

**Examining The Potential For Vitamin D Deficiency In Young Saudi Women Living  
In Canada: A Qualitative Study**

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## **Abstract**

More than a billion people worldwide suffer from vitamin D deficiency or insufficiency. Canada, which has a long winter and high latitude, has a high rate of vitamin D deficiency. The Middle East also, in particular Saudi Arabia, has one of the highest rates of vitamin D deficiency in the world. The purpose of this research was determining the knowledge, attitudes, and practices (KAP) concerning vitamin D of young Saudi women living in Canada. Health professionals with experience in both Canada and Saudi Arabia acted as key informants. This research assessed topics related to knowledge of vitamin D sources (supplementation, fortification, and exposure to the sun), attitudes regarding the importance of vitamin D, and practices indicating whether knowledge and attitudes were being implemented or not. The study was conducted in Canada. Eight Saudi women between the ages of 18- 45 y and 10 health professionals including physicians, nutritionists and nurses were recruited. Results showed that Saudi women had limited awareness of vitamin D deficiency and lacked motivation to use supplements. They also had limited sun exposure due to environmental and cultural reasons. The health professionals recommended that Saudi women increase their awareness of the risk of vitamin D deficiency and the importance of using vitamin D supplements. Recommendations for more research about Saudi women living in northern locations such as Canada are presented.

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## **Dedication**

This thesis is dedicated with deep love to my parents (Ali and Hamamah) for their continuous love, support and encouragement throughout my journey. Moms, and dad, without any doubt you are the people I owe most for pursuing my graduate studies.

I also dedicate this work to my amazing husband (Ali), who has supported me throughout the process. He has been supportive of my work and has shared with me so many challenges to complete this thesis.

I also dedicate this thesis to my beloved, and amazing daughters (Arin, Shaden, Randah and Shyhanna) for the love, patience and unlimited support that they have given me during this journey. Always surrounding me with their smiles, and honestly, your love gave me the will to complete this work.

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### List of Abbreviations

	Description
BMD	Bone mineral density
CHMS	Canadian Health Measures Survey
DRIs	Dietary Reference Intakes
EAR	Estimated Average Requirement
IOM	Institute of Medicine
IUs	International Units
KAP	Knowledge, attitude and practice
RDA	Recommended Dietary Allowance
UL	Tolerable Upper Intake Level
UV	Ultraviolet radiation
WHO	World Health Organization

## **Chapter 1**

### **Introduction**

#### **1.1 Introduction and Background**

The “sun vitamin,” as vitamin D is called, plays a critical role in public health (Fuleihan, 2009; Holick, 2009; Mithal et al., 2009). Vitamin D is essential for bone and muscle growth and development through all stages of life (Deluca, 2008; Holick, 2007, 2009; Institute of Medicine, 2010; Naeem, 2010). It also is important in the prevention of diseases such as cardiovascular disease (Giovannucci et al., 2008) and numerous kinds of cancer (Hypponen, Laara, Reunanen, Jarvelin, & Virtanen, 2001).

The main source of vitamin D is sun exposure, and researchers suggest that a person should spend between 15 to 20 minutes per day in the sun with skin exposed in order to produce enough vitamin D to prevent deficiency (Holick, 2007; Naeem, 2010; Sadat-Ali, 2006). Another source of vitamin D is dietary intake of vitamin D-rich foods such as egg yolk, fatty fish, beef liver, and mushrooms (Holick, 2007; Naeem, 2010; Otten et al., 2006; Whiting & Calvo, 2012). The amount of Vitamin D in the body can also be increased through the consumption of fortified foods or supplements (Holick 2004; Holick, 2008; Reichrath, 2008; Lips 2006).

Yet despite these recognized benefits and the apparent ease with which people should be able to maintain Vitamin D levels, more than a billion people worldwide suffer from vitamin D deficiency or insufficiency (Holick & Chen, 2008; Naeem, 2010).

Vitamin D deficiency is a major health problem globally (Holick, 2005; Holick &

Chen, 2008; Naeem, 2010), and it remains endemic even with all the medical advances over the last century (Naeem, 2010).

Vitamin D synthesis can be affected by different factors, including geographical location, age, use of sunblock, and clothing practices (Holick, 2008; Tsiaras & Weinstock, 2011). Consequently, a high level of vitamin D deficiency is associated with populations that live in high latitudes or that typically cover the skin with clothing (Vatanparast et al., 2013). In countries at high latitudes, such as Canada, where getting vitamin D from sun exposure can be difficult (Khalsa, 2009; Vatanparast et al., 2013), one might expect the prevalence of vitamin D deficiency to be high. Nevertheless, even in countries with sunny climates, the prevalence of vitamin D deficiency has been found to be quite high (Al-Turki, Sadat-Ali, Al-Elq, Al-Mulhim, & Al-Ali, 2008; Fuleihan, 2009; Holick, 2005; Sadat-Ali, Al-Elq, Al-Turki, Al-Mulhim, & Al-Ali, 2009).

Canada, which has a long winter, and high latitude, has a high rate of vitamin D deficiency (Langlois, Greene-Finestone, Little, Hidirolou, & Whiting, 2010; Whiting, Langlois, Vatanparast, & Greene-Finestone, 2011; Vatanparast et al., 2013; Holick, 2007; Rucker, Allan, Fick, & Hanley, 2002). According to Whiting et al. (2011), 25–67% of Canadians are not meeting the new Recommended Dietary Allowance (RDA) of vitamin D, which the Institute of Medicine (IOM) increased in 2011 from 400 to 600 International Units (IU). Additionally, about 13% of Canadians are not receiving the 400 IU of vitamin D that is essential to ensure bone health (Langlois et al., 2010; Whiting et al., 2011). Among newcomer populations to Canada, including immigrants and refugees, vitamin D deficiency is increasing (Vatanparast et al., 2013). Further, a study in Nova Scotia determined that women who wear body-covering clothes and live in northern

locations, which are both factors that decrease sun exposure, are at additional risk of vitamin D deficiency (Ojah & Welch, 2012).

Vitamin D deficiency in the Middle East may be attributed to limited sun exposure due to cultural reasons, dark skin color, very hot weather in some countries, limited outdoor activities, obesity, and limited consumption of fortified foods (Aloia et al., 2008; Bandeira, Gris, Dreyer, Eufrazino, Bandeira, & Freese, 2006; Dror & Allen, 2010). Indeed, Saudi Arabia has one of the highest rates of vitamin D deficiency (Al-Mogbel, 2012; Lips et al., 2006; Naeem, 2010). Saudi Arabia is a hot country that is sunny most of the year; thus, the climate affords the opportunity for residents to synthesise sufficient amounts of vitamin D (DeLuca, 2004; Naeem, 2010). Yet, numerous studies have found a greater frequency of vitamin D deficiency in Saudi Arabia among women (Alfawaz, Tamim, Alharbi, Aljaser & Tamimi, 2014; Al-Zoughool, AlShehri, Alqarni, Alarfaj, & Tamimi, 2015; Alsuwaida et al., 2013; Elshafie, Al-Khashan, & Mishriky, 2012). In several studies done in Saudi Arabia, approximately 81% of the female population reported occurrence of vitamin D deficiency with lower back pain (DeLuca, 2004; Siddiqui, 2007).

Many young Saudi women believe that maintaining healthy eating habits is enough to have a sufficient level of vitamin D (Christie & Mason, 2011), but, in fact, few foods naturally contain significant levels of vitamin D. Researchers stated that Saudi Arabia has vitamin D-fortified products such as milk, powdered milk, and yogurt, but not all brands are fortified (Sadat-Ali, Al Elg, Al-Farhan, & Sadat, 2013). However, most of the foods that are vitamin D-fortified contain vitamin D in smaller amounts than what is recommended by guidelines set for developing countries (Sadat-Ali et al., 2013).

Hence, Saudi women living in Canada or similar northern countries face a variety of health difficulties in their new environments. Given the possible consequences of vitamin D deficiency in Saudi women living in Canada, steps should be taken to address this health matter.

### **1.2 Research Questions**

This study examines the knowledge, attitudes, and practices (KAP) regarding vitamin D in Saudi women living in Canada. The research questions were:

- a. What knowledge about vitamin D do Saudi women living in Canada have?
- b. What are the attitudes and practices regarding vitamin D of Saudi women living in Canada?

### **1.3 Purpose of the Study**

The purpose of this study was to explore the knowledge, attitudes, and practices (KAP) of young Saudi women living in Canada and of health professionals with experience in both Canada and Saudi Arabia. This study examines topics related to knowledge of vitamin D sources (supplementation, fortification, and exposure to the sun), attitudes regarding the importance of vitamin D, and practices indicating whether knowledge and attitudes were being implemented or not.

Several studies have been conducted to explore KAP about vitamin D worldwide, such as those of Bonevski et al. (2013); Christie and Mason, 2011; Habib, Al-Motairi, and Al-Mutairi (2014); Kung & Lee (2006); Zhou et al. (2016); and Vu et al. (2010). However, the literature contains relatively few qualitative studies that explore KAP regarding vitamin D deficiency. Quantitative KAP studies are considered a suitable

method to discover and assess health behaviors. Recently, however, these surveys have been criticized by several researchers, who have expressed their concerns about the applicability of KAP surveys (Launiala, 2009), therefore, qualitative KAP research was carried out.

To our knowledge, no published study taking a qualitative approach has focused on Saudi women living in Canada.



## **Chapter 2**

### **Literature Review**

To contextualize the importance of vitamin D, the following literature review includes background information, including vitamin D intake, metabolism of vitamin D, assessment of vitamin D, consequences of vitamin D deficiency, and factors limiting vitamin D status. It also focuses on worldwide vitamin D deficiency, with more attention given to vitamin D deficiency in Canada and Saudi Arabia, particularly in Saudi women. Finally, it presents KAP studies concerning vitamin D.

#### **2.1 Background on Vitamin D**

Vitamin D, one of the oldest fat-soluble vitamins, has existed for more than 750 million years (Holick, 2003; IOM, 2010). Its discovery, however, did not occur until the early 20th century. Since then, the understanding of vitamin D's function has grown, it has gone from being seen as a simple vitamin to something more, a pro-hormone steroid (Holick, 2003; Naeem, 2010).

##### **2.1.1 Vitamin D Intake**

The main source of vitamin D is sun exposure. When the skin is exposed to ultraviolet-B (UVB) radiation, it converts 7-dehydrocholesterol to pre-vitamin D<sub>3</sub>, which is then converted to vitamin D<sub>3</sub> (Brannon et al., 2008; Holick, 1996, 2004; Reichrath, 2008). Vitamin D from the skin and diet is metabolized in the liver to 25-hydroxyvitamin D, and then it is metabolized to the active form of vitamin D, 1,25-dihydroxyvitamin D (Holick, 2007).

The relatively few natural food sources of vitamin D include egg yolk, fatty fish,

(e.g. salmon, mackerel, and tuna), beef liver; veal; and mushrooms (Holick, 2007; Otten et al., 2006; Naeem, 2010; Whiting & Calvo, 2012). Getting adequate vitamin D intake only from natural food can be challenging, as dietary sources alone are inadequate for obtaining enough vitamin D (Whiting et al., 2011). Therefore, the intake of fortified foods and supplements is necessary for maintaining levels of vitamin D necessary to ensure health. Fortifying food with vitamin D can provide a sufficient amount to prevent vitamin D deficiency (Holick, 2009).

Despite these available sources, a need for more sources of vitamin D still exists, such as more fortified foods in the marketplace to help people meet age-specific nutritional requirements. Vitamin D-fortified foods available in Canada include milk (liquid, powdered, evaporated, goat, and plant-origin milks), margarine, meal replacements, nutritional supplements, and formulated liquid supplements (Whiting & Calvo, 2012). Additional fortified foods include yogurt, breakfast cereals, orange juice, and several meal-replacement items, but the quantity of vitamin D in some of these foods is insignificant (Calvo, Whiting, & Barton, 2004; Holick, 2007).

In Saudi Arabia, vitamin D-fortified foods include products such as milk, buttermilk, and yogurt. However, a study done in Saudi Arabia established that most fortified foods that are supposed to be vitamin D-fortified truly have no vitamin D or vitamin D in lower amounts than what is suggested by guidelines set for developed countries (Sadat-Ali, Al Elq, Al-Farhan, & Sadat, 2013). Vitamin D also exists in supplement form as an additional approach for getting vitamin D (Holick 2004, 2007, 2008; Reichrath, 2008), as it is considered an appropriate way for confirming sufficient vitamin D levels.

### 2.1.2 Vitamin D Health Benefits

The link between vitamin D and bone health has been known for a century (Holick, 2007; Vieth, 2007). Vitamin D regulates calcium and phosphorus concentrations and ensures sufficient bone mineralization, growth, and muscle development (Cranney et al., 2007; Holick, 2007, 2008). It also supports the absorption of calcium and helps maintain a normal range of calcium in the blood (Holick, 2007; White, 2008). Further, it is essential for regulating bone remodeling. Specifically, vitamin D with calcium can protect children from developing rickets and older adults from developing osteomalacia and osteoporosis (Cranney et al., 2007; Holick, 2009; Whiting & Calvo, 2005).

