

**ASSESSMENT ON KNOWLEDGE, ATTITUDE & BELIEF ON
DIETARY CALCIUM & DAIRY INTAKE AMONG
UNDERGRADUATE STUDENTS, HEALTH CAMPUS,
UNIVERSITI SAINS MALAYSIA**

by

HAZIQA BINTI BOHARI

Dissertation submitted in partial fulfilment
of the requirements for the degree
of Bachelor of Health Science (Honours) (Nutrition)



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CERTIFICATE

This is to certify that the dissertation entitled “Assessment on Knowledge, Attitude & Belief on Dietary Calcium & Dairy Intake among Undergraduate Students, Health Campus, Universiti Sains Malaysia” is the bona fide record of research work done by Ms Haziqah Binti Bohari during the period from September 2017 to May 2018 under my supervision. I have read this dissertation and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation to be submitted in partial fulfillment for the degree of Bachelor of Health Science (Honours) (Nutrition).

Main supervisor,


.....

Dr. Norfarizan Hanoon Binti Noor Azmi

Senior Lecturer

School of Health Sciences

Universiti Sains Malaysia

Health Campus

16150 Kubang Kerian

Kelantan, Malaysia

Date: 4/7/2018

DECLARATION

I hereby declare that this dissertation is the result of my own investigations, except where otherwise stated and duly acknowledged. I also declare that it has not been previously or concurrently submitted as a whole for any other degrees at Universiti Sains Malaysia or other institutions. I grant Universiti Sains Malaysia the right to use the dissertation for teaching, research and promotional purposes.



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Haziqah Binti Bohari

Date: ...2/7/18.....

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LIST OF ABBREVIATIONS

RNI	Recommended Nutrient Intakes
KAB	Knowledge, Attitude and Belief
FFQ	Food Frequency Questionnaire
USM	Universiti Sains Malaysia
SPSS	Statistical Package for Social Science
WHO	World Health Organization

ABSTRAK

Pengambilan kalsium dikenalpasti mampu mengurangkan kejadian osteoporosis terhadap manusia. Kalsium adalah penting bagi manusia tetapi pengambilannya adalah kurang oleh golongan dewasa muda. Kajian ini telah dijalankan untuk mengenalpasti tahap pengetahuan, sikap & kepercayaan terhadap pengambilan kalsium dalam kalangan pelajar universiti di Kampus Kesihatan, Universiti Sains Malaysia, Kelantan. Kajian rentas telah dijalankan terhadap 158 pelajar berumur 18 hingga 32 tahun. Persampelan konvenien digunakan bagi memilih responden di sekitar kawasan kampus. Borang kaji selidik yang diubahsuai telah digunakan untuk menilai tahap pengetahuan, sikap dan kepercayaan responden, manakala *Food Frequency Questionnaire* (FFQ) digunakan bagi pengambilan kalsium. Berdasarkan *Recommended Nutrient Intakes* (RNI) bagi Malaysia, responden dikategorikan kepada dua kumpulan iaitu pengambilan kalsium tinggi (≥ 800 mg/hari) dan pengambilan kalsium rendah (<800 mg/hari). Analisa seramai 84.8% responden telah dikenalpasti mempunyai tahap pengambilan kalsium yang rendah di mana responden lelaki mempunyai tahap pengambilan kalsium yang lebih tinggi berbanding wanita. Lebih separuh daripada peserta mempunyai pengetahuan yang rendah iaitu 58.9%. Namun demikian, sikap dan kepercayaan mereka adalah positif, masing-masing mencapai 65.8% dan 65.2%. Tiada perkaitan yang signifikan dikenalpasti antara tahap pengetahuan, sikap dan kepercayaan dengan tahap pengambilan kalsium. Tambahan pula, tiada perkaitan yang signifikan di antara tahap pengetahuan, sikap dan kepercayaan berdasarkan jantina. Kajian juga mendapati tiada perkaitan yang signifikan dikenalpasti antara jantina dan tahap pengambilan kalsium ($p=0.211$). Secara kesimpulannya, sungguhpun tiada perkaitan yang signifikan terhadap pengetahuan, sikap dan kepercayaan dalam pengambilan kalsium dikenalpasti, ia masih boleh menjadi faktor yang menyumbang kepada pengambilan kalsium oleh responden.

Intervensi program seperti pendidikan kesehatan boleh dilaksanakan bagi meningkatkan pengetahuan, sikap dan kepercayaan pelajar universiti serta meningkatkan pengambilan kalsium.

ABSTRACT

Calcium intake has been recognised to reduce the incidence of osteoporosis in humans. Calcium is important for humans but deficient in diets of young adults. This study was conducted to identify the level of knowledge, attitude & belief in calcium intake among university students at Health Campus, Universiti Sains Malaysia, Kelantan. Cross-sectional study was conducted on 158 students aged 18 to 32 years old. Convenience sampling method used to select respondents around the campus area. A modified questionnaire was used to assess the level of knowledge, attitude and beliefs of the respondents, while the Food Frequency Questionnaire (FFQ) was used for calcium intake. Based on Recommended Nutrient Intakes (RNI) for Malaysia, respondents were categorized into two groups, high calcium intake (≥ 800 mg / day) and low calcium intake (< 800 mg / day). Analysis of 84.8% of respondents has been identified to have low levels of calcium intake where male respondents had higher levels of calcium intake than female. More than half of the participants had a low knowledge of 58.9%. However, their attitude and belief were positive respectively to 65.8% and 65.2%. There is no significant association found between the level of knowledge, attitude and belief with level of calcium intake. Furthermore, there is no significant association found between the level of knowledge, attitudes and belief based on gender. Study also found that there was no significant association between gender and level of calcium intake ($p = 0.211$). In conclusion, although no significant association found in knowledge, attitude and belief was identified, it still can be a factor that contributes to calcium intake of participants. Intervention program such as health education can be implemented to improve the knowledge, attitude and belief of university students and increase calcium intake.

