of SSB consumption among undergraduates' students. Moreover, the lifestyle of the undergraduate students which are usually loaded with assignments can be another factor for the high prevalence of SSB consumption.

High consumption of sugar-sweetened beverages will result in weight gain and causing various non-communicable disease (NCD) such as Type II Diabetes Mellitus and cardiovascular disease (Malik et al., 2013). Based on WHO 2020, overweight and obesity is recognized as abnormal or accumulation of fat in the body is excessive which might lead a risk to our health. Obesity rate in Malaysia is the highest in the South East Asia Region (Lin Khor, 2016). According to National Health and Morbidity Survey (NHMS) 2015, the national prevalence of overweight and obese among Malaysian were 30.0% and 17.7%, respectively (National Institute of Health Malaysia, 2015). The prevalence of overweight and obese continue to rise to 30.4% being overweight and 19.7% being obese in findings from NHMS 2019 (National Institute of Health Malaysia, 2019). High consumption of sugar-sweetened beverages has been linked with increasing of obesity as well as health burden in Malaysia. These beverages relatively high in calorie and sugar but contributed little or no nutritional value. Thus, consume in a large amount will lead to poor diet quality and increase the risk of weight gain (Ying Gan et al., 2019). Based on the data from the National Health and Nutrition Examination Survey (2005–2008), one in four of the US population obtain at least 200 calories, and 5% obtain at least 567 calories from SSB per day (Hu, 2013).

The finding in NHMS 2019 showed the prevalence of overall diabetes was 18.3%. There was an increasing trend in the prevalence as compared to the findings from NHMS 2011 (11.2%) and NHMS 2015 (13.4%) (National Institute of Health Malaysia, 2019). The increase of many SSB's manufacturing companies and fast-food restaurants, high availability of SSBs, poor food choices among the consumers were part of the factors that contributing to the development of these diseases and health problems.

Reduction on SSB consumption can helps to prevent death and disability in adults, and thus contributing to longevity (Singh et al., 2015). To date, there are quite a lot of

research studies carried out to find out the association between SSBs consumption and weight gain. However, the data on the knowledge, attitude and practice (KAP) is still lacking especially among undergraduates' students. It is very important to figure out whether these students have sufficient knowledge on SSBs especially among the medical students who will work as healthcare providers in the future. Besides, it is also critical to determine the association between knowledge, attitude and practice towards sugar-sweetened beverages and its intake among these students. The findings potentially contribute to developing suitable intervention measures in reducing SSBs consumption and raise the awareness on the negative impact of frequent consumption of SSBs.

Research questions:

1. What are the socio-demographic characteristics, anthropometry measurement, and score of knowledge, attitude and practice (KAP) towards sugar-sweetened beverages in undergraduates' medical students in USM Health Campus?
2. What is the frequency of sugar-sweetened beverages intake in undergraduates' medical students at USM Health Campus?
3. Are socio-demographic factors, score of knowledge, attitude and practice (KAP) towards sugar-sweetened beverages and Body Mass Index (BMI) associated with sugar-sweetened beverages intake in undergraduates' medical students of USM Health Campus?
4. Is there any mean difference in BMI and score of knowledge, attitude and practice (KAP) towards sugar-sweetened beverages between the subject's socio-demographic characteristics?

1.3 Significance of the Research

Noticeably, there is an increase trend in the sugar-sweetened beverages consumption among young adults, especially with the increase of can drinks vending machine that serve beverages such as soft drinks, energy and sport drinks, sweetened fruit beverages, as well as hot and cold cup beverage vending machine that serve coffee and tea around the campus compound. Many research studies concluded that frequent consumption of sugar-sweetened beverages is one of the leading factors leads to the rising in the prevalence of non-communicable diseases (NCD) among young adults.

The study population is undergraduates' medical students. Therefore, this study will figure out the current knowledge and understanding, attitudes and practice towards sugar-sweetened beverages among the undergraduates' medical students. In addition, the findings of the study highlight the importance of having awareness towards sugar-sweetened beverages consumption among the population to prevent non-communicable diseases. By increasing awareness among the undergraduates, they are able to make selection on healthy beverages and limit their sugar-sweetened beverages consumption.