New studies show that vitamin D protects against several chronic diseases and conditions (Deluca, 2004; Holick, 2007), such as cardiovascular disease (Giovannucci et al., 2008), diabetes, and some cancers (Hypponen, Laara, Reunanen, Jarvelin, & Virtanen, 2001). This new evidence of the benefits of vitamin D has encouraged organizations and researchers to call for new Daily Recommended Intake (DRI) recommendations for vitamin D (Ross, Taylor, Yaktine, & Del Valle, 2011). The previous DRI of vitamin D in Canada was 200–400 IU, depending on the person's age (Ross et al., 2011). In November 2010, the IOM increased the recommended intake of vitamin D for all DRI age and sex groups (Ross et al., 2011). The new DRI values are listed in Table 2.1.2

Table 2.1.2: 2011 Vitamin D DRIs

<b>Age</b>	<b>Recommended Dietary Allowance (IU/day)</b>	<b>Upper Level Intake (IU/day)</b>
<b>0 – 6 months</b>	400	1,000
<b>6 – 12 months</b>	400	1,500
<b>1 – 3 years</b>	600	2,500
<b>4 – 8 years</b>	600	3,000
<b>9 – 18 years</b>	600	4,000
<b>19 – 70 years</b>	600	4,000
<b>&gt; 70 years</b>	600	4,000
<b>Pregnant/Lactating</b>	600	4,000

Adapted from, Ross et al., 2011.

### 2.1.3 Metabolism of Vitamin D

Two forms of vitamin D exist: vitamin D3 (cholecalciferol), which is produced by skin cells, and vitamin D2 (ergocalciferol), which is provided through plant dietary sources (Brannon, Yates, Bailey, & Picciano, 2008; Naeem, 2010). There are several metabolites. The serum 25-hydroxyvitamin D [25(OH)D] concentration is not the biologically active hormone; rather it is the transport form (Naeem, 2010). The active form is 1,25-dihydroxyvitamin D, made in the kidneys and working elsewhere in the

body. In addition, 1,25-dihydroxyvitamin D is made and acts locally in cells (Naeem, 2010) (Figure 2.1.3).

Vitamin D3 (cholecalciferol) is naturally synthesized in the skin from 7-dehydrocholesterol via UV radiation or is consumed via diet (Brannon et al., 2008; Holick, 1996, 2004; Reichrath, 2008). The production of vitamin D by 7-dehydrocholesterol depends on the strength of the UV radiation, which differs with the angle of the sun's rays (Matsuoka et al., 1987; Matsuoka et al., 1992; Webb, Kline, & Holick, 1988). For vitamin D to be biologically active and affect other physiological functions, however, it must be converted to its active form (Omdahl, Morris, & May, 2002; Prosser & Jones, 2004; Reichrath, 2008). A biological form of pre-vitamin D3 is stored in the epidermis, and then undergoes an isomerization reaction to convert pre-vitamin D3 to cholecalciferol (Vitamin D3) (Holick, 2004a). The vitamin D-binding protein (DBP), a specific binding protein for vitamin D in serum, transports the vitamin D through the blood to the liver (Brannon et al., 2008; Holick, 1996, 2004a). The vitamin is then converted to 25-dihydroxyvitamin D (25(OH) D in the liver (Figure 2.1.3). This main circulating form of vitamin D is then transported to the kidney by the DBP and converted to the biologically active form that is 1,25 dihydroxyvitamin D. It then circulates as a hormone in the blood with major functions, such as controlling the concentration of calcium and phosphate, promoting bone growth, and affecting neuromuscular and immune functions (Brannon et al., 2008; Reichrath, 2008).

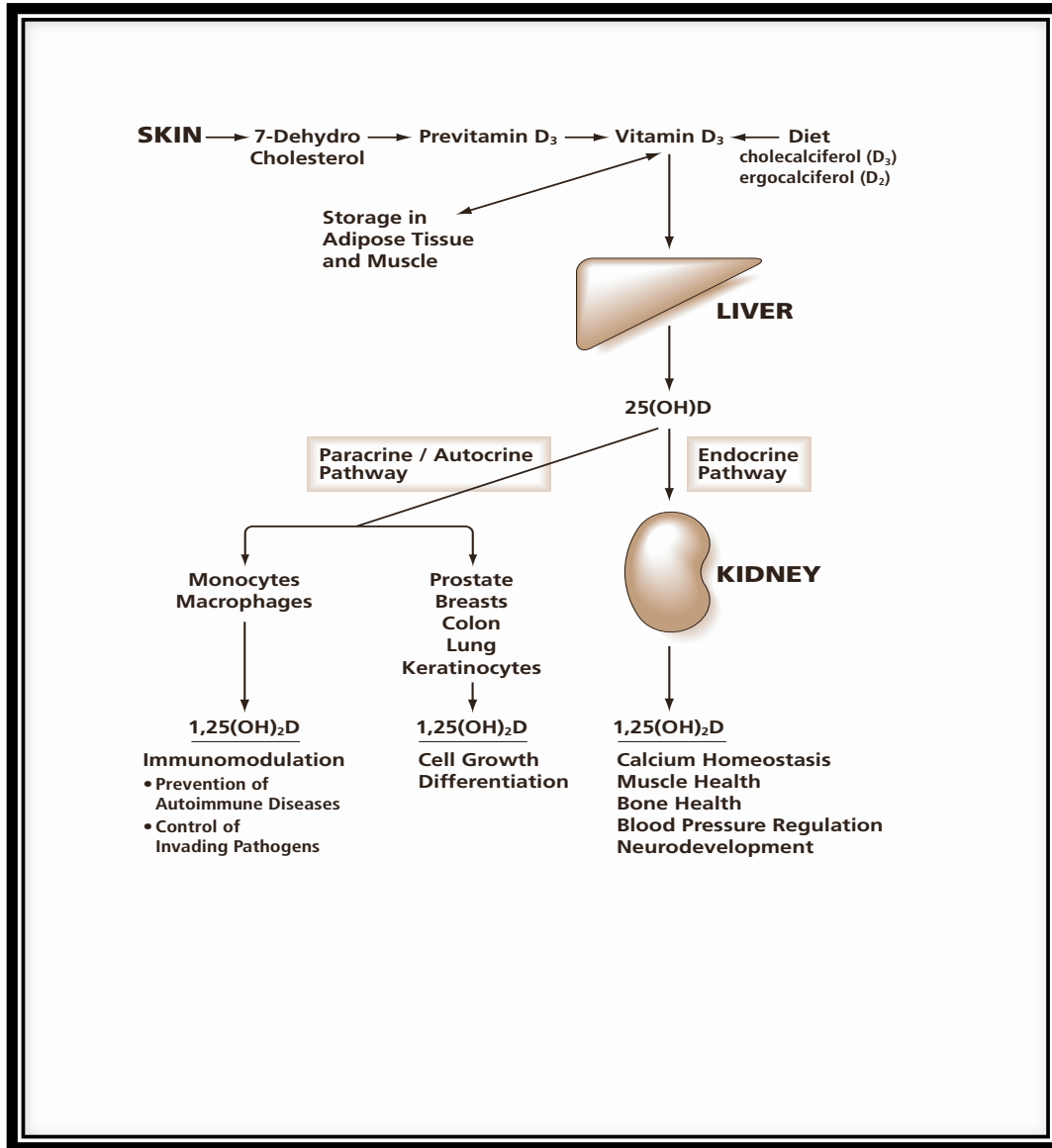


Figure 2.1.3: This schematic shows the synthesis and metabolism of vitamin D in the body to create the active form, 1,25 (OH) vitamin D, and how it influences health (Whiting & Calvo, 2012, pp. 811–838).

#### 2.1.4 Assessment of Vitamin D

The plasma concentration of 25-hydroxyvitamin D is used to measure an individual's vitamin D level (IOM, 2010). Subclinical deficiency is connected with concentrations of 30–50 nmol/L, and when concentrations are < 30 nmol/L, a person is considered to have vitamin D deficiency. A concentration of 25-OH D3 < 75 nmol/L means insufficient vitamin D levels (Holick, 2005; Mullin & Dobs, 2007). Optimal concentration of serum 25-dihydroxyvitamin D3 is signified as 75 nmol/L (Mithal et al., 2009). Unfavourable consequences are associated with serum concentrations > 125 nmol/L (IOM, 2010). Toxicity appears when serum 25(OH) D3 levels exceed 500 nmol/L (Vieth, 2006). Table 2.1.4.1 presents these levels and the amount of dietary vitamin D associated with each concentration.

Table 2.1.4: Serum 25-Hydroxyvitamin D [25(OH) D] Concentrations and Health for

adults 19-45 years of age.

Range for 25(OH)D		Vitamin D status	Dietary intake to meet 25(OH)D
<30 nmol/L	<12 ng/mL	Vitamin D deficient	N/A
30–50 nmol/L	12–20 ng/mL	Subclinical deficiency	600 IU #
75 nmol/L	30 ng/mL	Optimal level	1500IU*
>125 nmol/L	>50 ng/mL	Toxicity	4000 IU #

# Institute of Medicine \* Endocrine Society

Adapted from Institute of Medicine 2010 & Vieth 2006.

### 2.1.5 Consequences of Vitamin D Deficiency

Vitamin D deficiency results from a combination of poor dietary intake and limited sun exposure. What occurs as a result of poor intestinal absorption of calcium and phosphorus is hyperparathyroidism, which causes bone demineralization and, eventually, significant bone loss, which leads to osteoporosis and hip fractures (Holick, 2004b; IOM, 2010; Lips, 2001). In addition, at very low levels, vitamin D deficiency leads to rickets, which is a softening of the bones in children, and to osteomalacia in adults. Further, rickets and osteomalacia are the main causes of bone pain, muscle weakness, and skeletal distortion (Holick, 2007; Holick & Chen, 2008).

Vitamin D deficiency has also been linked to numerous other diseases, including increased risk of cancers, chronic diseases, and diabetes (DeLuca, 2004; Holick, 2005;



Whiting & Calvo, 2005). While a direct causal connection between vitamin D and breast cancer has not been observed, there are studies that show a link between them. One example in Saudi women focused on breast cancer, as vitamin D deficiency is associated with risk of breast cancer. Yousef et al. (2013) selected 240 participants from Saudi Arabia: 120 with breast cancer and 120 with no history of breast cancer. The women with breast cancer, ranging from stage I to IV, were between the ages of 18 and 75. The researchers assessed vitamin D in all of the women. The vitamin D levels were significantly lower in women with breast cancer. Women whose vitamin D levels were below 25 nmol/l had six times the possibility of having breast cancer, compared with four times the possibility of women whose levels ranged from 25–50 nmol/l. This study also showed that Saudi women have vitamin D deficiency because their skin pigmentation is darker and because they must shield their skin from the sun due to cultural and religious practices. The conclusion suggested that in Saudi Arabian females there was a correlation between vitamin D level and breast cancer risk (Yousef et al., 2013).

Numerous mechanisms have been posited to explain how and why vitamin D protects against cardiovascular disease (Holick, 2005). Alfawaz et al. (2014) examined the prevalence of vitamin D deficiency and its connection to some cardiometabolic indices amongst 3,475 patients visiting King Abdulaziz Medical City (KAMC) in Riyadh, Saudi Arabia. Variables of interest involved quantities of vitamin D, the glycemic and renal profile, and the amounts of calcium and phosphorous. The researchers found that the total frequency of vitamin D deficiency in the study was 78.1% in females and 72.4% in males. They concluded that vitamin D deficiency was typical of patients who visited KAMC and that vitamin D level was significantly related to rising age and

weight and markers of calcium homeostasis (Alfawaz et al., 2014).

#### 2.1.6 Factors Limiting Vitamin D Status

Different environmental factors affect skin synthesis of vitamin D (Batieha et al., 2011; Holick, 2007, 2008; Mithal et al., 2009; Tsiaras & Weinstock, 2011; Webb et al., 1988). These include atmospheric particulate matter, cloud cover, time of day, latitude (distance from the equator), season, age, use of sunscreen, clothing style, pregnancy, lactation, and skin tone (Batieha et al., 2011; Holick, 2008; Tsiaras & Weinstock, 2011).

Vitamin D deficiency is common during the winter because the UV radiation is not strong enough to produce adequate vitamin D in the body (Burgaz, Akesson, Oster, Michaelsson, & Wolk, 2007; Holick, 1996; Webb et al., 1988). In the winter and fall in the northern hemisphere, when the sun is closer to the horizon, there is no UVB, which is the wave length needed for skin synthesis (Holick, 1995; Kimlin, 2008).

