



## CHAPTER II

### LITREATURE REVIEW

The research will focus on the association between preferences, consumption and socio-demographic factors in Chulalongkorn Supporting staff. This chapter is a review of the relevant materials that was used to complete this study. The review will be divided into four major parts.

1. General Information about vitamin/ minerals
2. Operational Terms used in the study
3. Thai Reference Dietary Intake ( RDI )
4. Socio-demographic factors associations with vitamin/mineral supplement consumption.
5. Various types of preference.

#### **2.1 General Information about vitamins/minerals**

##### 2.1.1 Types of vitamins

Vitamins can be divided into two different categories based on their solubility. The two categories that vitamins can be categorized in are fat soluble vitamins and water soluble vitamins. Fat soluble vitamins include vitamin D, vitamin E, vitamin A, and vitamin K. Fat soluble vitamins contain carbon, hydrogen, and oxygen whereas water-soluble vitamins contain three elements plus nitrogen and plus sometimes sulfur (Vitamins Supplement Guide, 2006). Water soluble vitamins are folic acid vitamins, vitamin B12, biotin, vitamin B6, niacin, thiamin, riboflavin,

pantothenic acid, and vitamin C (ascorbic acid). Fat soluble are vitamins that are soluble in fat. Fat soluble vitamins such as vitamin A, vitamin E are absorbed in fat globules that travel through the lymphatic system of the small intestine and into the general blood circulation within the body. Fat soluble vitamins especially vitamin A and vitamin E are then stored in the body tissues and tend to remain there.

### 2.1.2 Roles of vitamins in the human body

Instead vitamins help the body metabolize nutrients in food and help the body to run and function smoothly (Vitamins Supplement Guide, 2006).

The roles which they function in our body can be classified into two categories: fat soluble vitamins and water soluble vitamins.

#### 2.1.2.1 Fat Soluble vitamins

Fat soluble vitamins include vitamin A, vitamin D, vitamin E and vitamin K.

Vitamin A can be used for vision, immune defenses, maintenance of body linings and skin, bone and body growth, normal cell development and reproduction (Vitamins Supplement Guide, 2006).

Vitamin D is a group of steroid molecules. Vitamin D is also known as the sun light vitamin (Vitamin Supplement Guide, 2006). The body is only able to synthesize vitamin D when, the sun's ultraviolet B strikes the skin (Vitamin Supplement Guide, 2006). Vitamin D is a key element in the body because it controls the level of calcium in the body from food, the blood, and also excretion of vitamin D in the urine (Vitamin Supplement Guide, 2006).

Vitamin E has a protective property of maintaining the protective property of maintaining the body's intracellular membrane by protecting the physical

stability and providing a defense line against tissue damage, which can be caused by oxidation( Vitamin Supplement Guide, 2006). According to many studies, vitamin E also has the characteristic to lower the risk of stroke (Leppälä et al., 2000)

Vitamin K plays a vital role in blood clotting and bone metabolism (Vitamins Supplement Guide, 2006). In addition vitamin K is used to reduce the risk of liver disease, jaundice, and mal-absorption or in association with long-term use of aspirin or antibiotics (Vitamin and Supplement, 2006).

#### 2.1.2.2 Water Soluble vitamins

Water soluble vitamins include the group of vitamin B and vitamin C (Vitamin Supplement Guide, 2006).

Vitamin B group includes: vitamin B1, vitamin B2, vitamin B3, vitamin B5, vitamin B7 and vitamin B9.

Vitamin B1 or Thiamin plays a role in the aid of body's nervous system and is essential for many important enzymes (Vitamins Supplement Guide, 2006).

Vitamin B2 (riboflavin) is important in human nutrition and plays a key role in the production of energy (Vitamin Supplement Guide, 2006). Vitamin B2 also is able to prevent and used to treat migraine headaches, cataracts, rheumatoid arthritis, and various skin disorders such as acne, dermatitis and eczema(Vitamin Supplement Guide.2006).

Vitamin B6 (pyridoxine) plays the role as coenzyme, which is involved in the metabolism of protein and carbohydrates, the production of insulin and red and white blood cells, synthesis of neurotransmitters, enzymes, and

prostaglandin. Vitamin B6 is requirement for the production of serotonin and is a key factor for a healthy immune system (Vitamin Supplements Guide, 2006).