CHAPTER 1

INTRODUCTION

1.1 Study Background

Calcium is one of mineral source that required by human body from wide variety of foods. It is found mainly in the hard part of bones, where it is stored; it is essential for healthy bones and is important for muscle contraction, heart action, nervous system maintenance, and normal blood clotting (Ross *et al.*, 2011). It is reported that higher calcium intake could lowered the occurrences of osteoporosis (Marcinow, 2015), Obesity, Type 2 Diabetes Mellitus (Pittas *et al.*, 2006), hypertension, coagulopathy, coronary artery disease and stroke (Pareira *et al.*, 2002). Source of calcium is found in many foods.

Dietary calcium originated from food source that associated with dairy product, vegetables and cereals, foods fortified with inorganic or organic calcium, and from dietary supplements containing calcium. Dairy food comes from milk, yogurt and cheese which supply the major source of calcium in a diet, whereas non-dairy source comes from grains, legumes, nuts, spices, fruits, meat, poultry, fish and eggs (Preedy, 2016). Calcium-rich foods among Malaysian population are fish with edible bones such as canned sardines and anchovies, beans and bean products including yellow dhal, tofu and tempeh (fermented soybeans), locally processed foods such as shrimp paste, cincaluk and budu, as well as vegetables like spinach, watercress, Mustard leaves, *Cekur Manis*, tapioca leaves, Kai-lan and broccoli (Ministry of Health Malaysia, 2005).

According to Recommended Nutrient Intake (RNI) for Malaysian, adequate intake are different according to age group. RNI for infants (0-5months) were different

based on feeding pattern, which is exclusively breastfeed (300mg) and formula-fed babies (400mg). For infants (6-11 months) required 400mg daily. For children group are classified into 3 group 1-3 years, 4-6 years and 7-9 years; which required 500mg, 600mg and 700mg respectively. Adolescent (10-18 years) required 1,000 mg per daily for both girls and boys. For adult (male; 19-65 years & female; 19-50 years) required 800mg per day. Lastly for older adult (women aged above 51 years; men aged above 65 years) needs 1000mg per day (Ministry of Health Malaysia, 2005)

However, it was reported that intake of calcium in Malaysian population did not achieve the adequacy level proposed by RNI (Boniface and Umberger, 2012). This situation occurs due to several factors that influence intake of dietary calcium and dairy into their diet pattern. However, it has been identified that calcium intake had relation with consumer's knowledge, attitude and beliefs (Boniface and Umberger, 2012., Marcinow, 2015). Knowledge of consumer was related to general nutrition, calcium nutrition and knowledge about osteoporosis. Whereas, for attitude and belief (inter-related to each other) covers health-related outcome, sensory and acceptance, cost, nutrition facts, influence from others and packaging or marketing.

Knowledge is known as body of information which consist of facts, opinions, ideas, theories, principles, and models (or other frameworks). Besides, it also refers to a person's state (ignorance, awareness, familiarity, understanding, facility, etc) of being with respect to some body of information (Barclay and Murray, 2000). At some level and in form, knowledge is known as logical prerequisite to the intentional performance of health-related behaviours (Williams, 2008). Knowledge depends on truth condition where some evidence was present to back up the claim (Richardson, 2016). Knowledge is power and necessary because it is very important to make healthier food choices. The more knowledge that one gains, the more likely it is for positive attitudes to develop

resulting in healthier food choices (Williams, 2008). Nutrition knowledge has been shown to have a positive impact on the selection of healthy foods (Cho and Fryer, 1974). Knowledge enables consumer to make informed decisions about their dietary calcium needs. It is a must in altered dietary habits as lack of knowledge was known to be most common obstacle to follow dietary recommendation. This proved with previous study where knowledge was identified as dominant factor in perceived ability to follow dietary recommendation (French, Moore, Vernace-Inserra and Hawker, 2005)

According to Richardson (1996), attitudes and beliefs were subset of a group of constructs that name, define, and describe the structure and content of mental states that thought to drive a person's actions. Attitude is defined as a mental and neural state of readiness, organized through experience, exerting directive or dynamic influence upon the individual's response to all objects and situations with which it is related (Allport, 1967). Rokeach (1968) stated that attitudes included the concept of belief where define as a relatively enduring organization of beliefs around an object or situation predisposing one to respond in some preferential manner (Richardson, 2016). However, concept of attitude has been narrowed by separating it from belief to prevent conceptual confusion. Then, attitude become 'learned predispositions to respond to an object or class of objects in a favourable or unfavourable way' (Fishbein, 1967).