Darker skin also is a factor because of greater amounts of melanin, which protects against absorbing UV radiation during sun exposure to UVB. This, in turn, decreases the skin's ability to produce vitamin D, as shown in Figure 2.1.3. Thus, people with a dark skin tone are at a higher risk of vitamin D deficiency because they require longer sunlight exposure, approximately 5–10 times what other ethnicities (with lighter skin tones) need for the same level of absorption (Gozdzik et al., 2008; Holick, 2008; Holick & Chen, 2008). A cross-sectional study done in sheltered accommodations in London, England, involved 222 older adults living there. Blood samples were taken for analysis of serum 25-hydroxyvitamin D (25[OH]D) concentration. Mean serum 25(OH)D concentration was 42.7 nmol/L, and 64.9% of the participants had serum 25(OH)D concentrations of < 50 nmol/L. The factors identified as being associated with lower serum 25(OH)D

concentration were non-White ethnicity and lack of vitamin D supplement consumption. The results of this study showed that vitamin D deficiency was highly prevalent among people with dark skin pigmentation whose use of vitamin D supplements was limited (Jolliffe et al., 2016). The study concluded that there is a clear connection between vitamin D deficiency and skin color.

Covering the body with clothing has been found to contribute to vitamin D deficiency (Al-Ghamdi, Lanham-New, & Kahn, 2012; Al-Mogbel, 2012; Garland et al., 2006, 2009). A study conducted in Jordan by Mishal (2001) calculated vitamin D levels and the effect of different styles of clothing in healthy young Jordanian women. Many women in Jordan cover the whole body for religious reasons; while some cover only their hands and faces, and others wear Western styles. Mishal (2001) found that 83.3% of women who fully covered themselves with clothing had vitamin D deficiency during the summer and 81.8% during the winter. In contrast, 54% of the women who were not fully covered were vitamin D deficient in the summer and 77.6% in the winter. Of those women who dressed in Western styles, 30.8% were deficient in the summer and 75% in the winter. This analysis illustrated that covered women are more likely to have a vitamin D deficiency than women who observe a Western dress style (Mishal, 2001).

Alsuwaida et al. (2013) described the prevalence of vitamin D deficiency in healthy Saudi adults. The researchers measured vitamin D levels of participants from two screening camps in Riyadh. The study of Saudi nationals aged  $\geq 18$  years old included 488 subjects, 50.2% of whom were males. The results showed that 29% of participants were vitamin D deficient, 22.7% were vitamin D insufficient, and 47.5% had usual levels of 25-hydroxy vitamin D. The results indicated that age was associated with vitamin D

levels (Pearson correlation = 0.183,  $p < 0.000$ ). The study concluded that vitamin D deficiency is common in healthy Saudi adults, particularly in females. Some potential explanations for this finding are wearing of traditional clothes, avoidance of the sun, and inadequate dietary intake (Alsuwaida et al., 2013).

Further, using sunscreen with an SPF of 8 or higher can reduce the production of vitamin D to one eighth of its normal production, as sunscreen dramatically reduces UVB absorption by skin (Holick, 2004a). In Beijing, China, Song et al. (2013) conducted a study to explore vitamin D levels in pregnant women and how levels were affected during the winter when pregnancy factors were taken into consideration. The study also considered environmental factors, namely air pollution in Beijing, and cultural preferences for avoiding the sun. Data were collected from 125 healthy pregnant women. Researchers examined these women's lifestyle factors and blood samples to assess vitamin D levels. The results showed that all of the women had vitamin D levels less than 75 nmol/L. Forty-five percent had levels less than 25 nmol/l, and 52% had levels between 25 and 50 nmol/l, even though 58 of the women stated that they were taking multivitamin supplements. Ultimately, the study concluded that vitamin D deficiency is common in pregnant women in China due to their cultural preference for avoiding sun exposure and also environmental factors of air pollution (Song et al., 2013).

## **2.2 Worldwide Vitamin D Deficiency**

Vitamin D deficiency is largely recognized as a serious health problem (Holick, 2004a, 2007) that affects large numbers of people worldwide (Tangpricha, Pearce, Chen, & Holick, 2002). The studies reviewed in this section attempted to assess the consequences of vitamin D deficiency.

### 2.2.1 Vitamin D Deficiency in Canada

Canada's high northern latitude increases the risk of vitamin D deficiency because of the resulting lower UVB exposure in winter; inadequate amounts of vitamin D can be created from November to February (Webb et al., 1988). Consuming foods fortified with vitamin D as well as foods that are natural sources of the vitamin are the main sources of vitamin D (Vatanparast, Calvo, Green, & Whiting, 2010; Calvo, Whiting, & Barton, 2004), but these are inadequate for obtaining sufficient amounts of vitamin D (Whiting et al., 2011).

The first study on the vitamin D status of Canadians used data from the 2007–2009 Canadian Health Measures Survey (Langlois et al., 2010). Data were collected via an in-home survey and physical measurements taken at a mobile exam center. The study measured the plasma 25(OH)D levels in blood using the 1997 DRI cut-off for deficiency at 27.5nmol/L, the cut-off for inadequate bone health at 37.5nmol/L, and the level for optimal health at  $\geq 75$ nmol/L (Langlois et al., 2010). The average 25(OH)D concentrations followed a U-shape by age, meaning that higher concentrations were found in children and the elderly (Langlois et al., 2010). In the total population, nearly 11% were below 37.5/nmol/L, nearly 90% were equal to or greater than 37.5nmol/L, ~35% were equal to or above 75nmol/L, and 4.1% fell below the 27.5nmol/L cut-off, classifying them at risk of deficiency, based on the 1997 cut-off. However, ~35% were above the cut-off for overall health and disease prevention (Langlois et al., 2010). Low milk consumption, defined as less than once per day, and a non-White racial background were associated with lower 25(OH)D levels. The researchers pointed out the difference between those classified as having a White background versus those with a non-White

background and milk consumption more than once per day, once per day, and less than once per day. Given the variables analysed, this study identified factors associated with lower vitamin D status, such as winter season, skin pigment, and frequency of milk intake (Langlois et al., 2010).

In a follow-up study, Whiting et al. (2011) found that supplement users had higher plasma concentrations of 25(OH)D than did nonusers and that there were no observed seasonal effects among supplement users. The prevalence of deficiency did, however, vary according to White/non-White status. The limited seasonal effect in the non-White group showed that sun exposure does not contribute to vitamin D status as much for this group (Whiting et al., 2011). The overall prevalence of risk for deficiency among non-White Canadians in the winter season was 20%, so one in five non-White Canadians is at risk of osteomalacia and rickets.

In another study, Vatanparast, Calvo, Green, and Whiting (2010) examined Canadians' vitamin D intake from dietary sources and compared intake to dietary guidelines, taking into account income, education, food security, chronic conditions, and ethnicity. They used data from the 2004 CCHS 2.2, which used a face-to-face interview and computer-assisted 24-hour recall as data-collection methods. The nutrient content of foods was calculated using a Canadian nutrient recipe database and a survey food database (Vatanparast et al., 2010). This research showed that food sources of vitamin D are widely available in Canada except in the context of moderate to severe food insecurity (Vatanparast et al., 2010); in addition, ~50% of dietary vitamin D comes from milk products (demonstrating the importance of fortification).

However, other studies have clearly indicated that vitamin D deficiency exists

among the new immigrant population in Canada. A study done by Vatanparast et al. (2013) showed that immigrants and refugees, particularly those living in northern-latitude countries, were at additional risk of increased vitamin D deficiency. This study evaluated circulating vitamin D levels of immigrant children at the national level; the results showed that insufficiency in calcium and vitamin D intakes was 76% and 89.4%, respectively. As for vitamin D status, 29% of participants were deficient, and an additional 44% lacked high enough levels of serum 25(OH)D for bone health. Important factors in serum vitamin D level were dietary vitamin D intake, sex, area of origin, and time of stay in Canada. Generally, immigrant children, especially girls, have lower plasma 25(OH)D than do non-immigrant children (Vatanparast et al., 2013)

A study by Ojah and Welch (2012) compared women who had lived in Nova Scotia for their whole lives and Muslim women who came from sunny, equatorial countries and wore concealing clothes and hijabs. The purpose of this study was to determine if living in a northern location added disadvantages to women who observed a covered-clothes style. Results showed that the two groups had common bone and muscle weakness related to vitamin D deficiency. The vitamin D status of Muslim women who wore hijabs and were living in Canada was compared to a sample-matched group of Western women by age, height, weight, and skin tone. Handgrip dynamometry assessed muscular strength, and a quantitative ultrasound of the calcaneus assessed bone status. The nutritional intake was taken by 24-hour recall. The results showed that the hijab group had lower serum 25(OH)D levels than did women who wore Western clothes. Bone status did not show large differences between groups. However, dietary intake of vitamin D was lower in the hijab group. This experimental study suggested that women

living in northern locations are at risk for vitamin D deficiency (Ojah & Welch, 2012).

Another Canadian study compared knowledge and practice of vitamin D among immigrant, refugee, and Canadian-born mothers. The participants included 94 mothers of children aged 0 to 3 years old. The main finding of this research was that both immigrant and Canadian-born mothers had good knowledge of the importance of vitamin D, took it properly, and gave it to their infants. The Canadian-born women reported gaining information about vitamin D from prenatal classes. Many mothers talked about receiving inconsistent guidance from health care suppliers (Moffat et al., 2014).

In a cross-sectional study conducted in the Calgary Refugee Health Program confirmed that Canadians, especially women and children, experience higher levels of vitamin D deficiency in comparison to people who live in Asia, Africa, and countries close to the equator, which have a lot of sunshine over a larger part of the year. Participants included 1,217 refugee women and children selected between 2005 and 2010. Serum 25(OH)D levels were measured, and a total of 69% of participants had serum 25(OH)D documented. Using the IOM recommendation for sufficient vitamin D levels ( $> 50$  nmol/L), researchers established that 61% of women and 42% of children had lower-than-optimal 25(OH)D levels. Mean levels of 25(OH)D were significantly lower across all age and sex groupings when compared with the general Canadian population. Women from the Middle East had lower mean 25(OH)D values (24.6 nmol/L, 95% CI 21.7 to 27.5 nmol/L), compared to other women from Asia, Africa, or South America. Female refugees aged 12 to 19 years old had lower mean values of 25(OH)D than males who participated in the study. The results showed that refugees and immigrants in high-latitude countries are also at high risk of vitamin D deficiency. All



age groups analyzed in the research had lower levels of vitamin D compared with the general Canadian population. Thus, health care suppliers need to be aware of this problem and support vitamin D supplementation among refugees (Aucoin et al., 2013).

### 2.2.2 Vitamin D Deficiency in Saudi Arabia

Vitamin D deficiency is becoming more and more alarming in Saudi Arabia (Sadat-Ali, AlElq, Al-Turki, Al-Mulhim, & Al-Ali, 2009). Research has examined the occurrence of vitamin D deficiency in the Saudi population, including diverse age groups; however, the deficiency was more common amongst females (Alfawaz, Tamim, Alharbi, Aljaser & Tamimi, 2014; Alsuwaida et al., 2013; Al-Zoughool, AlShehri, Alqarni, Alarfaj, & Tamimi, 2015; Elshafie et al., 2012; Kanan, Al Saleh, Fakhoury, Adham, Aljaser & Tamimi, 2013).

A study by Elsammak, Al-Wosaibi, Al-Howeish, and Alsaeed (2011) calculated the vitamin D states of healthy, young Saudi Arabians in the eastern region of the country. The sample included 139 blood donors (87 males and 52 females) who completed a questionnaire about clinical history, intake of vitamin D supplements, intake of calcium-rich foods, and exposure to sun. The researchers found low levels of serum 25(OH)D in both males and females (males 25 nmol/l, females 24.75 nmol/l). This prevalence of vitamin D deficiency is very high despite the fact that more than 90% of participants consumed adequate amounts of dairy products and more than 65% had sufficient exposure to sunlight (Elsammak et al., 2011).

In a study in Riyadh, Saudi Arabia, scientists studied healthy married couples who had no complaints of vitamin D deficiency (Elshafie et al., 2012). Fifty couples were selected for this research, and the participants were required to fill in a questionnaire and

give a short interview answering questions about their eating habits and any present risk factors that applied. The results revealed that men had higher levels of vitamin D because they exposed their skin to the sun more often and wore light clothes outside and at home. The analysis indicated that gender, high physical activity, and the intake of milk are among the main factors that positively influence vitamin D levels. Ultimately, the study concluded that married couples, especially wives, show low levels of vitamin D in Saudi Arabia and that females have low levels of vitamin D because they lead a sedentary lifestyle and consume less milk (Elshafie et al., 2012).

Almogbel (2012) conducted a cross-sectional study in primary health care centers of KAMC, Riyadh, in Saudi Arabia. The sample consisted of 465 young adult Saudi females aged 19 to 40 years. The participants completed a questionnaire to identify socio-demographic characteristics and other risk considerations, such as sun exposure and dietary intake. The study measured [25(OH)D], with cutoff values that were described as being deficient ( $< 25\text{nmol/L}$ ), insufficient ( $25\text{--}75\text{ nmol/L}$ ), and normal ( $\geq 75\text{ nmol/L}$ ). The final result showed that generally vitamin D deficiency was recognized in all subjects, with a mean level of  $18.34 \pm 8.2\text{ nmol/L}$  in all the subjects, while 79.1% showed vitamin D deficiency (serum 25(OH) D  $< 25\text{ nmol/L}$ ). However 20.9% showed vitamin D insufficiency (serum 25(OH) D between  $25\text{--}50\text{ nmol/L}$ ). The study concluded that the prevalence of vitamin D deficiency among young healthy Saudi females is 100% (Almogbel, 2012).