The finding of the research will provide information about the association between knowledge, attitude and practice towards sugar-sweetened beverages and its intake as well as the association between BMI and sugar-sweetened beverages intake among undergraduates' students.

1.4 Research Objectives

1.4.1 General Objectives

To study on the association between knowledge, attitude and practice (KAP) towards Sugar-Sweetened Beverage (SSB), Body Mass Index (BMI) and SSB intake in

Undergraduates' Medical Students in University Sains Malaysia Health Campus, Kubang Kerian, Kelantan.

1.4.2 Specific Objectives

1. To determine the socio-demographic characteristics, anthropometry measurement, and score of knowledge, attitude and practice (KAP) towards sugar-sweetened beverages in undergraduates' medical students in USM Health Campus.
2. To determine the frequency of sugar-sweetened beverages intake in undergraduates' medical students at USM Health Campus.
3. To identify the association of socio-demographic factors, score of knowledge, attitude and practice (KAP) towards sugar-sweetened beverages and Body Mass Index (BMI) with sugar-sweetened beverages intake in undergraduates' medical students of USM Health Campus.
4. To figure out whether there is statistically mean difference in BMI and score of knowledge, attitude and practice (KAP) towards sugar-sweetened beverages between the subject's socio-demographic characteristics.

1.5 Research Hypothesis

Null Hypothesis

1. There is no significance association between socio-demographic factors and its intake in undergraduates' medical students of USM Health Campus.
2. There is no significance association between knowledge level, attitudes and practice towards sugar-sweetened beverages and its intake in undergraduates' medical students of USM Health Campus.

3. There is no significance association between Body Mass Index (BMI) and sugar-sweetened beverages intake in undergraduates' medical students of USM Health Campus.
4. There is no mean difference in BMI between the subject's socio-demographic characteristics in undergraduates' medical students of USM Health Campus.
5. There is no mean difference in score of knowledge, attitude and practice (KAP) towards sugar-sweetened beverages between the subject's socio-demographic characteristics in undergraduates' medical students of USM Health Campus.

1.6 Conceptual Framework

Figure 1.1 shows conceptual framework which shows the association of socio-demographic factors, knowledge, attitude and practice towards sugar-sweetened beverages, body mass index and sugar-sweetened beverages intake (type and frequency of SSB intake).