There is considerable congruence of definition among these three disciplines in that beliefs are thought of as psychologically-held understandings, premises or propositions about the world that are felt to be true (Richardson, 2016). This supported by definition where belief as propositions was held to be true and accepted as guides for assessing the future, cited in support of decisions, or referred to in passing judgment on the behaviour of others (Goodenough, 1963). Besides, belief has been added as a way to describe a relationship between a task, an action, an event, or another person and an

attitude of a person toward it. According to philosophical approach mention by Green (1971) humans has been known to hold on incompatible or inconsistent belief (Richardson, 1996) and he suggested that people hold beliefs in clusters, and each cluster within a belief system may be protected from other clusters. Consumers are likely to combine positive and negative modelling. Different beliefs being expressed in other context which involved positive and negative consequences that contribute to complex and often inconsistent belief systems within an individual (Peterson, 2007).

1.2 Problem Statement

In Malaysia calcium intake remains low with daily calcium intakes of below 500 mg. Based on Malaysian Recommended Nutrient Intake (RNI), adult group (men: 19-65years & female: 19-50years) required to consume 800mg of calcium per day. However, National Health and Morbidity Survey (2014) stated that in all socio-demographic groups, the achievement of recommended level for calcium did not exceed 50% of RNI. This statement proved with prevalence of median intake for calcium was 357 mg/day or 43% of the RNI proposed. This indicates that calcium intake of Malaysian population was low than they supposed to have. Besides that, World Health Organisation (WHO) also reveals that throughout Asia calcium intake were found as inadequate compare to general recommended levels of 1000–1300 mg/day (International Osteoporosis Foundation, 2013). Inadequate calcium intake can increase the risk of developing Type 2 Diabetes Mellitus (T2DM,) cardiovascular disease (CVD), blood pressure and hypertension, and some types of cancer (Marcinow, 2015). However, the most important benefit from calcium is to promote bone health and prevention of osteoporosis in old age. Osteoporosis is one of the greatly underdiagnosed and undertreated in Malaysia even in high risk patient who have already fractured (International Osteoporosis Foundation, 2009). This situation might occur due to

osteoporosis is not among the national health priorities in Malaysia compared with other health disease.

Based on several surveys both of premenopausal and postmenopausal women (vulnerable group) consume calcium below 500mg daily (International Osteoporosis Foundation, 2013). Hip fracture is an incidents of osteoporosis occurred among vulnerable group. In aging population (age over 50 years) hip fracture has likely to increase in compare with incident in previous (1996–1997) where 90 per 100,000 individuals per year have hip fracture. Chinese population had the highest incidence of hip fractures compared to the Malays and Indians, accounting for 44.8% of hip fractures in women (International Osteoporosis Foundation, 2013). The inpatient hospital cost for hip fractures in 1997 was estimated to be 6.8 million USD (RM 22 million), and this is not counting rehabilitation or nursing home care costs. Hip fracture numbers and cost are expected to increase with an ageing population (International Osteoporosis Foundation, 2013).

It has been identified that level of awareness in Malaysia was high. Responding to a questionnaire, 87.1% of Malaysians had heard of osteoporosis, 97.1% identified low calcium intake as a risk factor and 75.8% knew postmenopausal status increased the incidence of osteoporosis in women. However, their consumption behaviour still below the adequacy. Previous studies stated many factor influence the intake of calcium product which related to knowledge, attitude and belief (Boniface and Umberger, 2012., Marcinow, 2015). Therefore, research was conducted toward undergraduate students in Health Campus of Universiti Sains Malaysia, to explore whether knowledge, attitude and belief on dietary calcium and dairy product influence calcium intake.

1.3 Significant of Study

Study is important in explore whether university students understand and realise about the importance of calcium on health-related outcome. Study has been formulated to assess the knowledge, attitude and belief on dietary calcium and dairy intake among adult. Based on student knowledges, awareness on consumption of dietary calcium and dairy intake has been evaluated. This awareness was related with the attitudes and beliefs of student in adapting healthy eating habits with increased calcium intake. Study helps in identify an adequate student's calcium level relative to their age group. Study finding provide the baseline data further improvement regarding the calcium intake among the young adult and provide baseline information for health professional or public health advocates in developing nutrition education programs for university students to increase calcium consumption. Besides, healthy eating habits were promoted according to requirement of energy intake in a day. This study encouraged students to change their eating style for healthier intake to get benefit from calcium-rich food and other macro-and-micronutrients.

1.4 Research Objective

General Objective

To assess the knowledge, attitude & belief of dietary calcium and dairy intake towards calcium intake among undergraduate students in health campus of Universiti Sains Malaysia, Kelantan

Specific Objective

1. To identify the level of calcium intake among undergraduate students in health campus of Universiti Sains Malaysia, Kelantan.
2. To identify the association between knowledge, attitude and belief of dietary calcium and dairy intake with calcium intake among undergraduate students in health campus of Universiti Sains Malaysia, Kelantan.
3. To identify the association between gender and knowledge, attitude and belief of dietary calcium and dairy intake among undergraduate students in health campus of Universiti Sains Malaysia, Kelantan.
4. To identify the association between gender and calcium intake among undergraduate students in health campus of Universiti Sains Malaysia, Kelantan.