A study done by Kanan et al. (2013) examined vitamin D status in a sample of 1,556 Saudi females aged around  $\geq 19$  years in an outpatient clinic in Riyadh, Saudi Arabia, during the summer and winter periods. Data were gathered by medical record

abstraction. The participants were split into two sets based on the time of their visit for collecting the blood samples. The summer group (659) was further divided into premenopausal and postmenopausal subsections. Similarly, the winter group 897 was subdivided. Vitamin D level was measured using high-performance liquid chromatography (HPLC). The results indicated that the high occurrence of vitamin D deficiency ( $25(\text{OH})\text{D} < 50 \text{ nmol/l}$ ) in both the premenopausal and postmenopausal groups (80% and 68%, respectively), in the summer, and during the winter (85% and 76%, respectively). The authors concluded that there was a high prevalence of vitamin D deficiency among the Saudi females in that study (Kanan et al., 2013).

A study was done by Al-Zoughool et al. (2015) in the east side of Saudi Arabia in the cities of Dammam and Al-Ahssa. They collected blood samples of 2,129 participants who were visiting outpatient clinics. Their 25-hydroxy vitamin D levels were measured by using HPLC. The final results of that study were that about 72% of the participants showed some level of vitamin D deficiency. Females had higher levels of vitamin D deficiency than did males in both cities. The researchers concluded that vitamin D deficiency is very high in their sample of the Saudi population (Al-Zoughool et al., 2015).

In 2015, Kearney et al. conducted a survey of 121 Muslim mothers living in Saudi Arabia and 77 Muslim women living in Ireland (Kearney et al., 2015). The researchers noted that only 29% of Irish women and 8% of the Saudi mothers had taken vitamin D during their pregnancies. Sixty-three percent of the Muslim mothers in Ireland and 37% in Saudi Arabia received recommendations to give daily supplements of vitamin D to their babies, but only 50% of mothers living in Ireland and 13% of women from Saudi

Arabia followed this medical advice. The results showed that vitamin D deficiency is evident among Muslim women and their babies both in Ireland and Saudi Arabia, with limited practises toward improving vitamin D supplement use (Kearney et al., 2015).

### 2.2.3 Vitamin D Deficiency in Different Places and Age Groups around the World

Studies worldwide have identified the causes of vitamin D deficiency in different populations with specific characteristics—for example, women in the Middle East, where there is limited sun exposure, limited consumption of vitamin D food sources, limited available vitamin D-fortified food, and limited vitamin D supplements (Aloia et al., 2008; Bandeira, Gris, Dreyer, Eufrazino, Bandeira, & Freese, 2006; Dror & Allen, 2010; Holick, 2004a). Further, vitamin D deficiency is common as well in the United States, the United Kingdom, and China (Holick, 2005; 2006; Forrest & Stuhldreher, 2011; Lips et al., 2006). The literature reviewed in this section indicated that people of different age groups in different locations around the world experience vitamin D deficiency.

Statistics show that about 40% to 100% of American and European senior men and women are deficient in vitamin D (Holick, 2005; 2006). Research carried out in Boston and Maine revealed that 52% of Hispano-American and Afro-American teenagers and 48% of Caucasian girls aged 13–14 years have low levels of vitamin D, and their index is below 50 nmol/l (Holick, 2005; Lips et al., 2006).

A study examined the occurrence of vitamin D deficiency in the U.S. population. Forrest and Stuhldreher (2011) analysed data using the National Health and Nutrition Examination Survey 2005 to 2006. The occurrence of vitamin D deficiency was 41.6%, with the highest rate seen in Blacks (82.1%), followed by Hispanics (69.2%). The researchers identified vitamin D deficiency in people with no college education, who

were obese, had insignificant health status, or were not consuming milk, as well as among those with hypertension. The authors found that vitamin D deficiency was common in the U.S. population, especially among Blacks and Hispanics (Forrest & Stuhldreher, 2011).

A study conducted in Amman, Jordan found that most newborns experience vitamin D deficiency (Khuri-Bulos et al., 2013). The researchers selected 3,731 newborns and measured their vitamin D levels. The results indicated extremely low levels of vitamin D. Nearly 95% of newborns had vitamin D levels less than 50 nmol/l (Khuri-Bulos et al., 2013). The lack of vitamin D supplementation practices among pregnant women led to decreased vitamin D levels in both women and newborns. Women should increase their KAP regarding vitamin D including consuming vitamin D supplementation and spending enough time to expose themselves to the sun during pregnancy (Khuri-Bulos et al., 2013).

A study done in Turkey by Guzel, Kozaoglu, Guler-Uysal, Soyupak, and Sarpel (2001) compared vitamin D status and bone mineral density (BMD) of Turkish veiled and unveiled women of reproductive age. The study showed that Turkish women could not create enough vitamin D in their bodies and that Turkish women who covered their whole bodies were vitamin D deficient. To combat this, researchers suggested an increased use of vitamin D supplements in Turkish women, especially veiled women.

Another study from Turkey measured the vitamin D levels among pregnant women and their newborns to determine the level of vitamin D deficiency and its prevalence in both mothers and babies. For this investigation, scientists selected 97 pregnant women. To assess vitamin D levels, researchers had the mothers take blood

tests, and their babies' vitamin D levels were assessed by taking blood samples from the navel string directly after birth. The research found that only two of the 97 women had vitamin D levels higher than 50 nmol/l. The average index of vitamin D for the mothers was 12.24 nmol/l, and for newborns, it was 10.75 nmol/l. The results of this research showed that pregnant woman and their babies are at high risk of vitamin D deficiency (Parlak et al., 2015). Women should increase their consumption of vitamin D food sources and supplements and their exposure to the sun in order to increase their vitamin D level.

Oman has a very comfortable geographical position, as it sits very close to the equator, and this factor should help people to produce natural vitamin D from the sunshine. For a study in Oman, subjects were selected from 206 healthy people aged 18 to 55 years old, and serum 25(OH)D concentrations were measured. The results of the research showed that (87.5%) of participants experienced a lack of vitamin D. Overall, 39% of the participants had levels below 25 nmol/l, and roughly 90% had levels below 50 nmol/l. The researchers concluded that low vitamin D levels were the result of people trying to avoid exposing their skin to the sunlight, limited food that is rich in vitamin D consumption, and lack of vitamin D supplements to use. Despite Oman having a suitable climate, people there experience vitamin D deficiency (Abiaka et al., 2013).

Research on teenagers' health in Saudi Arabia revealed an increasingly high spread of vitamin D deficiency (AlBuhairan et al., 2015). Investigators selected 12,000 adolescents from Saudi Arabia in order to identify bad health habits and health status. One of the main results of this study was that 96% of teenagers were vitamin D-deficient. This investigation indicated that increasing all people's awareness of and knowledge

about vitamin D is essential (AlBuhairan et al., 2015).

Mansour and Alhadidi (2012) conducted a study in Jeddah, Saudi Arabia, to assess vitamin D levels in children. The investigators selected 510 healthy children from 4 to 15 years old. The scientists investigated the diet of all the children, their exposure to sunshine, and their daily intake of vitamin D. The results revealed that all participants could be divided into two groups. The first group had relative vitamin D deficiency, and the second had severe vitamin D deficiency. Three hundred of those tested (nearly 59%) had relative deficiency, and 140 (nearly 28%) had severe deficiency. Among the participants, 55% were Saudis, 28% were Yemenis, and 12% were Egyptians. Saudis and Yemenis had lower vitamin D levels compared to Egyptians and others. This study also indicated that the main factors impacting vitamin D levels are the duration of the exposure to the sun and daily consumption of vitamin D. Overall, the prevalence of vitamin D deficiency in children and teenagers is very high in Jeddah due to the lack of sun exposure and the lack of consumption of vitamin-rich food (Mansour & Alhadidi, 2012).

### **2.3 Knowledge, Attitude, and Practice (KAP)**

A KAP study is organised and carried out to explore human behaviour connected to a certain topic (Vandamme, 2009; World Health Organization, 2008). KAP research studies three topics: knowledge (what people know), attitude (how they feel), and practices (what they do) (Goutille, 2009; Kaliyaperumal, 2004; Vandamme, 2009; World Health Organization, 2008). KAP works like an educational identification of the community (Kaliyaperumal, 2004). Ultimately, KAP studies require subjects to express their feelings, behaviour, and understanding of particular topics (Kaliyaperumal, 2004;

Vandamme, 2009; World Health Organization, 2008). The *knowledge* held by a population refers to the accurate understanding of a topic (Kaliyaperumal, 2004). *Attitude* refers to participants' feelings, ideas, and opinions concerning the topic. *Practice* indicates how knowledge and attitude are explained in people's actions. A KAP study is not actually a methodology but is more like a theoretical framework to analyse human behaviour (Kaliyaperumal, 2004; World Health Organization, 2008). Further, Kaliyaperumal (2004) stated that knowledge and practice questions should be open-ended, and researchers should avoid multiple-choice questions because they can result in participants guessing and giving false impressions of knowledge. Instead, in order to study attitudes, researchers should put forward statements and ask respondents to identify the level at which they agree with those statements.

### 2.3.1 KAP Studies Regarding Vitamin D

Several studies have been conducted to explore and assess KAP about vitamin D worldwide. All of these investigations indicated that increasing all people's awareness of and knowledge about vitamin D is essential.

One study done in Saudi Arabia explored KAP-related vitamin D deficiency (Christie & Mason, 2011). This study, which involved a sample of female Saudi students, produced qualitative data through eight in-depth, semi-structured interviews and one focus group. The study investigated KAP through sun exposure, supplementation, and fortification. Participants showed minimal understanding of vitamin D; for instance, they knew it was important for musculoskeletal reasons but had no further information about any other health benefits. Also, they stated that their knowledge about the sources of vitamin D came from schools, family members, or TV. Furthermore, many participants



were aware of sun exposure benefits, but they were not really clear about the period of sun exposure, time of day affecting intensity, direct sunlight, and the need to expose specific body parts for the body to create optimal vitamin D. The researchers concluded that knowledge of vitamin D was limited amongst Saudi female students, who had limited practices and attitudes toward improving vitamin D states (Christie & Mason, 2011).

In a study by Toher et al. (2014), the authors sought to establish the prevalence of suboptimal vitamin D status in pregnant women and to assess KAP levels regarding vitamin D in various ethnicities, focusing on two Dublin, Ireland, maternity hospitals. The 116 women participants were of Irish, Asian, sub-Saharan African, and Middle Eastern and North African (MENA) origin. Knowledge, attitudes, and practices regarding vitamin D were studied through an interview-assisted questionnaire. Vitamin D status was determined by measuring serum 25 D (25(OH)D). The final results showed that the median (interquartile range) 25(OH)D level was 25.9 (16.5–44.7) nmol/L. Using a cut-off point of < 30 nmol/L, the section at risk of deficiency was higher among MENA (88%;  $p < 0.001$ ) and sub-Saharan African women (68%;  $p = 0.019$ ) than Irish women (36%). Eighty-two women (71%) reported they had insufficient knowledge about vitamin D and its sources (Toher et al., 2013). Vitamin D, including supplement usage, was the strongest interpreter of 25(OH)D levels  $\geq 30$  nmol/L. The final conclusion was that awareness of vitamin D nutritional sources was poor among all groups. Suboptimal vitamin D status was common in this cohort of pregnant women, particularly those of sub-Saharan African and MENA origin (Toher et al., 2014). This investigation indicated that increasing all people's awareness of and knowledge about vitamin D is essential as there a clear limited

KAP surrounding vitamin D matters.

To explore KAP regarding vitamin D among 515 university medical students, a questionnaire linked to vitamin D and sun exposure was administered during a study in Nanjing, China (Zhou et al., 2016). The questionnaire focused on the students' intake frequency of foods rich in vitamin D and the intake of vitamin D supplements. The results presented that several participants avoided sun exposure because they did not want to get dark skin, and many of the participants used sunblock. The intake of foods rich in vitamin D was limited, and only a few of the students reported taking vitamin D supplements. The results stated that medical students in China had limited knowledge and negative behaviors regarding vitamin D (Zhou et al., 2016). The authors concluded that health education about vitamin D via the media and health care professionals should be increased in order to improve vitamin D levels. Expanding the basic knowledge of health professionals about vitamin D would improve attitudes and practices as well, and decrease vitamin D deficiency.