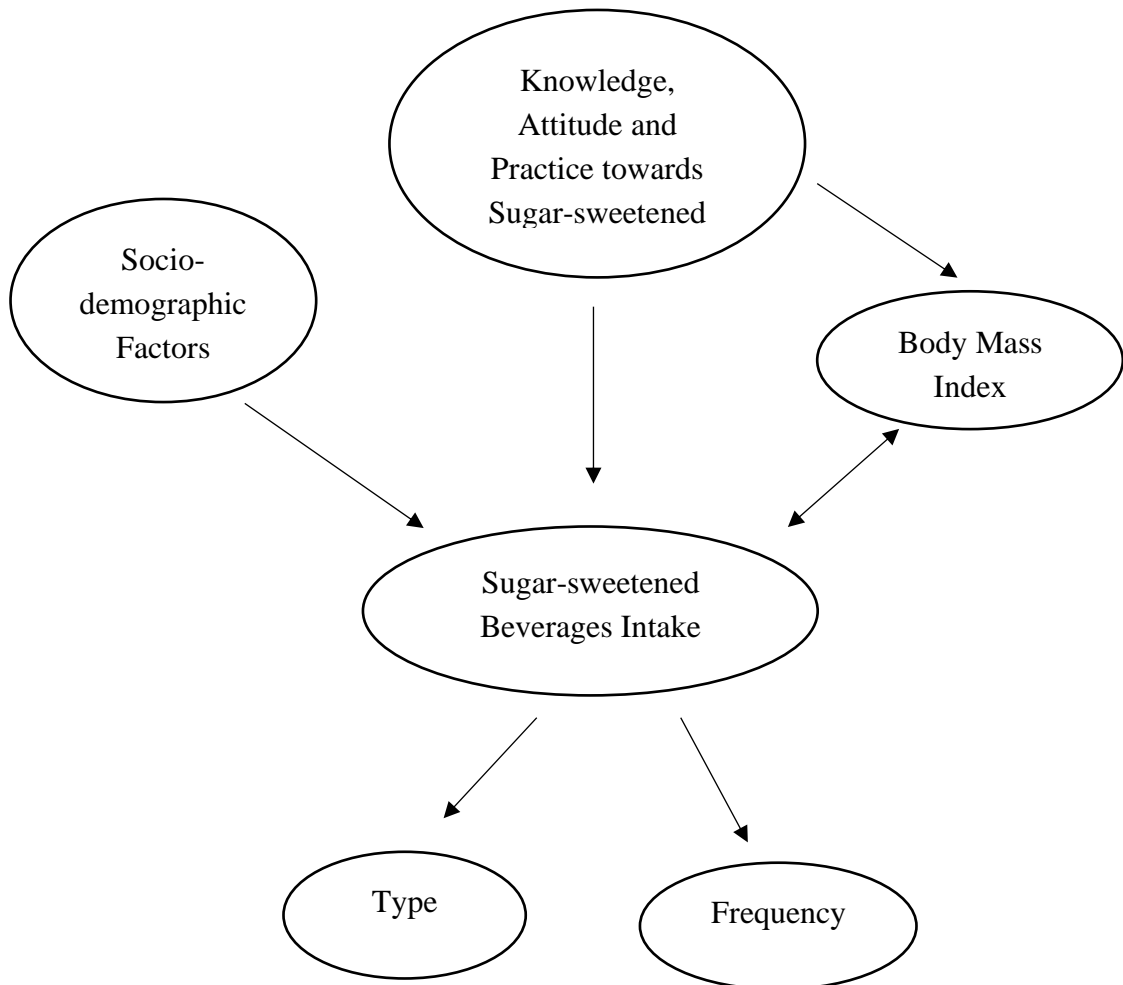


Figure 1.1: Conceptual Framework

CHAPTER 2

LITERATURE REVIEW

2.1 Prevalence of Sugar-Sweetened Beverages Intake

Malaysians' sugar-sweetened beverages intake has increased rapidly over the past 15 years. According to UNICEF's report, more than one third (36%) of students had sugary drinks at least once a day, and the average daily sugar intake for adolescents had increased from seven teaspoons in 2012 to 10 teaspoons in 2017, that was more than the recommended limit for adults. On average, Malaysians consume around 3kg of sugar per year in the form of sugary drinks (Marianne Clark-Hattingh & Lo, 2019). Based on food balance sheet data, per capita supply of sugar (from sugar crops comprising cane and beet sugar, and sugar and sweeteners comprising raw sugar, honey, other sweeteners) available for consumption in Malaysia increased from 297 kcal/day in 2005 to 385 kcal/day in 2009 (Lin Khor, 2016).

Based on Malaysian Adults Nutrition Survey (MANS) 2002/2003, the most frequently consumed beverage was plain water with majority of the population drank at least six times per day, followed by tea (1.8 times/day), coffee beverages (1.6 times/day), chocolate drink and cordial (1.4 times/day). 59% of population usually added approximately four teaspoons of sugar to beverages (Haslinda et al., 2008). In MANS 2014, the daily consumption of plain water had increased to 7 times per day. While there is a decrease in other beverages, for example tea (0.7 times/day) and coffee (0.5 times/day) (Aris et al., 2014).

A cross-sectional study conducted among undergraduates' university students in Terengganu found that on the average days, 71.1 % of the 350 respondents consumed more than one cup daily. The questionnaire for SSB intake used in this study has been

adapted from a questionnaire developed by Hedrick et al., (2012) and was modified according to the availability of beverages in Malaysia. The questionnaire includes items such as intake and frequency of several types of beverages (Aida Aliah et al., 2020). Another cross-sectional study conducted among 401 university students in Selangor showed the prevalence of intake of more than one cup of SSB on the average days was 89.3 %. SSB intake was assessed by frequency of intake in a week and in a day adapted from the Beverage Intake Questionnaire (BEVQ) (Ahmad et al., 2019). This shows a high percentage of SSB consumption among university students.