1.5 Research Question

1. What is the level of calcium intake among undergraduate students in health campus of Universiti Sains Malaysia, Kelantan?
2. What is the association between knowledge, attitude and belief on dietary calcium and dairy intake with calcium intake among undergraduate students in health campus of Universiti Sains Malaysia, Kelantan?
3. What is the association between gender and knowledge, attitude and belief on dietary calcium and dairy intake among undergraduate students in health campus of Universiti Sains Malaysia, Kelantan?
4. What is the association between gender and calcium intake among undergraduate students in health campus of Universiti Sains Malaysia, Kelantan?

1.6 Research Hypothesis

Hypothesis 1

H₀ = There is no association between knowledge, attitude and belief on dietary calcium and dairy intake with calcium intake among undergraduate students in health campus of Universiti Sains Malaysia, Kelantan.

H_A = There is an association between knowledge, attitude and belief on dietary calcium and dairy intake with calcium intake among undergraduate students in health campus of Universiti Sains Malaysia, Kelantan.

Hypothesis 2

H₀ = There is no association between gender and knowledge, attitude and belief on dietary calcium and dairy intake among undergraduate students in health campus of Universiti Sains Malaysia, Kelantan.

H_A = There is an association between gender and knowledge, attitude and belief on dietary calcium and dairy intake among undergraduate students in health campus of Universiti Sains Malaysia, Kelantan.

Hypothesis 3

H₀ = There is no association between gender and calcium intake among undergraduate students in health campus of Universiti Sains Malaysia, Kelantan.

H_A = There is an association between gender and calcium intake undergraduate students in health campus of Universiti Sains Malaysia, Kelantan.

CHAPTER 2

LITERATURE REVIEW

2.1 Overview of calcium

Calcium is mineral source found naturally in some foods where necessary by human body to build strong and dense bone. About 99% of calcium in human body were stored or deposited in bones and teeth. Bones undergone remodelling everyday by calcium moved in and out from it. Human body cannot produce calcium so if body lack of calcium, it will be taken from bones. Adequate calcium intake in human helped in muscle contraction, blood clotting and heart to beat. Calcium absorption was more effective with aid of vitamin D source such as sunlight, food or supplement (National Osteoporosis Foundation, 2018).

Human heeded to consume variety of food source to get enough calcium every day. Best source of calcium comes from food such as dairy products, green leafy vegetables, fish with edible bone, beans and legumes and grains (Ministry of Health Malaysia, 2005). Calcium adequate intake for human was different according to their age group and gender. For Malaysian, calcium intake for day consumption followed Recommended Nutrient Intake (RNI) for Malaysian suggested by Ministry of Health Malaysia (2005).

2.1.1 Calcium absorption and Metabolism

Calcium most commonly associated with the formation and metabolism of bone (Ross *et al.*, 2011). It is the most abundant minerals in human body and make up 1.9% of body weight (Preedy, 2016). Approximately, 99% of total body calcium are found as

calcium hydroxyapatite ($\text{Ca}_{10}[\text{PO}_4]_6[\text{OH}]_2$) in bones and teeth, where it provides hard tissue with its strength (Ross, Taylor, Yaktine, and Del Valle, 2010) and 0.9% and 0.1% are remain inside the cell and extracellular fluid respectively (Preedy, 2016,). This remaining calcium is critical in mediating vascular contraction and vasodilation (Ross *et al.*, 2010) nerve transmission, muscle contraction, intracellular signalling, blood pressure regulation, and hormonal secretion (Marcinow, 2015). Bone tissue served as a reservoir for and source of calcium for these critical metabolic needs through the process of bone remodelling (Ross *et al.*, 2010). Absorption of calcium across intestinal mucosa involves active diffusion (transcellular) and passive diffusion (paracellular) (Preedy, 2016). Active transport of calcium accounts for most calcium absorption at both low and moderate intakes, and dependent on activation by calcitriol (the active form of vitamin D) and the intestinal vitamin D receptor (Marcinow, 2015). Passive diffusion involves the movement of calcium between mucosal cells and often occurs when calcium intakes are high (Ireland and Fordtran, 1973). The highest diffusion of calcium occurs in the duodenum, jejunum, and ileum (Ross *et al.*, 2010).

In an individual if their intake of calcium is very low, the percentage of a given dose of calcium that absorbed (referred to as fractional calcium absorption) was inversely related with calcium intake (Ireland and Fordtran, 1973., Hunt and Johnson, 2007). The fraction of calcium absorbed rises adaptively as intake lowered (Ross *et al.*, 2010). This explained that, when human body required a lot of calcium their absorption will be increased which affect decreasing in fractional calcium absorption. According to Marcinow (2015), fractional calcium absorption can vary throughout the lifespan. Their range are approximately about 30% – 60% (in infancy), 25% of dietary calcium (in young adult) and absorption declined with age and further for females after menopause.

In order to ensure body function normally, it is critical to maintain the level of circulating ionized calcium and control the serum of calcium level by the aid of endocrine system. It is a system of glands that secrete hormones and is characterized by controlling factors and feedback mechanisms. Endocrine system involves major role for vitamin D metabolites, principally calcitriol, and Parathyroid hormone (PTH) (Ross *et al.*, 2010). When levels of calcium in blood are high, the thyroid gland will secrete calcitriol. This is leading to inhibition of vitamin D activation, impairment of the calcium absorption in the kidneys and intestine, and the inhibition of calcium liberation by osteoclast. The process will be in turn if levels of calcium in blood are lowered where the parathyroid gland secretes PTH, leading to vitamin D activation. Vitamin D together with PTH stimulates calcium absorption by kidney and intestine and stimulates osteoclast to resorb bone tissues liberating calcium to the blood (Preedy, 2016).