In Australia, food sources of vitamin D are limited, and getting sun exposure for adequate vitamin D is challenging due to the high risk of skin cancer and the use of sun protection (Bonevski et al., 2013). Further, there have been complicated vitamin D community health messages that may have confused people's understanding of topics related to vitamin D (Bonevski et al., 2013). This study assessed KAP of vitamin D and its sources. Fifty-two participants were selected for conducting six focus groups. The results showed low levels of vitamin D knowledge and some barriers, either personal or environmental, to sun exposure. The authors concluded that increased knowledge about the importance of sun exposure as the main source of vitamin D was needed, especially

for those at high risk for vitamin D deficiency, to balance the benefits of sun exposure with its harmful effects in order to decrease vitamin D deficiency (Bonevski et al., 2013).

Habib, Al-Motairi, and Al-Mutairi (2014) carried out a study in Saudi Arabia to explore the knowledge and practices of Saudi women regarding vitamin D and vitamin D deficiency. In that study, researchers used a descriptive design, and the sample consisted of 310 Saudi females around age 20 and above. The results showed that 29% of the participants had accurate knowledge about the importance of vitamin D, but only 19% used vitamin D supplements. Forty-six percent of the participants did not expose themselves to sun daily; however, out of that group 16.6% exposed themselves to the sun for fewer than 10 minutes daily. The study indicated that there was a positive connection among information of females and their practices toward improving vitamin D level. In general, lack of awareness about vitamin D deficiency was noted. The conclusion highlighted the need to increase women's information and practice toward vitamin D (Habib et al., 2014).

In summary, it has become clear that vitamin D is a significant component for public health; however, despite this, vitamin D deficiency has grown into a worldwide epidemic. Getting adequate vitamin D from food sources alone can be difficult, and dietary sources alone are inadequate for obtaining sufficient quantities of vitamin D (Whiting et al., 2011). Exposure to sun is also difficult for some groups who avoid the sun for cultural or personal reasons. One of the groups that has been identified as high-risk is Saudi women. Further, most studies have shown lack of knowledge, poor attitudes, and little or no practices related to vitamin D (Bonevski et al., 2013; Christie & Mason, 2011; Habib et al., 2014; Vu et al., 2010). Therefore, exploring Saudi women's KAPs

regarding vitamin D—even in a different location, such as Canada—is research worthy of further study. This is especially true because of the limited available literature on Saudi women living specifically in Canada and regarding their vitamin D knowledge, attitudes, and practices.

## **Chapter 3**

### **Research Methods**

This chapter describes qualitative research methods and provides a detailed explanation of the exploratory-qualitative descriptive design. Further, it describes the study setting and the sample population along with the inclusion criteria. It discusses the method of data collection and the procedure of data analysis, and, finally, the strategies that were used to confirm trustworthiness, the researcher's background, ethical considerations, dissemination of findings, and the time frame.

#### **3.1 Qualitative Approach**

The purpose of qualitative research is to understand the world in which we live, why things are the way they are, and how we deal with emerging social phenomena (Hancock, 1998). Qualitative studies focus on the experiences, perceptions, opinions, and feelings of participants, who respond to questions asking 'why?', 'how?', and 'in which way?' (Denzin & Lincoln, 1994; Hancock, 1998; Van Den Hoonaard, 2012). Thus, it illuminates reasons for actions and gives voice to individuals whose opinions are infrequently heard (Sofaer, 1999; Van Den Hoonaard, 2012). Qualitative research can explain social experiences, and facts as they happen and help researchers ascertain the conditions under which they occur; it can offer rich explanations of complicated, unique, or unexpected events. Also, qualitative studies are valuable in the early stages of investigations because they can help researchers develop their hypotheses (Sofaer, 1999); qualitative research is usually an inductive method that fosters the development of theory (Hancock, 1998).

In sociological work, the qualitative approach allows researchers to develop an understanding of a community by observing the participants in their normal settings, thereby clarifying problematic data and generating richer, more complete evidence (Hoepfl, 1997; Van Den Hoonaard, 2012). Adopting qualitative methods is particularly useful in situations when researchers know little about an area of interest; are trying to understand complex situations; are exploring participants' opinions; are attempting to determine how participants experience a situation and the meaning they make of something; or are trying to understand a phenomenon deeply (Richards & Morse, 2007). Qualitative approaches further are suitable in conditions where there is a demand to recognise the variables to be tested quantitatively later on (Hoepfl, 1997).

As the main aim for this study was exploring and assessing the KAP concerning vitamin D of Saudi women living in Canada, a qualitative approach was selected. The qualitative approach was selected as the one most suitable for fulfilling the aims of the study because it would enable the researcher to capture the women's practices, attitudes, beliefs, and lifestyles regarding vitamin D (Hoepfl, 1997; Richards & Morse, 2007; Sofaer, 1999; Van Den Hoonaard, 2012). Further, the qualitative approach would allow the researcher to give a voice to Saudi women living in Canada, a group that has not been heard from yet regarding vitamin D (Hoepfl, 1997; Sofaer, 1999; Van Den Hoonaard, 2012).

### 3.1.1 Exploratory-Qualitative Descriptive Design

There are several traditional methods of qualitative research, including grounded theory, phenomenology, and ethnography (Patton, 1990; Thorne, 2008). Those methodologies explore subjects' experiences and views. For example, grounded theory

uncovers the drivers underlying human action, and the goal is to generate theory, while phenomenology investigates human experiences; the aim is to define and describe those experiences and clarify their meaning (Patton, 1990; Thorne, 2008).

Although these qualitative methods are well known, exploratory-qualitative descriptive design is becoming increasingly common. Among the qualitative methods employed in current literature, qualitative descriptive design is one of the most-used techniques. Sandelowski (2000) stated that qualitative descriptive design is an approach that is selected when the aim of the researcher is the description of phenomena. This means that the researcher stays close to the original data (Sandelowski, 2000). The purpose of qualitative description is to clarify the outcomes in an extremely thorough, exhaustive, and accurate manner, free from bias. It attempts to convey the reality of the experience using everyday language. A qualitative descriptive design further provides a snapshot of each participant's practices, actions, and experiences as they occur in daily life (Houser, 2013; Sandelowski, 2000).

Qualitative descriptive questions could include the following: 'What are the concerns of people about an event? What are people's responses (e.g., thoughts, feelings, attitudes) toward an event? What reasons do people have for using or not using a service or procedure?' (Sandelowski, 2000). Qualitative descriptive design is used by researchers to capture individuals' experiences and use them to discover common themes (Houser, 2013; Sandelowski, 2000). The qualitative descriptive design allows researchers to focus on gathering comprehensive data on the participants, as the main consideration in a qualitative descriptive approach is learning from the subjects under study (Sandelowski, 2000; Sullivan-Bolyai, Bova, & Harper, 2005). Research using a qualitative descriptive

design may find a broader audience because the results are reported in everyday terms rather than in terms of a philosophical framework (Houser, 2013; Sandelowski, 2000; Sullivan-Bolyai et al., 2005). Consequently, the qualitative descriptive appeared to be the most appropriate design for this project.

### 3.1.2 Thematic Analysis

Thematic analysis is a process that includes classifying, exploring, and recording ideas in sets of data (Braun & Clarke, 2006). Thematic analysis includes categorisation and classification as well as theme identification; it is the most commonly used analytical method in qualitative studies (Boyatzis, 1998). Further, it defines portions of documents (data) that can be meaningful for the whole study (Braun & Clarke, 2006). Thematic analysis helps the researcher make sense of qualitative data and interpret the information that is given by participants (Boyatzis, 1998). Simply, thematic analysis manages and explains documents (Braun & Clarke, 2006).

Researchers using thematic analysis may identify themes through induction or deduction (a theoretical way). However, this study employed an inductive way that involved identifying the themes that emerged from the interview data files (Braun & Clarke, 2006; Patton, 1990). There may be a connection between the themes that are identified and the particular questions that were asked of the study subjects (Braun & Clarke, 2006).

## **3.2 Setting, Research Sample and Recruitment**

A sample is a subsection of a particular population from which the data will be gathered (Coyne, 1997; Marshall, 1996; Patton, 1990; Sandelowski, 1995). Sampling is a serious step that should be done critically to insure that there nothing will adversely



impact the quality of the results (Coyne, 1997; Marshall, 1996). Sampling methods commonly are designed to find a range of particular participants, as variety is important; diversity increases the possibility of identifying a variety of experiences around participants to ensure the validity of the themes generated from the data. Subjects differ in their communication skills (Sandelowski, 1995), so selecting suitable participants is truly essential for qualitative research (Creswell, 2007). The research participants for this study comprised two groups: Saudi women living in Canada and health professionals from different places around Canada.

### 3.2.1 Inclusion Criteria

The inclusion criteria that were considered in recruiting Saudi women were: living in Canada; female; between 18 and 45 years old; not health professionals; did not have a close family member in a health profession related to nutrition; and had lived no more than five years in Canada. The inclusion criteria for the health professionals were: some experience in nutrition; from different fields and areas related to nutrition, such as physicians, dietitians, pharmacists, nutritionists, and nurses; having worked or trained in Saudi Arabia; and living in Canada at time of interview.

### 3.2.2 Sampling Process

In qualitative research, there is a need for using one of the various types of sampling methods such as purposeful sampling or snowball sampling (Creswell, 2007). An appropriate sampling approach supports finding participants who can provide deep, rich, and consistent data for the study (Coyne, 1997; Creswell, 2007; Marshall, 1996). Consequently, for the purpose of this study a purposive sampling technique was utilised to recruit participants who were selected based on specific characteristics of importance.

Non-probability purposeful sampling is one of the most used selective techniques because it can highlight specific features of a population that are of interest to the researcher, thus allowing the investigator to answer the research questions (Sandelowski, 1995). This qualitative descriptive design study was conducted in Saskatoon, in the province of Saskatchewan. The sampling process began by approaching the head of the Saskatoon Saudis' Association with the research poster (Appendix A). The Saskatoon Saudis' Association is a non-profit organization that was established informally through the Saudi Cultural Bureau (SCB) to help Saudi students, and families fit into their new environment. The head of the SCB was asked to post the research poster on the Saskatoon Saudis' Association Facebook page to recruit young Saudi women living in Canada and was asked to send the poster by email to all Saudi families living in Saskatoon. The Saskatoon Saudis' Association Facebook group included almost all of the Saudi students and families living in Saskatoon. Also, he was able to contact most of the Saudis' Association heads around Canada by email, so he was asked to spread the invitation letter to health professionals around Canada (Appendix B).

All interested participants – those who had responded to the invitation emails or posters – were sent a copy of the consent form by e-mail. Only those who met the inclusion criteria were selected. Since selecting a comfortable place for doing an interview would let the participants feel free and open to share their experiences and willing converse honestly (Creswell, 2007), a mutually convenient date, time, and place for the interview was discussed with each of the young Saudi women. The health professionals' data collection was done by telephone. Before each interview, the participants were asked to provide some demographic information.

Of the potential five physicians, four nutritionists, and four pharmacists who replied to the invitation emails or posters, only those who met the inclusion criteria were chosen. Two from each profession were then selected – that is, two physicians, two pharmacists, two nutritionists, two nurses, and two dietitians. Ten was considered an adequate number (Denzin & Lincoln, 1994; Hancock, 1998; Van Den Hoonaard, 2012). Nutritionists and dietitians had earned a bachelor's degree of nutrition science, however, dietitians completed an internship program at a healthcare organizations.

### 3.2.3 Sample Size

Commonly, in qualitative research, five to 25 subjects are sufficient and appropriate for data development and delivering standard themes from the diverse experiences, skills, and practices of participants (Polkinghorne, 1989). Data collection in qualitative research is time-consuming. Its thoroughness requires the use of small samples (Denzin & Lincoln, 1994; Hancock, 1998; Van Den Hoonaard, 2012) due to the large amount of data that is produced by participants. The participants included 8 Saudi women and 10 health professionals.

### 3.2.4 Informed Consent

The University of Saskatchewan consent guide was followed in preparing consent forms (Appendix C1) and (Appendix C2). Participants were asked to give their completed consent form to the researcher before the interview. The participants were reminded that their participation was voluntary and that they would be able to withdraw from the interview process at any time. They also were reminded of their right to remove any part of the data if they preferred. Contact details were provided to participants if they had any questions or concerns during or after the data collection process.

### 3.3 Data Collection

Qualitative data are gathered through direct meetings with people, one-to-one or group interviews, or by observation. The most common methods of data collection used in qualitative research are focus groups and interviews (Hancock, 1998; Van Den Hoonaard, 2012). The interview is a valuable technique that is also used to collect qualitative data (Van Den Hoonaard, 2012). Interviews can be used as the main strategy for qualitative data collection or in combination with observation or additional procedures (Van Den Hoonaard, 2012). The intent of conducting interviews is to allow participants, in a one-on-one setting, to describe the topic in their own words and in ways that are significant to them (Van Den Hoonaard, 2012). Such interviews also can be used to explore views and to allow participants to talk about their experiences, beliefs, and attitudes, one individual at a time. Interviews encourage participants to think about their experience in ways they may not have done before the interview began; thus, they are interactional activities used to generate data, not just collect data (Van Den Hoonaard, 2012). Therefore, interviews were utilised for collecting data from Saudi women living in Canada.