2.2 Type of Sugar-Sweetened Beverages

In 2019, National Health and Morbidity (NHMS) published a finding study on the intake of commercially packed ready to drink (CPRD) beverages, premixed beverages and sugar added self-prepared drinks among adults in Malaysia. Commercially packed ready to drink beverages (CPRD beverages) refers to carbonated and non-carbonated drinks such as CocaCola, 100 plus, Sprite, soy milk, chrysanthemum tea, lemon tea, and milo. Premixed drinks are instant drink products containing sugar, for example premix coffee, tea, chocolate, soy, and cereal. Sugar added self-prepared drink is coffee, tea, chocolate or malted beverages added with sugar and/or sweetened condensed milk or sweetened creamer.

The national prevalence of sugar added self-prepared drinks intake of at least once in a week among the respondents was the highest, 85.6% followed by CPRD beverages (38.9%) and premixed drinks (23.1%) The result showed that respondents in the age group of 18-19 years old had the highest prevalence of CPRD beverages intake at 64.7% while lowest prevalence of premixed drinks intake at 16.2%. Respondents with tertiary education had the highest prevalence of sugar added self-prepared drinks intake at 86.3%

Kelantan recorded the highest prevalence of sugar added self-prepared drinks intake with 97.7% (National Institute of Health Malaysia, 2019). It is believed that the self-prepared drinks sold in Kelantan are high in added sugar. Therefore, the undergraduate's students who further study in Kelantan will most probably have higher tendency to consume self-prepared drinks with high amount of added sugar when they are staying here.

2.3 Factors Associated with Sugar-Sweetened Beverages Intake

2.3.1 Availability and Attainable Price

The availability and attainable price of sugar-sweetened beverages is one of the factors that makes it tempting for consumers to purchase (Aida Aliah et al., 2020). The increased number of self-operated vending machines selling sugar-sweetened beverages such as soft drinks, fruit sweetened juices, canned coffee, energy, and sport drinks inside the university makes the purchasing of these products easier. Based on a study conducted among 1,839 students at 13 schools serving grades 6 to 8, students purchase sugar-sweetened beverages by roughly three times more than any other type of beverages through vending machine. With the increase of fast-food restaurants, 66% of the respondents reported visiting the fast-food restaurant at least once in a week. Number of visits to fast-food restaurants was also directly associated with sugar-sweetened beverage intake (Wiecha et al., 2006). Moreover, studies showed that a higher proportion of SSB consumption among lower household income (Barrett et al., 2017). This is most probably due to the affordable price of these beverages. CocaCola in some of the fast-food restaurants are sold with unlimited refill, but mineral water will be charged with extra RM1.00. Marketing strategies of the manufacturers of soft drinks such as Coca-Cola, PepsiCo also contributed to the recent rise in soft drink consumption (Wiecha et al., 2006).

2.3.2 Social and Environmental Changes

Furthermore, being enrolled in a university or any higher-level education institutions, students experience several social and environmental changes. These changes involve increased independence in daily living and decision making in all domains including health (Aida Aliah et al., 2020). Majority of the university students are staying in the hostel provided and away from home. Therefore, they spend most of the time together with their friends. The SSB intake among university students can also be influenced by peers. A recent review showed that parents and peers are crucial to young adults' attitudes towards food (Guidetti et al., 2012). One study found that there was a greater influence of peers in determining the adolescents' preference for sweet food than parents. Peer influence may occur through strength of friendship and social pressure (Gupta et al., 2018). Moreover, stress perceived is another factor that leads to increase of sugar-sweetened beverages consumption. Research study conducted among 136 undergraduate students suggested that stress increase consumption of high-energy comfort foods and sugary beverages such as energy drinks in college students. Participants who indicated higher levels of perceived stress reported more days on which at least 1 energy drink was consumed during the past 30 days (Pettit & Debarr, 2011). Medical students have been found to experience stress due to their academic studies. Students are reported to feel guilty if they did not spend their limited spare time on learning (Bergmann et al., 2019). Therefore, these undergraduate students will have higher SSB consumption to release their stress.