2.1.2 Source of Calcium

Calcium for body requirement can be taken in form of dietary calcium, dairy product and supplements (Marcinow, 2015). However the most notable source is through consumption of dairy product (Buchner, 2013). In Malaysia Food Pyramid, milk and dairy product (cheese & yogurt) were recommended to be taken 1-2 serving every day by whatever age (Kementerian Kesihatan Malaysia, 2012). According to Warr, Rodriguez and Penm (2008), Malaysians consumed approximately 44 kilograms (kgs) of milk per person a year, compared to 25, 18 and 40 kgs in Thailand, China and the Republic of Korea, respectively. Besides milk and dairy products, dietary calcium in Malaysian diet comes from fish with edible bones (canned sardines and anchovies), beans and beans product (yellow dhal, tofu and *tempeh* (fermented soybeans), legumes (eg.,lentils), grains (eg.,whole wheat bread) (Marcinow, 2015) locally processed (shrimp paste, *cincauk* and *budu*) as well as vegetables (spinach, watercress, mustard

leaves, *cekur manis*, tapioca leaves, *kai-lan* and broccoli) (Ministry of Health Malaysia, 2005). Calcium fortified product were currently available among food manufacturer in Malaysia's market such as high-calcium milk, yogurt, breakfast cereals, biscuits and even rice (Ministry of Health Malaysia, 2005).

2.1.3 Calcium bioavailability

Calcium are absorbed depends on food source and their bioavailability (amount that can be absorbed and used by the body) (Buchner, 2013., Marcinow, 2015). The absorption of calcium from dairy products is approximately 30%, and from calcium-rich foods it is nearly 60% (Marcinow, 2015). There are certain component of food products that interfere with the absorption of calcium such as oxalic acid and phytic acid. Both of them act as inhibitor which forming as insoluble complex with calcium that cannot be absorbed in the gut. However, they would not be the risk of calcium deficiency if person consume variety of food in their diets (Buchner, 2013). There are some food items that considered as poor source of dietary calcium despite their high calcium content due to low calcium bioavailability such as spinach, collard greens, and fibre-containing wheat products (Ross *et al.*, 2010). Calcium supplement is another source that struggling being consume by individuals to achieve requirement. It has been tested in pure chemical form and shown to have absorbability similar with dietary source of calcium (Marcinow, 2015).

2.1.4 Recommendation of Calcium Intake

Intake of calcium required to be taken adequately as it promote bone maintenance and neutral calcium balance (Ross *et al.*, 2011). During adulthood (19-50years; female and 19-65years; male), bone formation and resorption will be balance after attainment of peak bone. Zeng, Li, Xiong, Su and Wan (2011), stated that calcium

balance among Asian was achieved at intakes of 340-540 mg/day. There are two intervention studies showed that 1000 mg of calcium supplement was able to slow down bone loss by about 1% in premenopausal women. Other statement recommended 600mg/day would be beneficial on bone mass (Ho *et al.*, 1994), 750 mg/day with intake of 20-40g/day of animal protein (FAO/WHO) and 800mg/day (Zeng *et al.*, 2011). Ross *et al.* (2011) provide reasonable basis for an Estimated Average Requirement (EAR) for calcium of 800mg/day of calcium after being rounded from observation value of 741mg/day. Based on these considerations, the proposed RNI for calcium for adults in Malaysia is set at 800 mg/day for male and female (Ministry of Health Malaysia, 2005).

Ministry of Health Malaysia (2010) released Malaysian Dietary Guideline with 14 key messages which co-related to each other be followed by Malaysian. Dietary calcium might be balanced by following key recommendation: (1) Eat a variety of food within your recommended intake (follows Malaysian Food Pyramid), (5) Eat plenty of fruits and vegetables every day, (6) Consume moderate amount of fish, meat, poultry, eggs, legumes and nuts, and (7) Consume adequate amount of milk and milk products (everyday). In Malaysian Food Pyramid, calcium intake are suggested to be consume; milk and dairy product (1-3 serving per day), legumes ($\frac{1}{2}$ - 1 serving per day), vegetables (3 serving per day) and cereals product (4-8 serving per day) (Kementerian Kesihatan Malaysia, 2012).

2.2 Calcium Intake in the Malaysian Adult Populations

Status of calcium in Malaysian was identified through their nutrient intake either enough for age requirement or not. According to survey conducted in National Health Morbidity Survey (2014), energy intake among Malaysian population fall short of the recommended intakes and lower than previous survey. Daily median energy intake of

Malaysian adult was 1455kcal/day or 64% of the Recommended Nutrient Intakes (RNI). Throughout the respondent for whole Malaysia, East Malaysia zones had higher energy intake and RNI achievement (66%) compared to Peninsular Malaysia counterparts (63%). RNI achievement for urban respondents had higher energy intake (66%) than their rural counterparts (62%). This might be related as frequency intake of common food items such as rice, sugar, leafy vegetables, marine fish, sweetened condensed milk, local kueh, anchovy and biscuits were higher in the rural than among the urban subjects (Norimah *et al.*, 2008). National Health Morbidity Survey (2014) shown that median intake for calcium was 357 mg/day or 43% of the RNI. Achievement of recommended level for calcium did not exceed 50% for all sociodemographic groups and found as one of the most inadequate minerals. Based on survey finding, women and respondent above 20-year-old groups are shown to be frequently consumed full cream milk however the amount consumed was below the recommendations (Norimah *et al.*, 2008).