Qualitative interviewing uses open-ended questions in either unstructured or semi-structured interviews. Open-ended questions afford the chance for finding different means of considering and accepting the subject under study (Patton, 1990). The semi-structured interviewing technique lets the investigator prepare for the interview and organise the participants' experience; it also provides subjects the chance to articulate their interpretations using their own expressions (Offredy & Vickers, 2013; Polit & Beck, 2008). Numerous investigators have chosen to select semi-structured interviewing during

conducting qualitative research, as the outline of questions can be ready before the interview time (Offredy & Vickers, 2013). For this particular study, semi-structured interviewing was utilised because the semi-structured interview guide offers a rich set of questions that can offer consistent, comparable qualitative data (Offredy & Vickers, 2013). The interview guide consisted of open-ended questions (Appendix D), and (Appendix E).

An interview guide is a planned, organised list of queries that the investigator intends to use in all interviews (Hoepfl, 1997). This ensures that he or she covers similar material with each participant, where there are no prearranged replies (Hoepfl, 1997). Interview guides are handy in interviews where time is limited because they make the data collection effort more organised and inclusive (Lofland & Lofland, 1984).

For this study, an interview guide for the Saudi women living in Canada was adapted from those used in the Brand (2008) and Kung and Lee (2006) studies, a study on validated sunlight questionnaires, and also the Christie and Mason (2011) qualitative study.

In semi-structured interviews, where the researcher needs to obtain rich data (Offredy & Vickers, 2013), it is worthwhile to tape-record the interviews and transcribe the recordings for the process of analysis. A tape recorder is crucial and can make it simpler for the investigator to attend to the interview, not note taking. Tapes also have the benefit of recording data more trustworthily than jotting notes (Patton, 1990).

In qualitative research, face-to-face interviews have long been the most prevalent interview technique. However, recent decades, telephone interviews have become more common, and there is an increase in their use as a way of collecting qualitative data

(Opdenakker, 2006).

For this particular study, face-to-face semi-structured interview and telephone interview techniques were chosen. Face-to-face semi-structured interviews were the chosen technique for collecting the data with Saudi women living in Canada. Telephone interviews were used for collecting interview information from health professionals.

Data collection was conducted in the English language, which was the second language of all participants. Depending on the participants' English skills, a translation for the interview guides was provided. Arabic, which was the mother tongue of all 18 participants, was used during the interview process with three young Saudi women. Their transcripts were then translated into English after the interview. To guarantee that the translation and transcribing processes were correct and presented the participants' opinions fairly and accurately, the entire process was done by the researcher. The researcher made sure to select words that matched the exact meaning in English, because Arabic is a rich language, and each single English word might have a different meaning in Arabic. Notes were taken during the interviews to explain some words, and the researcher used both interviews and informal discussions to provide more clarification (Polit & Beck, 2012). For the other five young Saudi women and the 10 health professionals, there were no problems in using the English language for the interviews.

For the health professionals, each interview lasted for approximately 30 minutes by telephone. The interview was audiotaped and transcribed verbatim. Before the interviews, information about the study was sent to the participants by email, and they reviewed the consent. Signatures for the consent form were obtained via oral consent or a thorough email – the participants chose whether to sign and scan the form before sending

it to the researcher, or just review it and agree orally. After each interview was audiotaped and transcribed, a transcript release form was sent to the health professionals to review (Appendix F). They reviewed the transcript release form and had the opportunity to review transcripts and to add, alter, or delete information from the transcript as appropriate.

### **3.4 Data Saturation**

In qualitative studies, there are different opinions and ideas regarding the term ‘data saturation’. Some have recommended that researchers collecting qualitative data should continue until each theme becomes rich, strong, and duplicated within several situations, events, and experiences (Morse & Richards, 2002). Further, data saturation has been defined as the stage at which no different ideas emerge from the data (Guest, Bunce, & Johnson, 2006). However, other researchers suggested that reaching saturation is difficult, as it is a changeable concept and also challenging to measure (Denzin & Lincoln, 1994).

After eight participants were interviewed, the interviews with Saudi women living in Canada ceased. This decision was made when the data appeared to be saturated, as it presented no new directions and some repetition of ideas was noticed (Morse & Richards, 2002).

The health professionals participating in this study were assumed to have rich thoughts, experiences, and ideas on the topic. However, decisions were made to stop recruiting participants after reaching 10 participants. It is not certain whether data saturation was reached (Morse & Richard, 2002); however, a consistent and connected theme was generated, and it was believed that the data from this group produced effective

results and a fair conclusion. It was deemed effective, as the basic goal of recruiting health professionals for this particular study was to increase the level of understanding, knowledge of differing views, and depth of information. The decision to stop sampling in qualitative studies must take into account the research goals (Hoepfl, 1997).

### **3.5 Data Analysis**

The words, expressions, and sentences that are spoken by participants during the interviews were considered data (Borra & Earl, 2000). The data analysis process began shortly after data collection started. Development and analysis of the transcripts took was a staged process. Interviews were fully transcribed by the researcher to ensure reliability and clarity. The researcher listened to each audiotape while reading the transcript of the interview and made minor corrections where she had mistyped or omitted an occasional word or emphasis. Then, all interview transcripts were read multiple times to achieve familiarity. Transcripts were numerically coded to protect the participants' privacy and confidentiality. When the researcher was satisfied that the transcripts were accurate, numbers were added to the lines, making it easier to find the quotations from the original transcript.

Subsequently, the data were analysed by reviewing and identifying the themes (Borra & Earl, 2000), utilising an inductive approach in thematic analysis that supported the identifying of themes highly connected to the purpose of the study (Braun & Clarke, 2006). Final results were provided in a written report with quotations from the participants. Then, the emergent themes were analysed using thematic analysis (Boyatzis, 1998). An inductive thematic analysis was selected for this study, as there are numerous benefits for utilising this method, including flexibility, discovering and developing of



themes, clarification of themes maintained by data, suitability for investigating people’s experiences, and effectiveness in evolving categories with data (Boyatzis, 1998; Braun & Clarke, 2006). Dr. Whiting; the research supervisor, participated in the process of theme development. Dr. Whiting’s valuable involvement helped to increase the validity of the study. The researcher followed an outline for using thematic data analysis by Braun and Clarke (2006), shown below in Table 3.1.2.

Table 3.1.2 *Outline for Using Thematic Data Analysis*

<b>Phase</b>	<b>Phase Description of the process</b>
1. Familiarising yourself with your data:	Transcribing data (if necessary), reading and rereading the data, noting down initial ideas.
2. Generating initial codes:	Coding interesting features of the data in a systematic fashion across the entire data set, collating data relevant to each code.
3. Searching for themes:	Collating codes into potential themes, gathering all data relevant to each potential theme.
4. Reviewing themes:	Checking in the themes work in relation to the coded extracts (Level 1) and the entire data set (Level 2), generating a thematic ‘map’ of the analysis.
5. Defining and naming themes:	Ongoing analysis to refine the specifics of each theme, and the overall story the analysis tells; generating clear definitions and names for each theme.

6. Producing the report:	The final opportunity for analysis. Selection of vivid, compelling extract examples, final analysis of selected extracts, relating back of the analysis to the research question and literature, producing a scholarly report of the analysis.
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Adapted from Braun and Clarke (2006), *Using Thematic Analysis in Psychology* (p. 35).

### 3.6 Data Trustworthiness

Trustworthiness is established by considering the credibility, dependability, conformability, and transferability of the study (Lincoln & Guba, 1985; Thorne, 2008). Credibility is the criterion to estimate the truthfulness and clarification of the data (Lincoln & Guba, 1985; Sandelowski, 1986; Thorne, 2008). To guarantee credibility, participants are asked for more clarification during the data collection process. Notes were taken during the interview, with reflections and comments that also helped and increased the credibility. Additionally, health professionals were asked to review and edit transcripts, allowing them to revise, delete, or change their words if they liked. This ensured that what had been written was what they meant (Lincoln & Guba, 1985). Also, the transcripts were checked to avoid mistakes, which increased dependability further (Polit & Beck, 2012). They all indicated that the transcripts were accurate.

Transferability indicates that the study findings are relevant and appropriate to fit into situations and conditions outside of the study area. It also ensures that rich explanations of the research are provided, with the data used to describe the different aspects of the phenomenon under study, thereby providing a comprehensive background for the readers (Lincoln & Guba, 1985; Polit & Beck, 2012).

The research supervisor, Dr. Whiting, also reviewed and checked the data before

agreeing on the accuracy and meaning of the results, thus making sure that the data reflected participants' views, ideas, and opinions. The researcher took notes throughout the data collection process to describe some non-verbal communication between herself and the participants, and she used interviews and informal discussions to provide a comprehensive understanding of the phenomenon. All of the above process was done in order to increase the level of conformability (Polit & Beck, 2012; Thorne, 2008).

### **3.7 Researcher's Background**

As the researcher's gender, culture, socioeconomic status, and experience might affect the study's findings and interpretations, it is essential to describe the researcher's background (Creswell, 2007). I am originally from Saudi Arabia; I grew up in a middle-class, two-parent home, with five brothers and two sisters. I was born in South Saudi Arabia, where I studied at elementary school and high school, and then I did my undergraduate degree. I was influenced to study nutrition because of my mother, who is very passionate about food and how important it is for the body. She implanted that thinking deep in both my mind and my heart.

I graduated with first-class honours, and as a result of that, I worked as a teaching assistant (TA) in the Department of Nutrition. Working in this job has enabled me to finish my master's degree and will allow me to start a Ph.D. degree under sponsorship. From the first day I went to college, the head of the Department of Nutrition encouraged me to start thinking about doing a master's degree.

I had several responsibilities in the college: I taught undergraduate students in courses including Basic Nutrition, Human Nutrition, and Nutrition for Patients (along with several other courses); I was a research assistant; I was an academic advisor for

first-year nutrition students; and I was also doing the lab work for two doctors' classes. In all, I have three years of experience in nutrition. I was highly motivated for my work.

Out of college, I have three little girls; I am very caring about their food, giving them supplements, and raising them with the same idea I got from my mother: 'a good brain is a result of a good body'. When I had a chance to start my master's degree, I came to Saskatoon, Canada to start my degree at the University of Saskatchewan. In September 2013, I began graduate studies in nutrition. I had to take care of my girls and study at the same time, so I paid a lot of attention to their food. As we were new in Saskatoon, the only way to maintain a healthy meal, appropriate for us, was by cooking every day. I cooked for my family, my daughters, and my husband, because I personally thought they would not make healthy choices if I did not do it for them. At the same time, I made sure we were all taking supplements: multivitamins for the kids, and vitamin D, calcium, and magnesium for my husband and me. I have been taking vitamin D for a long time, as I have been suffering from chronic back pain for a couple of years, and because the diagnosis led to a dead end, I ended up relying on vitamin D, with compensations with calcium.

Thus I have developed a personal interest in the topic of vitamin D. Therefore, my background, culture, work experience (with young women as my students), health experience, job in academia, opinions on healthy food, and informal relationship with Saudi women in Canada could all have potentially influenced my interpretation of this study. However, in conducting interviews I attempted to remain "neutral" on the topic of vitamin D.

### **3. 8 Ethical Considerations**

Ethical approval from the University of Saskatchewan Advisory Committee on Ethics in Behavioral Science Research was obtained before beginning the study (Appendix G). Then, an informed consent was developed to include participants' right to withdraw or refuse to participate in the study, their agreement to participate in the study, and an acknowledgement to protect participants' rights.

After the end of the study, all participants' contact details will be destroyed. Participants' identities will remain anonymous, and the confidentiality of their data will be maintained. In written records, all names will be deleted. Files will be stored on a password-protected computer and in a locked drawer in Dr. Whiting's office, Room 3212 E-Wing. Anonymity of participants will be maintained when the researcher uses direct quotes by assigning code names on the transcripts. After the study has been completed, participants' contact information and other data will be destroyed. Consent forms will be separated from other files and kept in a secured cabinet. However, data will be stored for at least five years following publication of the results.

### **3.9 Dissemination of Findings**

Study results were distributed among young Saudi women living in Canada through invitation to Research Day to view a poster. A PDF of the final report will be offered to health professionals who participated in the interviews.

### **3.10 Time Frame**

This study was conducted from December 2014 to 2015. Ethical concerns and approval were obtained from the University of Saskatchewan Research Ethical Committee prior to commencing data collection. Data collection took about four months (January 2015 to April 2015), and data analysis and interpretation took an additional 6

months (March 2015 to August 2015). Finally, the study's findings will be presented and distributed in 2016.

## **Chapter 4**

### **Findings**

#### **4.1 Introduction**

This chapter begins with a description of the participants' demographic information. Then, it presents the themes that emerged. Results for the Saudi women living in Canada included three major themes: (a) a lack of awareness about vitamin D, (b) a lack of sun exposure, and (c) a lack of motivation in using supplements. Within these themes, several subthemes also emerged, as shown in Table 4.3. Also, the chapter describes the themes that emerged from the interviews with health professionals which included three major themes: (a) health professionals' assumptions about Saudi women's knowledge about vitamin D, (b) new knowledge about the importance of vitamin D, and (c) how to ensure that Saudi women get sufficient vitamin D. The analyses of the two sets of data were performed separately.