2.3.3 Education Level of the Consumers

There are many research studies on the relationship between education level of the consumers and sugar-sweetened beverages intake, but different results were obtained. Han et al. (2013) found that individuals with higher education levels display a higher

likelihood of consuming sugar-sweetened beverages than their peers with lower education levels (Han et al., 2013). Income-related factors have previously been described as factors that attribute to insufficient of knowledge in nutrition. However, there were also evidences suggesting that education is not associated with sugar-sweetened beverage intake (Pollard et al., 2016). Although university students who are pursuing their tertiary students can be classified into high education level, but studies on sugar-sweetened consumption among university students in Malaysia resulted that the prevalence of intake of more than one cup of SSB on the average days among these students was high with 71.1 % in Terengganu and 89.3 % in Selangor. Therefore, more research studies have to be done to find out the association between education level and sugar-sweetened beverages consumption.

2.3.4 Knowledge, Attitude and Practice Towards SSB

According to the study conducted among high school students in Korea, the group with higher level of sugar-related nutrition knowledge had generally desirable sugar intake behaviour. Sugar-sweetened beverages such as soda, fruit juices, flavoured drinks, sports and energy drinks was significantly found to be consumed less frequent in the group with high level of sugar-related nutrition knowledge (Joo et al., 2017). However, the community seems to have low understanding and knowledge on added sugars. Based on the survey done by Tierney et al. (2017), majority (65%) of the participants aged 18 years and above reported that they had no knowledge of the revised WHO guidelines on reduction of added sugar intake from 10% to 5%. Besides that, the awareness was significantly lower amongst younger people. Many participants were unable to correctly identify natural sugars and artificial sweeteners in accordance with WHO guidelines (Tierney et al., 2017). Many consumers have reported that nutrition labels are an important source of information and label use tends to be higher among those with higher

levels of education. Regular use of sugar information on nutrition panels was associated with a significantly lower density of added sugar. It is showed by almost 48% of consumers reported that they changed their purchasing behaviour due to nutritional labels (Drichoutis et al., 2006). Based on the cross-sectional study conducted among 165 university students in Kuantan, majority of the respondents (57.6%) were moderately making use of the nutrition label. The use of nutrition label section was assessed based on a list of five answers which are never, rarely, sometimes, often or always. The respondents were asked whether they made use of every single statement stated in the nutrition label of foods such as serving size, calories, fat, protein, carbohydrates and more (Nadya, 2013).

Fahmi Teng et al. (2019) conducted a research on knowledge, attitude and practice (KAP) of sugar-sweetened beverages (SSBs) amongst adolescents in Malaysian secondary schools in Selangor. This was a cross-sectional study involving 439 adolescents aged between 13 to 17 years old using KAP for the SSB questionnaire and BEVQ questionnaire. The study revealed a higher level of attitude (88.4%) among the participants. This means that the participants were aware the needs to read the food labels and ingredients as well as the importance to purchase on beverages without added sugars. However, the level of lifestyle choices among the participants were poor. This showed that there was no limitation in SSB intake even with a good attitude towards SSB intake. This might due to the relatively low level of nutrition-related knowledge which reflects the low level of awareness amongst the participants in practising good habits to limit their intake (Fahmi Teng et al., 2019).

2.3.5 Unhealthy Food Pattern and Lifestyle

Studies determined that individual who preferred snacks, high fat food and fast food in their diet were more likely to choose high calorie sweetened beverages with little

or no nutritional value. On the other hand, individuals who practice a healthier food pattern were more likely to have non-caloric beverages pattern (Duffey & Popkin, 2006). Referring to USDA Dietary Guidelines, a healthy food pattern refers to eating with a variety of protein foods, vegetables and whole fruits, select on whole grains, fat-free or low-fat dairy products (Dietary Guidelines for Americans 8th Edition, 2016).

Moreover, individual who practice sedentary lifestyle will have more frequent sugar-sweetened beverages consumption. The unhealthy lifestyle behaviours include lack of moderate or vigorous physical activity and watching two or more hours of television per day (Rehm et al., 2008). Therefore, people who practice sedentary lifestyle will have higher consumption of sugar-sweetened beverages, as they tend to consume SSBs while watching television or sitting in front of the computer.