Vitamin B5 or pantothenic acid, panthothenic acid is an antioxidant water-soluble vitamin that is required by the body in order to be able to break down carbohydrates, proteins, and fats (Vitamin Supplement Guide, 2006). In order for the human body, to have proper growth, reproduction and go through bodily process vitamin B5 is essential (Vitamin Supplement Guide, 2006). Not only does vitamin B5 help with growth it also metabolize nutrients, manufacture antibodies to produce vitamin D (Vitamins and Supplement, 2006).

Vitamin B7 or biotin (vitamin H), biotin has the capability and aids in the synthesis of fatty acids, in energy metabolism, and in the synthesis of amino acids and glucose (Vitamin Supplement Guide, 2006). Biotin is an essential coenzyme for four carboxylase enzymes, each which is essential for metabolism and it also plays a role in helping certain enzymes in the body (Vitamin Supplement Guide, 2006).

Vitamin B9 or folic acid, aid is a synthetic form which is used for food fortification and nutritional supplements (Vitamin Supplement Guide, 2006). Folic acid is very important in human growth and development, especially in cell division and DNA synthesis (Vitamin Supplement Guide, 2006). Folic is important in almost every stage of the human especially that require growth such as pregnancy (Vitamins and Supplements, 2006).

Vitamin C (ascorbic acid) and its sodium, potassium and calcium salts are used as antioxidant food additives (Vitamin Supplement Guide, 2006). The body requires vitamin C to maintain bones, blood vessels, and skin (Vitamin

Supplement. Guide 2006). Vitamin C helps build and maintains the tissues of the human body and strengthens the immune system (Vitamin Supplements, 2006).

### 2.1.3 Source of vitamins

Fat soluble vitamins can also be found in many sources of plants and animals (Wikipedia, 2008). For example, vitamin A is a fat soluble vitamin can be found in nature in two different sources: performed vitamin A and pro-vitamin A, or carotene (Wikipedia, 2007). The vegetable source of beta-carotene is fat and cholesterol free. Sun light is an important source of vitamin D. Milk and fatty fish have high content of vitamin D (Vitamins supplements guide, 2006). Vitamin E can be found in germ of a seed or grain (Wikipedia, 2008). Lastly, vitamin K, which is the last fat soluble vitamin, can be found in broccoli, Brussels sprouts, cabbage, spinach, cauliflower and kale (Vitamins and supplements, 2006).

Water soluble vitamins such as thiamine (vitamin B1) can be found in fortified bread, cereals, pasta, whole grains, lean meats (especially pork), fish, dried beans, peas and soybeans (Vitamin Supplement Guide, 2007). Riboflavin or vitamin B2 can be found in organ meats, almonds, mushrooms, whole grain, soybeans and green leafy vegetables (Wikipedia, 2008). Niacin or vitamin B3 can be found in dairy products, fish lean meats, nuts and eggs (Vitamins Supplement Guide, 2008). Adenine (vitamin B4) can be found in whole grain, raw unadulterated honey, bee pollen, royal jelly, propolis, most fresh vegetables and most fresh fruits( Wikipedia,2008). Pantothenic Acids or vitamin B5 can be found in cheese, corn, eggs, liver, meats, peanuts, peas, soybeans, and wheat germ (Vitamin Supplement Guide, 2007). As for the vitamin B6 include white meat (poultry and fish), bananas, liver, whole-grain breads and cereals, soybeans and vegetables. Folic acid can be easily found in leafy

green vegetables, citrus fruits, beets, wheat germ, and meat. Lastly vitamin B12 can be found in food sources in protein-bound forms (Vitamin and Supplement, 2007). Panagamic acid can be found in whole grain such as brown rice, brewer's yeast, pumpkin and sunflower seeds, and beef blood (Vitamin Supplement Guide,2007). Vitamin B17 can be found in many fruit seeds such as the apple, peach, cherry, orange, plums, nectarine and apricot (Wikipedia, 2008). The last water-soluble vitamin is vitamin C which can be found in cabbage and many dark green leafy vegetables, mango (Wikipedia, 2008).