Table 4.1 Interview Guide for Saudi Women Living in Canada

- What do you know about vitamin D?
- Where did this information on vitamin D come from?
- What advice, if any, have you received about how to prevent vitamin D deficiency?
- What are some food sources of vitamin D?
- Tell me what you know about vitamin supplements?
- What factors would you consider important when buying vitamin supplements?
- Tell me what you know, if anything, about food fortification?
- Vitamin D is synthesized in the skin upon exposure to sunlight. What do you think are the best times of the day to be exposed to the sun?
- Please tell me how much time you spend in the sun at different times of the year (probe for each season – in spring, summer, fall, winter)
- When you spend time in the sun, which parts of your body are usually uncovered? Can you explain why?
- How do you feel about sun exposure? Do you like going into the sun? Can you explain why? Or why not?
- Can you tell me what things would help you to follow guidelines about how to prevent vitamin D deficiency?

Adapted from Christie & Mason, 2011 and Kung & Lee, 2006

## **4.2 Participant Demographics**

Eighteen participants were interviewed in this study, eight were the Saudi women's group and 10 were the health professionals' group. All participants responded to the recruiting e-mails and invitation letters (Appendix G).

All eight Saudi women participants were originally from Saudi Arabia and were living in Saskatoon, Canada. Four of them stayed at home, and of these, one had her master's degree in business and was waiting to start her doctoral degree, while the other three had finished high school in Saudi Arabia and planned to start their baccalaureate degrees at some point. The other four participants were studying; two of them were working on their master's degrees in computer science, one was in environmental studies, and one participant was working on her doctoral degree in computer science. Their age range was 19–45 years. All participants were Muslim, wore hijabs, and were married. Six of them had children, one participant was pregnant for the first time, and one had no children. All of them had been in Canada for 2–4 years.

The second group was the health professionals group, comprising two physicians, two pharmacists, two nutritionists, two dietitians, and two nurses. Of the 10 participants, three were Egyptian and seven were Saudis. All participants in this group had 3–7 years of experience practicing in Saudi Arabia and Canada. All were living in Canada for work or study purposes. There was one male—a physician—and all other participants were female.

## **4.3 Themes for Saudi Women Living in Canada**

Thematic analysis brought forward three major themes and eight subthemes (Table 4.3). These themes provided a description of the KAP regarding vitamin D of



Saudi women living in Canada.

Table 4.3: Themes and Subthemes Generated from the Saudi Women’s Interviews

Themes	Subthemes
1) Lack of awareness about vitamin D	General vitamin D
	Sources of participants’ information
2) Lack of sun exposure	Poor practices regarding sun exposure
	Negative attitudes regarding sun exposure
	Barriers for receiving sun exposure
3) Lack of motivation in using supplements	Reasons for the Lack of Motivation
	Poor practices regarding vitamin D supplements
	Negative attitudes toward vitamin D supplements

#### 4.3.1 Lack of Awareness about Vitamin D

During the interviews, the women’s knowledge about vitamin D was explored by considering the women’s awareness of numerous topics, such as vitamin D sources, vitamin D-fortified food, vitamin D supplements, benefits of vitamin D, and factors that might decrease an individual’s vitamin D level. This main theme included two main subthemes: (a) general vitamin D knowledge, including numerous topics associated with vitamin D, and (b) sources of participants’ information.

#### 4.3.1.1 General Vitamin D Knowledge

When asked *'What do you know about vitamin D?'* numerous participants indicated an absence of familiarity with and lack of interest in vitamin D. Beyond knowing that *'it comes from the sun'*, most participants seemed to lack any further information about vitamin D. Participants additionally displayed minimal interest in learning new concepts concerning vitamin D. For example, one participant clarified that she did not know much about vitamin D because no one reads nutrition information (Quote 1).

*'Who is going to stop and read labels, posters about vitamins, minerals, and stuff? I think no one, unless something is really interesting'.* (Quote 1)

The deficiency of information about vitamin D among Saudi women living in Canada became even more apparent through exploration of the various subtopics.

##### 4.3.1.1.1 Knowledge about Sources of Vitamin D

When participants were asked, *"What are some food sources of vitamin D?"* they gave a variety of responses. Most of participants recognized the sun as one source of vitamin D (Quote 2 and 3); however, it appeared that not all understood that vitamin D can also be obtained from foods.

*'I do not really know much about [vitamin D] . . . . It comes from the sun, but I do not know anything else about it'.* (Quote 2)

*'We can get it from the sun and some types of foods like milk . . . but I don't remember which kinds of food contain vitamin D'.* (Quote 3)

A few participants identified and classified some incorrect sources of vitamin D, such as

calcium (Quote 5), fruits, and vegetables (Quote 4), and one participant even thought that fruit and vegetables were more important than sunlight as a rich source of vitamin D.

Also, one participant mentioned incorrect information about a variety of food sources of vitamin D in its natural form (Quote 6), and another participant talked about how cooked vegetables contain vitamin D (Quote 7).

*'Fruit and vegetables contain vitamin D and, in my opinion, are more important than the sun'.* (Quote 4)

*'Calcium, and the sun—both [of them] have vitamin D'.* (Quote 5)

*'Mainly all kinds of food have vitamin D but in different amounts'.* (Quote 6)

*'I think cooked vegetables contain vitamin D'.* (Quote 7)

Regarding milk as a source of vitamin D, numerous participants correctly indicated dairy products (Quote 3 and 8); however, several did not identify any food sources with vitamin D besides milk (Quote 8).

*'I know that milk is the most important thing for vitamin D, but other than that, I really don't have any idea'.* (Quote 8)

One participant, who had been diagnosed as deficient in vitamin D before the study, mentioned additional sources of vitamin D (Quote 9), but no other participants offered similar information. However, one participant had read about mushrooms before the interview, and she knew we would be asking about vitamin D deficiency in young Saudi women living in Canada (Quote 10). A few participants believed seafood to be a good source of vitamin D; however, they were not certain if that information was accurate (Quote 11). A few participants stated that eggs were good sources of vitamin D, and two

of them specified egg yolks (Quote 12 and 13).

*'Milk and other milk products, salmon and tuna, cod liver oil, egg yolk, mushrooms. I read about sources of vitamin D after I had been diagnosed [with] vitamin D deficiency'. (Quote 9)*

*'Actually, I did some research about this question [laughs] . . . I found something very interesting with the mushrooms... If they [get] exposure to ultraviolet radiation, they can have vitamin D, so eating them will give us vitamin D. So . . . this is mainly [what] I heard'. (Quote 10)*

*'I think that's fish. I'm not sure though'. (Quote 11)*

*'In the egg, mostly in the egg yolk...'. (Quote 12)*

*'The sunlight—the main source—and egg yolk, and that's what I know...'. (Quote 13)*

#### 4.3.1.1.2 Food Fortification

Initially, most of the participants were not familiar with the phrase *food fortification* (Quote 14), but some of them guessed at what it might mean. One participant guessed the meaning of the phrase correctly, even though she said she had no knowledge of it (Quote 15). The participant who had been diagnosed with vitamin D deficiency correctly identified the meaning of the term *food fortification*, and was able to list several fortified foods available in Canada (Quote 16). However, interestingly, after we explained the phrase *food fortification* to one participant and interviewed her more extensively regarding her food purchases, she mentioned that she had read about it before

in the store but had not paid much attention to it because she did not know the idea behind the phrase (Quote 17).

*'Sorry, but what is the meaning? Is that the same question as the food sources or what?'* (Quote 14)

*'I don't know what it means, but I think it means adding vitamin D to the food'.*  
(Quote 15)

*'As I know, some food is fortified with vitamin D, calcium, or omega-3. For example, some kinds of cereals are vitamin D-fortified; some kinds of eggs are omega-3-fortified. Orange juice [is fortified] with vitamin D'.* (Quote 16)

*'In the supermarket, I see [that] some of the milk says "fortified with vitamin D", even the eggs. I think orange juice, too'.* (Quote 17)

Although no question specifically asked the participants about the availability or limitation of fortified foods in Saudi Arabia, the participants' home country, some participants mentioned that in Saudi Arabia, public health messages about vitamin D and vitamin D-fortified foods are limited (Quote 20). They believed that this contributes to a lack of knowledge of and awareness about vitamin D-fortified foods (Quote 18). Participants stated that they did not know much about food fortification in Saudi Arabia, so when they came to Canada they did not have adequate background information. For example, they did not have knowledge about what the phrase *fortified food* means or why it is important to eat food that is fortified with vitamin D. One participant, who had never been aware of the availability of fortified food in Saudi Arabia, thought that *fortified food* referred to salt fortified with iodine, and she did not know that there were other fortified

foods available in the marketplace or that some foods were fortified with vitamin D (Quote 18). Also, the participant who had been diagnosed with a vitamin D deficiency stated that because she had read about vitamin D while dealing with her illness, she knew that *fortified food* was not a common term in Saudi Arabia (Quote 19).

*'We do not have [fortified food] in Saudi Arabia . . . I never heard about it from TV or advertisements . . . . I don't think anyone even told me. I know there is salt with iodine, so that's why I thought the same as here. I meant just [the] salt is fortified'.* (Quote 18)

*'In Saudi Arabia, it is not easy to find food [that is] vitamin D-fortified. Even the word is not usual in public or [among] health professionals'.* (Quote 19)

*'People in Saudi Arabia do not really talk about vitamins, like why vitamin D is important, or something like fortification. I mean . . . I do not know so much about vitamin D because no one told me . . . We do not really have health messages . . . . Maybe there were some . . . at least I never heard of any'.* (Quote 20)

#### 4.3.1.1.4 Knowledge about Other Benefits of Vitamin D

Participants presented limited awareness of any benefits of vitamin D other than that it is necessary for bone health (Quote 21). None of them talked about osteomalacia (softening of the bones in adults) as a symptom of vitamin D deficiency. The participant with vitamin D deficiency said that vitamin D is essential to control some pain, such as leg pain. None of them mentioned any other functions of vitamin D.

Concerning vitamin D and its role in regulating calcium and phosphorus concentrations, one participant mentioned that it is 'important for the body to absorb

calcium' (Quote 21), but it was not clear that the other participants who mentioned calcium were aware of this function. A few realized that vitamin D is connected to calcium in some way or may benefit the regulation of calcium, but minimal information was given by anyone (Quote 21).

*'All I know is, it's a vitamin that's important for the body to absorb calcium, and it's important for the bones'.* (Quote 21)

Regarding the risks of vitamin D deficiency, no participants indicated clear knowledge about it. The one participant who had vitamin D deficiency mentioned knee pain and back pain associated with vitamin D deficiency. She said that she had heard about vitamin D's link with depression after being diagnosed with vitamin D deficiency (Quote 22), and then the link was reinforced by her treatment process. Further, one participant specified that she had watched a YouTube video about people with psoriasis which recommended vitamin D supplements (Quote 23).

*'One of the facts that surprised me about vitamin D [deficiency] is that it can cause depression'.* (Quote 22)

*'I heard that vitamin D is important for people who have psoriasis or something. . . specifically from YouTube'.* (Quote 23)

Furthermore, with regard to factors that might decrease the amount of vitamin D in any individual, a few participants stated that the long winters in Saskatoon and layers of clothes they had to wear might decrease their sun exposure (Quote 24); however, no participants indicated knowledge of any other factors (e.g., time of day, skin pigmentation) that might decrease the amount of vitamin D they absorbed through the skin.

*'Because of the long winter in Saskatoon... we do not go outside in winter and always wear the hijab as well, [so] we can't really get enough exposure to [the] sun'. (Quote 24).*

#### 4.3.1.2 Sources of Participants' Information

Regarding the question *'Where did your information on vitamin D come from?'*, participants stated that they got their information from several sources. The main source was the Internet, particularly through social media such as Facebook, Instagram, and YouTube (Quote 25). Doctors were a second source of information about vitamin D (Quote 27).

*'My information came from ...mainly from the Internet'. (Quote 25)*

*'Several places . . . like YouTube, Facebook, [and] Instagram . . . I am following several physicians' pages on Instagram'. (Quote 26)*

*'My information . . . [came] from physicians, doctors. I do not know exactly where it came from, but it [was] from everywhere'. (Quote 27)*

The third source of participants' information about vitamin D was parents, family members, friends, or other acquaintances (Quote 28). Almost all participants mentioned that their mothers and grandmothers, in the context of discussing the importance of laying babies in the morning sun, had told them that the best time for sun exposure was in the morning (Quote 29).

*'Some of my information I read about . . . and some of [it was] from families, friends, my parents'. (Quote 28)*

*'I heard . . . from my mother [and] grandmother to always put your babies in the sun in the morning, to have vitamin D...'. (Quote 29)*



The fourth source of the participants' information about vitamin D was school; several participants said they had learned what they knew from school or further education (Quote 30). Television and traditional print media (e.g., books, articles in newspapers and magazines) also provided information about vitamin D to the participants (Quote 31).