2.3.6 Body Mass Index (BMI)

Based on a few research studies, obese or overweight individual usually consumed sugar-sweetened beverages more frequent than normal weight individual. In the study conducted by Abdul Majid et. al (2016) on the nutritional intake among 1361 Malaysian adolescents showed that the sugar intake in obese adolescents was 30.9% higher than normal weight. Obese adolescents consumed relatively higher amounts of sugar either from food or beverages (approximately 10 teaspoons per day) (Abdul Majid et al., 2016). In the study of intake patterns among Malaysian medical students, consumption of SSB was 1.5 soft drinks per week for obese or overweight and one soft drink per week and normal weight subjects (Boo et al., 2010).

2.4 Effects of Frequent Sugar-Sweetened Beverages Intake

2.4.1 Weight Gain and Obesity

A prospective cohort study done by on African women followed for six years reported that those who increased their SSB intake from less than or equal to one serving per week to more than one serving per week gained approximately 6.8kg whereas those who decreased their intake gained the least weight of 4.1kg (Palmer et al., 2008). Another study showed that a reduction in SSB intake of one serving per day was associated with weight loss of 0.49kg and 0.65kg at six months and 18 months, respectively (Chen et al., 2009). A 21-week randomized controlled trials strongly suggest sugar-sweetened beverages promotes positive energy balance and weight gain, especially for overweight and obese people (Houchins et al., 2012).

Sugar-sweetened beverages may lead to weight gain due to decreased satiety and positive energy balance in which the limitation of calories at subsequent meals is incomplete to compensate for SSBs calories (Malik et al., 2010). SSBs usually contain an average of 140 to 150 calories and 35 to 37.5 g of sugar per 12-oz serving. Therefore, an individual who has high intake of SSBs without the decrease in the calories per serving of normal dietary intake, then weight-gain is expected (Wolff & Dansinger, 2008).

Moreover, the consumption of SSB decreased satiety and with a faster recurring feeling of hunger. Therefore, it leads to an increased energy intake compared to the group that received energy from solid foods. Individual who consume SSB will feel hungry faster as compare to those taking solid food, although with same amount of calories. Thus, there is the risk of an increased intake of calories in the next meal, or more frequent meals will be taken resulting in positive energy balance (Prinz, 2019). Furthermore, certain food such as added-sugars food with high fructose corn syrup may be capable of triggering

addictive responses in some individuals, leading at last overeating or binge eating (Gearhardt et al., 2009).

2.4.2 Type II Diabetes Mellitus

There are various studies reported on the association of SSB consumption with the increased on Type II Diabetes Mellitus (T2DM). Based on the study conducted by Koning et.al, the rising risk of T2DM was directly proportional to the amount of sugar-sweetened beverages consumed. This means that the higher the consumption of sugar-sweetened beverages, the higher the risk of developing T2DM. The study reported a 16% increased risk of T2DM when one serving of sugar-sweetened beverages were taken per day (De Koning et al., 2012). Another study conducted among the Singapore population reported a positive association between consumption of soft drinks and juice and risk of incident T2DM. The result showed that there was a 42% increased risk in participants reporting 2 soft drinks per week compared with those without soft drinks consumption after adjustment for demographic, lifestyle, and dietary factors (Odegaard et al., 2010).

Sugar-sweetened soft drinks may increase the risk of T2DM due to the large amounts of high-fructose corn syrup added in it which causes rapidly raising blood glucose and insulin concentrations. The elevation of blood glucose was rapid and start within 30 minutes after the start of drinking and effects disappear within 2 hours (Janssens et al., 1999). Similarly, to high-fructose corn syrup, sucrose is one of the main ingredients used in beverages, juices and food. Sucrose is simple carbohydrates which can be readily absorbed (Amin et al., 2013). These simple carbohydrates contribute to a high glycaemic load of the overall diet. High glycaemic load (GL) diets have been shown to induce glucose intolerance and insulin resistance, therefore increase the risk of T2DM (Disease, 2002). Moreover, the caramel colouring used in cola type soft drinks is high in advanced

glycation end products (AGEs) and may further increase insulin resistance and inflammation (Brennan et al., 2000).

2.4.3 Other Effects

Although there is accumulation of data suggest on the association between higher SSB consumption with development of hypertension. However, the evidence relating SSB intake to cardiovascular risk is still limited (Malik et al., 2010). In the Nurses' Health Studies I and II, there were a positive association between both types of soda beverages (sugared cola and diet cola beverages) with an increased risk of hypertension. Women who consumed more or equal to 4 SSB's per day had a 44 % and 28 % higher risk of incident hypertension respectively, compared to infrequent consumers (Winkelmayr et al., 2005).