#### 2.1.4 Types of minerals

Currently there are six available forms of mineral supplements on the market for consumers (Office of dietary supplements, 2007). The mineral supplements available on the market include: chromium, folate, iron, magnesium, selenium, and zinc (Office of dietary supplements, 2007).

##### 2.1.4.1 Roles of Minerals in the Human Body

Chromium is a mineral that the human body in small amounts. although its mechanisms of action and the amounts needed for optimal health are not well defined (Office of dietary supplements, 2007). Chromium is capable of enhancing insulin, a hormone that is required to enhance metabolism, storage of carbohydrate, fat, and protein in the body (Office of dietary supplements, 2007).

Folate is a water-soluble B vitamin that can be naturally found in food (Office of dietary supplements, 2007). Folic acid is the synthetic form of folate that can be found in supplements and often added in fortified foods (Office of dietary supplements, 2008). Folate assists in the productions and maintains of new cells (Office of dietary supplements, 2007). This is especially important during periods of

rapid cell division and growth such as infancy and pregnancy (Office of dietary supplements, 2007).

Iron is an essential mineral for the regulation of cell growth and differentiation (Office of dietary supplements, 2007).

Magnesium fourth most abundant mineral in the body and is essential to good health (Office of dietary supplement, 2007). Approximately 50% of total body magnesium is found in bone (Office of dietary supplement, 2007). The other half is found predominantly inside cells of body tissues and organs (Office of dietary supplement, 2007). Only 1% of magnesium is found in blood, but the body works very hard to keep blood levels of magnesium constant (Office of dietary supplement, 2007)

## **2.2 Operational term**

Attitude of regarding vitamins supplements, there are 13 statements regarding the attitude towards vitamin and mineral supplements consumption. Each statement has a different purpose. The 13 statements cover 5 different aspects of preference that directly consumption and attitude towards consumption. The five aspects of preference include

- Affordability preference
- Brand Preference
- Convenience Preference
- Personal Preference

Consumer refers to those who are currently consuming any form of vitamin or mineral supplement at the time of the study. In addition, when referring to consumer

in this study it also means that this interviewee is also a member of the supporting staff population at Chulalongkorn University. When refereeing to consumers we will not take in account, the duration of consumption or frequency of consumption.

Mineral supplement: refers to any form of supplement that is a mineral that is consumed on a weekly or daily.

Non-consumer refers to those that are not currently consuming any form of vitamin or mineral supplement at the time of the study. In addition in order to be considered as a non-consumer the interviewee must also be a member of the supporting staff population of Chulalongkorn University.

Knowledge of vitamin and mineral, this term refers to the understanding and knowledge about vitamin and mineral supplements. The knowledge of vitamin and mineral supplements will also refer to the source of vitamin or mineral supplements. The highest possible score for the knowledge section of the structured questionnaire is 20, where the lowest score is 0.

Practice of vitamin and mineral supplements, this term refers to the current usage of vitamin or mineral supplements. In order to be currently practicing vitamin or mineral supplement, the interviewee must also be part of the supporting staff population of Chulalongkorn University to consider as practicing vitamin or mineral supplement usage. Although practice of vitamin or mineral will not take account of the duration, frequency, or the type of vitamin or mineral supplement currently consuming. As long as, there is consumption of vitamin or mineral supplement will be considered as practice of vitamin or mineral supplement.

Supporting staff, the term supporting staff refers to those that are currently work at Chulalongkorn University, although our study will exclude janitors, canteen



workers, security guards, drivers and gardeners. Any of the supporting staff, which was willing to participate in the study, were asked to fill in the questionnaire. The supporting staffs were chosen at random, regardless of gender, age, education and income.

Vitamin supplements, refers to a vitamin supplement that is available on the market that can be used as a dietary supplement.

### **2.3 Thai RDI**

The Thai reference dietary intake is the recommended dietary intake for the average Thai person, living in Thailand (Wikipedia, 2007). The Thai reference dietary intake consists of a table, which has all the essential vitamins and nutrients required that a normal Thai citizen should consume (Food and Drug Administration Thailand, 2008). Table 2.1 shows the average intake of each vitamin and mineral that the average Thai citizen should consume into their diet. The value of some nutrients such as vitamin A for Thai people is a lot higher when compared to the dietary intake of vitamin A for the USFDA standards (Food and Drug Administration, Thailand 2008).