In previous study it was found that for the age group of 19 years old and above, female achieve about 82.5% of RNI for energy compared with male achieve 79.8% of RNI for energy. This indicates that students do not meet the requirement for calcium and iron intakes. This study also stated more than 90% for both gender did not meet RNI for calcium (male; 97.3% & female; 98%) (Abdul Hakim, Muniandy and Danish, 2012). Other study stated that, females failed to meet the RNI levels for energy (80.5%), protein (45.5%), and iron (68.2%) intakes as compared to the males (73.0%, 25.3%, and 17.3% respectively). This statement explained that majority of the respondent did not meet the RNI levels for energy, vitamin C, thiamine, riboflavin, niacin, calcium and iron. (Gan, Mohd Nasir, Zalilah and Hazizi, 2011). Dietary practice for adult based on Malaysian Adult Nutrition Survey (MANS) 2014 are assessed and resulted they are

consume below than recommendation in a day; 59.1% of adult consume fruits below recommendation, 81.7% for vegetables, 73.6% for milk and dairy products, 81.9% for legumes and nuts (Ministry of Health Malaysia, 2016).

2.3 Calcium and its Relation to Health Outcome

Intake of calcium-rich product such as dietary calcium and dairy product affect health-related outcomes in individual. It substantially reduced the risk of osteoporosis, hypertension, obesity, colorectal cancer, and type 2 diabetes mellitus. Besides, they help in achieving optimal bone health and other positive-health outcomes (Marcinow, 2015).

2.3.1 Peak Bone Mass

Peak bone mass is the amount of bone acquired when accrual ceases or plateaus at some point after completion of growth and development (Gordon *et al.*, 2017). It also known as the amount of bone in the skeleton at any age as result of the amount of bone gained during growth, from uterine life to skeletal maturity, and loss of bone that occurs with aging (Mora and Gilsanz, 2003). The pubertal years were critical period for bone mass acquisition, but the process by which new tissue produced by the growth plate was turned into metaphyseal bone (endochondral ossification) and the relative roles of androgens, oestrogens, and insulin-like growth factors in the adolescent growth spurt (Gordon *et al.*, 2017). Skeletal mass increases from approximately 70 to 95 g at birth to 2400 to 3300 g in young women and men, respectively. These gains are achieved through longitudinal growth and bone modelling and remodelling, which proceed at different rates at various skeletal sites (Mora and Gilsanz, 2003). Dietary calcium was associated with increased calcium retention in adolescents up to 1300 mg/d above which the increase is not statistically significant (Weaver, 2008). Diets rich in dairy products (milk, yogurt, cheese) protein (shrimp, soy bean, soy milk, tofu), and fruits

(orange, etc) and vegetables (kale, broccoli) and low in salt were considered bone healthy diets (Pu, Chen and Xue, 2016). Adequate physical activity before and during puberty was also important. Exercise and dietary calcium can interact to enhance bone strength through improved bone geometry (absorption, excretion and bone turnover) (Weaver, 2008).

Calcium intake was low when consumption of dairy product low (Weaver, 2008). Some epidemiologic studies shown an increased prevalence of osteoporosis in regions where dietary calcium intake was extremely low (Mora and Gilsanz, 2003). A 6-year longitudinal assessment of calcium intake on bone in a large diverse study cohort of 1743 children found that dietary calcium had a positive effect, after adjustment for age, height velocity, and physical activity, on bone accrual at the lumbar spine in nonblack females with no effect on other ethnic groups or in males (Gordon *et al.*, 2017). A randomized, controlled trial in adolescent girls showed that a milk intervention increased serum IGF-1 which was presumed related to the greater bone gain in the intervention group (Weaver, 2008). In controlled supplementation trial studies showed that subjects given additional calcium for 1 to 3 years had greater gains in bone mass than did control subjects. Although bone size increased as a result of added dietary calcium in two studies, the response to calcium varied with skeletal site, pre-treatment calcium consumption, and pubertal stage. Greater bone mineral gains have been generally reported at cortical skeletal sites in pre-pubertal subjects and in girls whose habitual dietary intake was less than 850 mg per day (Mora and Gilsanz, 2003).