There are a few studies report on the link between dietary sugar intake and changes in lipoproteins or lipid. Larger consumption of SSBs with added sugar such as high-fructose corn syrup can lead a lowering of HDL-C and an increase in triglyceride levels (Dhingra et al., 2007). Several studies have shown an inverse association between dietary sucrose and high-density lipoprotein (HDL) cholesterol. Based on the data from the Coronary Artery Risk Development in Young Adults (CARDIA) study, a consistent inverse association between increased dietary sucrose intake and HDL cholesterol concentrations was reported. A diet high in sucrose is associated with an elevation of plasma triglyceride concentrations (Howard & Wylie-Rosett, 2002).

CHAPTER 3

METHODOLOGY

3.1 Study Design

The research design used was cross-sectional study which is suitable for population-based surveys.

3.2 Study Location

The study was conducted in University Sains Malaysia Health Campus, which located in Kubang Kerian, Kelantan, a state located in the north-eastern corner of the Peninsula Malaysia. Based on the survey carried out by the Institute of Public Health, amount of sugar intake was higher among the states from the East Coast which are Terengganu, Kelantan and Pahang (National Institute of Health Malaysia, 2019). Besides, it is also a strategic location because all the undergraduates of school of medical sciences stay in the hostel provided by the university. The location is chosen as it is easily accessible and travelling cost-saving.

3.3 Study Population

The population of this study was the undergraduate students from school of medical sciences, University Sains Malaysia Health Campus. This included students from first year, the new intake to fifth year, final year students. A students' name list obtained from academic office of school of medical sciences was used to sample the subjects for this research.

3.4 Sample Size Calculation

Sample size was calculated using single proportion formula. The formula is as below:

$$n = \left(\frac{Z}{\Delta}\right)^2 p (1 - p)$$

n = estimated sample size

Z = standard value at 95% confidence level

p = anticipated population proportion

Δ = the desired level of precision

The level of confidence is set to be 95%, and the Z-score value for 95% confidence level is 1.96. The desired level of precision is set at 8%. In the previous study reported on the association between the sugar-sweetened beverages consumption and BMI, the results revealed that 21.7% of the respondents consumed at least three cups of SSB daily, which is categorised into high consumption (Aida Aliah et al., 2020). Therefore, the population proportion will be 0.22.

$$n = \left(\frac{1.96}{0.08}\right)^2 0.22 (1 - 0.22)$$

$$= 103$$

$$n = 103 + 10\%$$

$$= \mathbf{114}$$

Based on the calculation, after considering 10% drop out rate, the total sample size required for this study was **114** undergraduates.

3.5 Research Subject Criteria

3.5.1 Inclusion criteria

- a) Individual aged 18 and above.

- b) Individual pursuing a Degree in Medicine in University Sains Malaysia.
- c) Individual willing to participate in the study.

3.5.2 Exclusion criteria

- a) Individual pursuing USM-KLE International Medical Programme.
- b) Individual undergoing any dietary intervention.
- c) Individual taking medication that could interfere with normal pattern of beverages consumption.
- d) Pregnant and lactating mother.
- e) Individual having pre-diabetes, diabetes mellitus type I or II diagnosed by medical doctors.

3.6 Sampling Method

The sampling method used to select subject for this research was convenient sampling method, which is a non-probability sampling method. All respondents were voluntarily recruited. Informed consent from the respondents who were willing to participate was obtained before the recruitment in this study.

3.7 Research Tool and Instrument for Data Collection

In this study, data collection was carried out through a set of validated questionnaires. The questionnaire consisted of 3 parts which were socio-demographic section, knowledge, attitude and practices (KAP) towards sugar-sweetened beverages questionnaire and beverage intake questionnaire (BEVQ).

3.7.1 Socio-demographic Information

The sociodemographic data includes age, gender, ethnicity and monthly family income. All the question had been created in both Malay and English version to ensure the subjects can fully understand all the questions.