Table 2.1: Average Recommended dietary Intake ( THAI RDI)

<b>Nutrient</b>	<b>Recommended Dietary Intake (Thai RDI)</b>
<b>Fat-soluble vitamins</b>	
Vitamin A	800 µg RE* (2,664 IU)
Vitamin D	5 µg (200 IU)
Vitamin E	10 mgα - TE** (15 IU)
Vitamin K	80 µg
<b>Water-soluble vitamins</b>	
Vitamin B <sub>1</sub> (Thiamin)	1.5 mg
Vitamin B <sub>2</sub> (Riboflavin)	1.7 mg
Niacin	20 mg
Vitamin B <sub>6</sub>	2 mg
Folic acid	200 µg
Pantothenic acid	6 mg
Biotin	150 µg
Vitamin B <sub>12</sub>	2 µg
Vitamin C	60 mg
<b>Electrolytes &amp; Minerals</b>	
Sodium	2,400 mg
Potassium	3,500 mg
Chloride	3,400 mg
Calcium	800 mg
Phosphorus	800 mg
Magnesium	350 mg
Iron	15 mg
<b>Trace minerals</b>	
Zinc	15 mg
Copper	2 mg
Manganese	3.5 mg
Fluoride	2 mg
Iodine	150 µg
Selenium	70 µg
Molybdenum	160 µg
Chromium	130 µg

## **2.4 Socio-Demographic factors association with vitamin/mineral supplement consumption.**

Socio-Demographic factors are known to be highly associated with vitamin/mineral supplement consumption (Kim et al., 2001; Driskell & Giraud, 1996, Yong et al., 1990 ; Kim et al., 2003; Pedro et al., 2004; Balluz et al., 2000 & Sebastian et al., 2007; Rock et al., 2007; Lyle et al., 1998; Ishihara et al., 2003). Several studies shown that demographic factors such as Age, Alcohol Consumption, Education level, Ethnicity, Gender, Income, Health perception, Living location, and Occupation, Smoking status, all have an impact on the consumption on vitamin/ mineral supplement (Kim et al., 2001; Driskell & Giraud et al., 1996; Yong et al., 1990; Kim et al., 2003; Pedro et al., 2004; Balluz et al., 2000; Sebastian et al., 2007; Rock et al., 2007; Lyle et al., 1998; Ishihara et al., 2003).

### **2.4.1 Age**

Age can be divided into four main groups: Children, Teenagers, Adults, and Elderly (Kim et al., 2001; Driskell & Giraud, 1996; Yong et al., 1990; Kim et al., 2003; Pedro et al., 2004; Balluz et al., 2000; Sebastian et al., 2007; Rock et al., 2007; Lyle et al., 1998; Ishihara et al., 2003). The prevalence of vitamin/mineral supplement consumption was more prevalent in teenagers in Korea, when compared to primary school children (Kim et al., 2001). The reason for this is because, the teenagers took more vitamin/ mineral supplement when compared to the children in the study is because they felt more fatigue due to the intense studying (Sun et al., 2001). In another study, women who of an older age of more than  $\geq 60$  years old would consume more vitamins than woman of less than 60 years old (Rock et al., 2007). Men with an age of 71 years old and older were likely to consume more vitamin/

mineral supplements when compared to men with an age range of 51-70 years old (Sebastian et al., 2007). Those who are over 65 are more likely to consume vitamin/mineral supplements except for vitamin E, which were more prevalent among those in their middle years and iron consumed most highly among the young (Block et al., 1987).

#### 2.4.2 Alcohol Consumption

Alcohol Consumption and the usage of vitamin and mineral supplement according to some studies have some association with consumption of vitamins and mineral supplements (Block et al., 1987; Kim et al., 1993). Woman who used specific vitamin supplements (non-multivitamin supplement) were more likely to consume alcohol regularly (Insum et al., 1993). Vitamin and Mineral supplement also showed an association with the type of alcohol consumed (Block et al., 1987). Beer drinkers are less likely to consume vitamins supplements whereas those who drink wine were more likely to consume vitamins (Block et al., 1987).