2.3.2 Bone Health and Osteoporosis

Osteoporosis was at highest risk for post-menopausal white and Asian women (Cleaveland Clinic, 2015). Osteoporosis characterized by low bone mass and

deterioration of bone structure (U.S. Department of Health and Human Services, 2004). According to the National Institutes of Health, half of all women over age 50 and a quarter of men older than age 50 will break a bone due to osteoporosis. There is about 25 percent of women with osteoporosis will develop a vertebral deformity, and 15 percent will break a hip. Men with osteoporosis can also have broken, although not as often as in women. However, more than 30 percent of people who break a hip die within a year (Cleveland Clinic, 2015). Calcium intake plays a major part in the maintenance of skeletal integrity throughout life (Holbrook, Barrett-Connor and Wingard, 1988). Each day, we lose calcium through our skin, nails, hair, sweat, urine and faeces, but our bodies cannot produce new calcium (National Osteoporosis Foundation, 2018). Calcium is an important nutrient for the development and maintenance of bone mass and for the prevention of bone loss later in life to reduce osteoporosis risk (Ross *et al.*, 2011). Marcinow (2015) explain that adequate calcium intake minimizes bone loss in the elderly, reduces the risk of fracture, and augments the osteo-protective effect of oestrogen therapy in females. In order to protect bone and absorb calcium in a body, vitamin D plays an important role suitable with their requirement (under age 50; 400-800IU daily & age 50 and older; 800-1000IU daily). Children need vitamin D to build strong bones, and adults need it to keep their bones strong and healthy. Inadequate vitamin D, may affect bone loss, low bone density, and susceptible to bone break (National Osteoporosis Foundation, 2018). A review from previous prospective study stated the research group reported that baseline calcium and vitamin D intakes were associated with a greater total hip and femoral neck BMD in young males ages 16 to 24, and that females over the age of 25 who were maintaining a high calcium (≥ 1500 mg/day) and vitamin D intake (≥ 400 IU/day) at follow-up had improved BMD of the lumbar spine, total hip, and femoral neck (Marcinow, 2015).

Risk of hip fracture was associated with dietary calcium. The risk of hip fracture decreased in relation to increasing levels of calcium intake in both men and women. Italian Multicentre Study shown that the age-adjusted risk of hip fracture was inversely associated with dietary calcium whether considered as mg per day or as nutrient density (mg per 1000 kcal). The significant independent inverse association of dietary calcium with subsequent risk of hip fracture (relative risk = 0.6 per 198 mg/1000 kcal) (Holbrook *et al.*, 1988). In previous cohort study, there was an apparent decrease in risk of osteoporosis for every 300 mg increase of dietary calcium intake (non-linear association). Study stated rate of first fractures and prevalence of osteoporosis were highest in the lowest quintile of dietary calcium intake. Within the lowest quintile, the risk of fracture increased for every 100 mg decrease in calcium intake, and indicates that association exist in increasing risk of osteoporosis (Warensjo *et al.*, 2011).

2.3.3 Blood Pressure and Hypertension

Sidney Ringer at the University of London was the first that observed calcium was required for cardiac muscle contraction (Resnick, 1999). This physiologic observation of calcium, now over a century old is understood as a necessary component of a final common pathway in broad range of physiological stimuli that in the aggregate contribute to blood pressure homeostasis (Resnick, 1999). Dietary Approaches to Stop Hypertension (DASH) include a combined diet rich in fruits, vegetables, low-fat dairy products and low in total and saturated fat which also known as Mediterranean diet. Previous prospective study shown blood pressure in subject with and without hypertension were effectively reduced with DASH compared with diet rich in fruits and vegetables alone (Wang, Manson, Buring, Lee and Sesso, 2008).

By using correlation coefficient for initial analysis of data, milk consumption and blood pressure were suggested to have inverse association. Further analysis conducted indicates that those drinking no milk had twice the prevalence of hypertension as those who drank a quart or more per day (Garcia-Palmieri, Costas, Cruz-Vidal, Sorlie, Tillotson and Havlik, 1984). In large prospective cohort study of middle-aged and older women, they found an inverse association between low-fat dairy product intake and the subsequent risk of hypertension. The association was moderate, graded, and independent of known risk factors for hypertension. In contrast, they found no association between high-fat dairy intake and the risk of hypertension. Calcium and vitamin D intake in diet were inversely associated with risk of hypertension. The association between low-fat dairy intake and a reduced risk of hypertension was substantially attenuated by adjustment for dietary calcium (Wang *et al.*, 2008).

2.3.4 Other Health Consideration

Consumption of dietary calcium and dairy product intakes has been associated with other a health outcome, including an increased risk of developing Type 2 Diabetes Mellitus (T2DM). In a prospective cohort study of men, it showed modest inverse association between dairy consumption, especially low-fat dairy consumption, and incidence of T2DM (Choi, Willet, Stampfer, Eric Rimm and Hu, 2005). Several studies linked that higher calcium intakes can help in lowering body weight or lowering weight gain over time (National Institute of Health, 2017). There is an inverse association between milk product and weight status in cross-sectional studies (Marcinow, 2015). Dietary calcium reported to affect intracellular calcium where impact on adipocyte lipid metabolism and fatty acid absorption in gut and component of milk products reported to had positive impact on weight management by appetite regulation and food intake (Marcinow, 2015). However, clinical trials do not approve a link between higher

calcium intakes (neither dietary calcium nor calcium supplementation) and lower body weight or weight loss. This supported by review of published studies on calcium from supplements or dairy products on weight management which proposed similar finding (National Institute of Health, 2017).