3.7.2 To access knowledge, attitude and practices (KAP) towards SSB

The KAP questionnaire had a total of 20 dichotomous questions grouped into 3 domains. There were 10 questions for knowledge, 5 questions for attitude and 5 questions for practice. Each domain consisted of a dichotomous scale that require a response of either Yes/No or Agree/Disagree. The dichotomous scale was chosen to make the selection of answer clearer and easier because only two options are provided (Revilla et al., 2014). Moreover, this type of scale is usually less time consuming and the confusion while answering the questionnaire can be avoided. The questionnaire had been tested for reliability and well validated by the young adults in Malaysia (Fahmi Teng et al., 2019). The permission to use the questionnaire had been requested from Dr Norsham Juliana Nordin and granted on 26th November 2020. The questionnaire was attached in the Appendices section.

A correct response for each question was given a score of 1, whereas for each wrong response represented a score of 0. Scoring was done by summarising all the responses from the subjects to each question. Each domain was categorised into two levels of indicators based on the scoring. For knowledge domain, the maximum score was 10. Subject who scores ≤ 4 indicates poor knowledge while ≥ 5 indicates good knowledge. For attitude and practice domain, the maximum score was 5, respectively. Subject who scores ≤ 2 indicates poor attitude or practice while ≥ 3 indicates good attitude or practice.

3.7.3 To access the SSB intake using BEVQ-15

The adapted Beverage Intake Questionnaire – 15 was used to access the habitual intake of different beverages on a weekly basis. The adapted questionnaire was used in few studies (Fahmi Teng et al., 2019) (Aida Aliah et al., 2020). These included plain water, 100% fruit juice, sweetened juice beverage, full-cream milk, low fat or fat-free milk, skimmed milk, soft drinks, energy and sport drinks, sweetened tea or coffee, alcoholic drinks and more. The subjects were requested to mark the frequency of a beverage consumption in the past month. There were seven categories of responses, ranging from “never or less than 1 time per week” to “more than two times per day”. During analysis, the categorisation was further simplified into three primary categories. ‘No SSB intake per day’ indicates low SSB intake, ‘one or two times per day’ indicates moderate intake and ‘three or more times per day’ indicates high SSB intake. The adapted questionnaire is attached in the Appendices section. The relative validity and reliability of the BEVQ-15 was evaluated (Hill et al., 2017).

3.7.4 Anthropometry measurement

Anthropometry measurements that were assessed in this study included weight, height, and body mass index (BMI). In order to minimise physical contact with the respondents due to Covid-19 pandemic, both weight and height were measured by the respondent and filled into the questionnaire. Body Mass Index (BMI) was calculated by dividing weight (kg) by height squared (m^2). WHO cut off point is used to classify the subjects into different categories following the table below (Weir & Jan, 2019). During analysis, the categorisation was further simply into three primary categories in which overweight and obese will be combined into one category.

Table 3.1 BMI classification according to WHO cut off point

Category	Body Mass Index (BMI)
Underweight	$< 18.5 \text{ kg/m}^2$
Normal weight	$18.5 - 24.9 \text{ kg/m}^2$
Overweight & obese	$\geq 25.0 \text{ kg/m}^2$

3.8 Data Collection Procedure

Data collection was started once the official approval from Human Research Ethics Committee (HERC) of USM as well as the permission from Dean of School of Medical Sciences were obtained. Data was collected from January until May 2021.

First, a students' name list with email address obtained from academic office of School of Medical Sciences was used. An invitation email to participate the study was sent to all undergraduates' medical students. The email consists of the research title, objective, and the link of Google Form.

Moreover, each batch representatives from school of medical sciences were briefed on the study, objective, procedures of the study. They were clearly informed that the participation is voluntary, and no penalties or loss of benefits will involve in refusal to participate. Once the batch representatives understand the research study and agree to help to spread the study information to their batchmates, a link of Google Form that consist of informed consent form and set of questionnaires were sent.

The subjects were required to fill up the informed consent form. Then, the subjects are requested to answer a questionnaire and provide their anthropometry information (weight and height). However, the subjects have the right to quit the study at any time.

The subjects were required to tick for socio-demographic data on age, gender, ethnicity, and monthly family income, answer for knowledge, attitude, and practice