#### 2.4.3 Education

Education and the usage of vitamin and mineral supplements had a very high association (Barbra et al., 1998; Block et al., 1987; Cherry et al., 2007; Insum et al., 1993; Block et al., 2007). Vitamin / mineral supplement consumption was highly associated with education level, the higher the education the study area had the higher percentage of consumption of vitamins (Block et al., 2007). For example, in a study by Block 2007, 86 % of those who were studied consuming multiple supplements had higher than a high school education (Block et al., 2007). In addition, those with higher education than of a high school level were more likely to consume vitamins

supplements such as vitamin C supplement and vitamin E supplement (Rock et al., 1998).

#### 2.4.4 Ethnicity

Ethnicity is also related to the consumption of vitamins/mineral supplements. According to several studies woman who consumed vitamin/minerals supplement from Caucasian ethnicity were more likely to consume vitamins when compared to African-american ethnicity (Block et al., 1987). According to Block, 1987 only 17.7 % of the African American studied consumed vitamin/mineral supplements regularly. In addition Caucasian was 10 –times more likely to consume vitamin C supplement when compared to African-Americans (Block et al., 1987). Vitamin supplement usage in California Teachers study shows that multivitamin and specific supplement users tend to be Caucasian (Hoggatt et al., 2002).

#### 2.4.5 Exercise

Exercise and the usage of vitamins and mineral supplements can be associated (Ishihara et al., 2003; Lyle et al., 1998). Ishihara, 2003 showed in his study that when there was a regular exercise routine, there was more likely chance of consuming vitamins or mineral supplements when compared to those who did not consume vitamins or mineral supplements.

#### 2.4.6 Gender

Gender and vitamin and mineral supplement use can be highly associated with the frequency of consumption and willingness to consume. In many of the studies reviewed females are more likely to consume vitamins or mineral supplements when compared to men (Lyle et al., 1998; Balluz et al., 2000; Block et al., 1987, 2007). Women were in addition more likely to consume vitamins regardless of their

age, when compared to men. Men who consumed vitamins or mineral supplements tended to be much older (Rock et al., 2007). In a study done by Block, 1987 according to the study's results showed that at the time 21.6 percent of Americans woman consumed supplements regularly when compared to 19.4 percent of American men who consumed vitamins or mineral supplements regularly.

#### 2.4.7 Income

Income similar to other demographic factors has an influence on the consumption and usage of vitamins or mineral supplements (Balluz et al., 2000; Block et al., 1987, 2003; Kim et al., 2003, 2007; Rock et al., 2003; Ishihara et al., 2003). The usage of vitamins and mineral supplement usage is even more prevalent in teenagers in Korea that came from middle class to higher income families (Kim et al., 2003, 2007). In a study by Block in 1987 showed that those who consumed vitamins or mineral supplements were more likely to come from a higher income family. In the year 2003, Block performed a similar to the one in 1987 and that showed that 61.9 percent of users multiple vitamins families had an annual income equal to or greater than 70,000 US dollars a year.

#### 2.4.8 Health perception

Health perception or current health status according to several studies has an impact on the decision to consume or consumption of vitamins or mineral supplements (Fennell et al., 2004; Ishihara et al., 2003; Greger et al, 2001&Foote et al., 2003). Many studies have suggested that the study population that consumes vitamins or mineral supplements will have a healthier health status or perceive their health as healthy when compared to non-users (Fennell et al., 2004; Greger et al., 2001&Foote et al., 2003). In addition, users of vitamins or mineral supplements

choose to consume the supplements due to their health status. For example, in a study by Rock, 2000 showed that out of 350 people that had been diagnosed with cancer 48 percent of the reported had decided to use vitamins immediately after they had been diagnosed with cancer. On the contrary, other studies suggested that the study population that had considered themselves healthy or had an efficient diet did not consume any form of vitamin or mineral supplements (Ishihara et al., 2003).