Calcium-rich foods build relationship with risk of developing cardiovascular disease (CVD). Risk of CVD reduced with intake of calcium by decreasing intestinal absorption of lipids, increasing lipid excretion, lowering cholesterol levels in the blood, and promoting calcium influx into cells (National Institute of Health, 2017). Besides that, high calcium intake could induce fatty acid and bile to bind to calcium and regulates blood pressure as blood calcium by modulating renin-angiotensin system (Pu *et al.*, 2016). However, calcium intake and risk of CVD were found to be unclear. This statement supported by cohort study where both total and dietary calcium intakes of 1,400 mg/day and higher were associated with higher rates of death from CVD and ischemic heart disease than intakes of 600–1,000 mg/day (National Institute of Health, 2017).

2.4 Factor associated with calcium intake

Several studies have been examined that Malaysia food trends and their demands on food product from source of calcium might be influenced by sociodemographic, knowledge, attitude and belief of individual. Sociodemographic include income and gender of consumer. Knowledge covers on calcium facts and benefit (Trung *et al.*, 2014), whereas attitude and belief comprised of nutrition fact and health consideration (Trung *et al.*, 2014), sensory attribute (taste and smell), cost (Marcinow, 2015), packaging and marketing (Boniface and Umberger, 2012) and social acceptance.

2.4.1 Sociodemographic

2.4.1.1 Income

Relationship between price factor and consumer behaviour exists when purchasing milk (Karajdova and Tábořecka-Petrovicova, 2015). The decrease in production and the excessive price-hike limits the consumption of milk. Study in Sri Lanka stated high price showed negative impact on fresh milk consumption (Alwis *et al.*, 2009). This was a reason of milk and dairy products beyond the reach of the poor (Islam, Lamberg-Allardt, Karkkainen and Ali, 2003). Besides, small whole fish, dry fish and shrimp are also expensive (Peterson, 2007). Eddy *et al.* (1999) reported that older women were concerned with the cost of dairy foods because they were retired and had fixed incomes. In cross-sectional study conduct in Bangladesh, subject from low income group have different pattern in food composition of the diet compared to high income group (Islam *et al.*, 2003). According to previous study, individuals may limit milk product consumption based on the perception that modified milk products (e.g., fortified and low-fat options) are expensive and not economical (Marcinow, 2015). This

statement is supported with study which found participant in their study consume less than one serving of milk per day due to statement "milk is expensive compared to fizzy drinks" (Wham & Worsley, 2003).

In many develop country, milk price are not regulated and making them unpredictable and always changings (Barkema *et al.*, 2015). High income group consumed variety of food whereas low income group lacked variety. Consumers with higher income were more likely to purchase milk and consume dairy products (Trung *et al.*, 2014). Study found most of respondent in their study did not feel cost of dairy foods was too high because these foods were necessities (Hagy *et al.*, 2000). Animal product (such as meat, fish, and egg), milk and dairy products and fruits found had significantly higher intake in high income group (Islam *et al.*, 2003). Many seemed to realize that convenience increases cost (Hagy *et al.*, 2000).

2.4.1.2 Gender

Poor eating habits and obesity are important public health issues especially among young adults who are experiencing transition into university life (Nelson *et al.*, 2008). Most university students make their own food choices (Šataliæ, Bariæ & Keser, 2007). High proportion of them failed to meet recommended macro-and micro-nutrient (Gan *et al.*, 2011). Previous study found almost all of their participants did not meet the RNI level for calcium intake, which in relation with one-third of the participants reported they had not taken milk for the past this seven days (Gan *et al.*, 2011). Gender has been documented to cause difference in eating behaviour. Malaysian Adult Nutrition Survey (MANS) revealed calcium intake in both men and women across socio-demographic groups did not meet the recommended intake (Marlini *et al.*, 2008). Female found had better dietary habits as compared to their male counterparts (Gan *et*

al., 2011). Previous study by found that female students more commonly consume milk and milk products, fruits, vegetables, cereals, cakes and sweets while male found to be more commonly consume soft drinks, meat, fish and fast food (Mikolajczyk *et al.*, 2009., Huang *et al.*, 2003). Food consumption survey in Singapore found that their population did not have a habit of drinking milk, but generally preferred full cream milk over sweetened condensed milk (Norimah *et al.*, 2008). Milk consumption in Korea still very low and finding indicates woman probably more likely to be aware and more knowledgeable about the health benefits of milk (Sook, 2003., Norimah *et al.*, 2008). This is because milk drinking was associated with a lower risk in osteoporosis (Chee *et al.*, 2002). Thus, situations lead to higher frequency of milk intake among women and increase frequency of milk intake among women (Norimah *et al.*, 2008).

2.4.2 Knowledge

Malaysian nowadays are more aware on nutrition fact and benefit in making their food choice which including micronutrient such as calcium intake through their diet. Rezai, Mohamed and Shamsudin (2011), reported that respondent found to be willing to buy organic vegetables to get healthier. Besides, Quah and Tan (2010) found for each 10-year increase in age, Chinese-Malaysian consumers are about 11% more likely to purchase organic food products. Malaysians also now spend more on milk and dairy products than rice and this is driven by evidence and awareness that dairy products can provide essential vitamins and nutrients as well as other health benefits (Boniface and Umberger, 2012). For example, probiotic microorganisms present in yogurt contribute in maintaining and improving consumer intestinal bacteria as health promoting properties (Fuller, 1989). However, nutrition misinformation and misjudge about calcium product by consumer might be occurred without proper education (knowledge) (Peterson, 2007).