#### 2.4.9 Living location

In many studies the living location of the users of vitamin and mineral supplement is compared with the living location of non users (Block et al., 1987; Ishihara et al., 2003). According to the study by Ishihara it showed that the location of living has a very high association with the usage of vitamin and mineral supplement usage. The study showed that the majority of consumers of vitamin and mineral supplement lived in metropolitan areas (Ishihara et al., 2003). For example, in areas such as Suita, Katsushika and Ishikawa, which were highly influenced by westernization, had a higher prevalence of vitamins and mineral supplements usage when compared to the other study areas in Japan (Ishihara et al., 2003). In another study by Block, 1987 showed that living in the West coast of America were more likely to consume vitamins when compared to the South region of America where the prevalence of consumption was the lowest. The rate of consumption of vitamin and mineral supplement, in the west coast of America was three to five times higher when compared to the south region of America (Block et al., 1987).

#### 2.4.10 Occupation

It has been shown that occupation can also influence the use of vitamin or mineral supplement usage (Ishihara et al., 2003). According to the study by Ishihara,

they found that those were in the farming, forestry, and fishing group industry had a lower prevalence of vitamin or mineral supplement usage, when compared to other occupations in the study such as an employee of company or a professional (Ishihara et al., 2003). Occupation may influence the usage of vitamin and mineral supplement due to the social life and working environment (Ishihara et al., 2003). Studies have shown that those in the agricultural sector of the study had more conservative thinking methods and were less likely to consume vitamin or mineral supplements (Ishihara et al., 2003).

#### 2.4.11 Smoking status

Smoking status similar to alcohol consumption has been associated in some studies with the usage of vitamin and mineral supplement (Block et al, 1987; Rock et al., 2000; Ishihara et al., 2003). According to Block, 1987 showed in his study that there was no association between vitamin or mineral supplement use in past smokers or current use of tobacco, but there was an association between the number of cigarettes smoked per day and vitamins or mineral supplement usage. On the contrary, Ishihara study showed that the majority of users of vitamins or mineral supplement were former smokers when compared to other never or current smokers (Ishihara et al., 2003).

### 2.5 Types of preference

In this study we also look at the different type of preference that consumer of vitamins and non consumers that have the desire to consume vitamins. Different articles have been reviewed in order to identify the different types of preference. Scientific journals and both business journals have been used in order to classify preference. Preference can be divided according to 5 categories that constitute:



affordability preference, brand preference, convenience preference, personal preference and satisfaction preference.

#### 2.5.1 Affordability preference

Affordability preference refers to the ability to pay or spend money on a certain product. Affordability preference in vitamin supplement consumption refers to the ability or willingness to buy vitamin supplement or consumption due to social economic factors or education of the consumer (Dana et al., 2004).

#### 2.5.2 Brand preference

Brand preference refers to consumption of a particular brand of vitamin supplements or consumption of vitamin supplement because of the symbolic meaning that is consistent with their self-concept (Groves et al., 2005). Therefore, the preference of consumption of a particular brand of vitamin supplement or vitamin supplement will be because they see themselves as the target group or those that should consume this product. Brand preference will exclude any preference due to

#### 2.5.3 Convenience preference

Convenience preference refers to the preference of easy or how less time consuming the consumption of vitamin supplement was for the interviewee (Kenneth et al., 2007). Convenience preference of vitamin supplement consumption refers to the consumption of vitamin supplement and the frequency of consuming and willingness to prolong usage (Kenneth et al., 2007).

#### 2.5.4 Personal preference

Personal preference of vitamin usage refers to the usage for personal reasons. For example, the reason of usage may be because of health reason, or friend

recommendation. Personal reference excludes preference from the media or advertisements.

#### 2.5.5 Satisfaction preference

Satisfaction preference refers to the satisfaction obtained from consuming vitamin supplements (Kenneth et al., 2007). Satisfaction preference includes health satisfaction or emotional satisfaction when consuming vitamins. Health satisfaction in terms of lowering cholesterol level or improve in bone density mass. Health satisfaction, will be upon the interviewee own personal judgment. Secondly, emotional satisfaction refers, how satisfied the consumer is when consuming vitamins, the consumer may feel that they are more energetic or feel healthier.