*'We learned about vitamins, minerals, and other stuff during school. I remember in biology, science, and nutrition'.* (Quote 30)

*'My information . . . [comes from] TV, YouTube, the Internet, magazines, books . . . [she laughs] . . . everywhere'.* (Quote 31)

#### 4.3.2 Lack of Sun Exposure

The interviews with Saudi women living in Canada revealed the theme of an insufficient amount of sun exposure, due either to a lack of information regarding the importance of sun exposure or to other causes. Three subthemes were identified: poor sun exposure practices, negative attitudes regarding sun exposure, and barriers to receiving sun exposure.

Most of the participants were aware that sun exposure is beneficial, but they did not necessarily know the best time for sun exposure, the optimal length of time recommended for sun exposure, or which parts of the body should be exposed. For example, there were a variety of responses to the question about what time is best for sun exposure, ranging from sunrise to sunset; however, all participants qualified their responses by saying that they were not sure of the accuracy of their information (Quote 32). Several participants guessed the best time for sun exposure to be in the early

morning, but they had limited information surrounding the matter of sun exposure (Quote 33).

*'The early morning and certain times in the afternoon, like from 4 pm until sunset . . . right? I am not sure actually'. (Quote 32)*

*'I do not really know . . . how long is enough for me to [be exposed] to sunlight . . . Also, I am not sure, but the morning and before sunset I believe [are] both good times*

*. . . We always hear this information . . . I am not sure actually'. (Quote 33).*

#### 4.3.2.1 Practices Regarding Sun Exposure

Limited sun exposure was common among the study participants. One participant, for example, gained sun exposure while walking from her home to the bus and vice versa, but she stated that this activity depended on several considerations (Quote 34).

*'Usually, in all the seasons, I just walk from home to [take] the bus to the university. My house [is] near the bus stop, but mostly I walk in fall, spring, summer. [In] winter, of course, [there is] not a lot of walking, [but I walk] maybe around two hours in summer and spring. Then, during the fall, because it [rains] sometimes, it is less than two hours. In general, I do not like to walk [unless there is] good weather during summer'. (Quote 34)*

Another practice mentioned by one participant was walking while she shops, but she said that this activity depended on her mood. She wears a long hijab and feels that if the weather is too sunny, too hot, or rainy, she would prefer to take a taxi rather than continue walking (Quote 35).

*'In fall, as I said, I [walk] a lot when I go shopping, for example . . . maybe I*

*[walk] two hours. It depends on myself. If I like to walk, then I will walk about one to two hours, but if I feel like I can't, I will maybe walk for just half an hour. . . so [approximately] three or five hours a day, [depending] on [my] mood'.*

(Quote 35)

One participant mentioned that she goes sunbathing once a year in a private spot during her holiday to Saudi Arabia (Quote 36).

*'If we go out [of Saskatoon], like in Saudi Arabia at Jeddah's chalet, . . . I can stay outside without [the] hijab. It's a closed place and it's a private place, so I can be [outside] without [the] hijab, and then I can expose [myself] to the sun. It's not a lot actually, but if we have a chance, then I will have a sunbath . . . maybe once a year'.* (Quote 36).

A few participants stated that they did not have time for exposure to the sun, due to their busy lives (Quote 37).

*'... I used to go for a walk with some friends, for . . . half an hour or something, but even in summer or fall, it [was] really hard'.* (Quote 37)

None of the participants mentioned that they purposely avoided sun exposure for fear of getting darker skin or for any other cosmetic reason (Quote 38).

*'You mean avoid the sun because afraid of getting dark skin? No, actually, I never thought of that, I do not go outside in the sun, because I do not like it, not because I am afraid of getting darker or something'.* (Quote 38)

No one mentioned the practice of using a parasol to provide shade from the sun, but a majority of participants stated that they do not go outside if the sun is shining and the temperature is high.

Even though a few participants indicated that they walk every day to the bus to get from their homes to school—allowing them to get exposure to the sun—a majority of participants stated that daily exposure to the sun is challenging due to Saskatoon’s weather. Winter starts in late October and lasts until early March, so even if there were sufficient sunlight, participants believed that the cold weather limited them from going outside in winter.

#### 4.3.2.2 Participants’ Negative Attitudes Toward Sun Exposure

Several participants expressed associating time in the sun with pleasant relaxation. However, nearly all were concerned about being too hot under the sun, something they indicated they dislike. They cared more about being comfortable and not sweating than they cared about exposure to sun (Quote 39).

*‘I do not like the sun. I do not like the feeling of being hot . . . I mean, I get angry quickly when I feel hot. So I do not prefer to stay in the sun ever, ever. I like warm weather, no sun, no cold, with some clouds.’* (Quote 39)

When we discussed the matter of getting a tan with one participant who used a treatment for her face, she denied that she had any concerns about her skin getting dark. At one point in her interview, she mentioned that she had been advised to use sunscreen with SPF (Quote 40).

*‘When I buy the moisturizer, they recommend that I buy a sunscreen, the moisturizer that has SPF of 30 or 35. I’m not sure what that means. Is it just because I exfoliate my face almost daily?’* (Quote 40).

A few participants who had a favorable attitude toward using sunscreen mentioned that they worried about the risk of skin cancer with sun exposure. They said that when they go

outside, it is only to relax for a short time and they would not consider sitting under the sun for more than 30 minutes (Quote 41).

*'I have heard, "it will bring you skin cancer." I hear a lot about that, that [a lot of] exposure to the sun . . . will hurt your skin and maybe cause skin cancer, so I try not to expose [my skin] to the sun too much...'. (Quote 41)*

Another participant shared that she regularly opens the windows to let sunlight come inside the house, even if only for few minutes for exposure to sunlight (Quote 42).

*'Even in my apartment when there's sun, I open the windows and try to expose myself and my daughter to the sun at least for a few minutes'. (Quote 42)*

Despite wearing their hijabs all the time in public places, many participants said that they do not expose themselves to the sun simply because the weather conditions are often not suitable (Quote 43).

*'In the summer, it's annoying to . . . be exposed to the sun. It's very annoying especially if the sun is very hot'. (Quote 43)*

In the participants' opinion, if it is rainy or windy during spring, summer, or fall, then there is no opportunity to walk or get outside (Quote 44). The best chance of walking or sitting outside is in summer, but several factors limit such activities. For example, the participants said they would go outside for a picnic when the temperature is not too high and the sunlight not strong, but even then they would need a shaded place to relax (Quote 45).

*'During fall and spring, it depends if there is no rain because it's hard to walk in the rain. Yeah, it depends on the weather; sometimes, the weather and environment control us'. (Quote 44)*

*'Going outside and [getting] exposure to the sun is dependent on the weather; if the temperature is very nice, for example, between 25 or 18 to 10 [degrees Celsius], it's okay, but [if it is higher than that], it's hard'.* (Quote 45)

We discussed what constitutes a high temperature from the participants' perspectives. They described it as *'when you stand up and feel your body is hot'* and when *'you [are] sweating after 10 minutes in the sun'*. Even the group who said they liked to walk in the sun qualified this, explaining that the walks were restricted to the early morning or a shaded yard.

Regarding the duration of exposure, the variety of the participants' responses showed several behaviors. The most important factor governing the duration of exposure was the need to finish tasks outside. For example, they may need to walk from the house to the bus, so they are exposed to the sun, but it is tangential to their primary purpose (Quote 46). If they go outside purely for enjoyment, such as to have picnics, they will stay as long as there is a nice breeze and shade, but if there is full sun and the temperature is high, they will leave directly. One participant stated that she likes to go out if the weather is convenient (Quote 47).

*'Actually, I go outside each time, every season, but [I never intend] . . . to get vitamin D . . . or to get exposure to the sunlight. No, I just go outside for shopping, for example, or [to] visit someone, or buy something...so, no, I never [think] of exposure to the sun'.* (Quote 46)

*'I actually love to spend time in the sun if the temperature is acceptable'.* (Quote 47)

#### 4.3.2.3 Barriers to Sun Exposure

Almost all of the young Saudi women living in Canada who participated in this study said that receiving sun exposure was difficult due to the following barriers: (a) wearing a full hijab (Quote 48 and 49), (b) limited outdoor activities (Quote 51), (c) Saskatoon's weather (Quote 56), and (d) concern about skin cancer (Quote 60).

Clothing styles covering the whole body, completely or nearly completely, were related to the Islamic religion, as all of the participants mentioned, and limited the parts of the body that could be exposed to the sun. When asked about which body parts they usually exposed to the sun, all participants gave the same response: hands and face only. All of the participants were Muslims, and therefore covered their bodies when they were outside or when they were surrounded by men, as was revealed during the interviews. Several participants emphasised the link between wearing the hijab and the lack of sun exposure (Quote 49).

*'Almost all my body [is] covered, except my hands [and] face, of course. The reason is we have in Islam [the] hijab, [and] we are not supposed to show people our bodies'.* (Quote 48)

*'One of the factors that I think causes . . . vitamin D deficiency is that we [are] always covered, and most of the time there are men around [so] that we cannot uncover'.* (Quote 49)

The participant with vitamin D deficiency mentioned that even though she had tried to uncover some areas of skin, it was not always easy (Quote 50).

*'Actually, after I [discovered] that I have a vitamin D deficiency, I tried to go outside and spend some time in the park. I tried to expose my legs and arms. This*

*can be done only if there are no men around, which is always hard*'. (Quote 50)

It emerged that the outdoor activities of young Saudi women living in Canada were also limited, which decreased their opportunities for sun exposure. Many of them declared that they did not engage in any outdoor activities (Quote 51). Several participants emphasised that, just as they did not engage in an outdoor activities in Saudi Arabia, they do not engage in any outside activities in Canada (Quote 52).

*'Even if it is good weather, I do not like to walk outside. As you know, we get to stay inside always in Saudi Arabia . . . . We do not really do outdoor activities there, you know, . . . because it is extremely hot. Here in Saskatoon, [it is] the same . . . . [There are few] outdoor activities [except for] picnics sometimes...'*

(Quote 51)

*'Our bodies did not like hot... We did not go outside under the sun, I mean in the past [in Saudi Arabia] . . . .Nobody [went] outside for walking . . . or exercising . . . Now [we] usually [do] not [go outside] . . . . We like to be inside under cold conditions'*. (Quote 52)

A majority of participants indicated that they were dependent on using cars, so they moved from a house to a car, to a building, and so on, which limited their chance of sun exposure as well (Quote 53).

*'We all have cars . . . . We are dependent on cars, as you know. Also I do not think I will walk [on] a hot sunny day!! . . . . [I walk] only from my home to [the] car, then from my office to [the] car again... That's it'*. (Quote 53)

Some participants mentioned that they lived in apartments, which also limited their chances of exposure to the sun in private places (Quote 54). They assumed



that if they had backyards, roofs, or balconies that would ensure their privacy, then they would get more opportunities to gain exposure to the sun (Quote 55). That said, another group living in townhouses with backyards stated that even though they had backyards, with the long cold winter or the hot summer in Saskatoon, their opportunities to get exposure to the sun were still limited (Quote 56).

*'I'm living in [an] apartment, so there's no opportunity to be exposed to the sun by any way'. (Quote 54)*

*'In Canada, I don't expose [myself] a lot to the sun, . . . but if I [had] a backyard in my house, it might be different'. (Quote 55)*

*'I have a backyard [where] I can go out before the sunset for a while, but to be honest, I do not usually do it. It is too hot outside in summer, even before sunset'. (Quote 56)*

Many mentioned that in the summer, there is enough opportunity to go outside, but as they have to stay in their hijabs all the time, they prefer to stay inside (Quote 57).

*'I usually try to spend more time in the sun during the spring and summer; the weather is very nice and encourages me to do so. However, because I am covered . . . I do not like to go to parks or something. We stay home usually . . . It is so hot with the hijab to be outside'. (Quote 57)*

The majority of participants indicated a preference for indoor activities, such as gatherings or social events (Quote 58).

*'[I enjoy] getting together with friends during the weekend sometimes . . . [and] visiting each other sometimes . . ., but outdoor activities not so much actually . . . It is not easy to engage in any outdoor activities'. (Quote 58)*

Some stated that they had registered for a gym membership at some point (Quote 59).

*'I was walking to the gym last couple of months, but then I skipped it, so now I do not walk so much, or [get] exposure to sun. You know, [my friends and I] skipped gym together. I think we [Saudi girls in Canada] are not doing any activities now [in Saskatoon] . . . I mean outside our homes'.* (Quote 59)

The use of sunscreen as a protection against skin cancer appeared to be a cause of limited sun exposure for a few of the participants, who mentioned that they used sunscreen products when exposed to the sun to protect their skin (Quote 60).

*'The more exposure [I have] to the sun, [the greater the risk] that it will maybe hurt me, so I use protection, I use sunblock ... Every day, actually. Every time I go out—especially during the summer and during the winter sometimes, because I heard that if you go out [into] the sun without protection, then maybe you will hurt your skin... That's why I use protection from the sun'.* (Quote 60)

#### 4.3.3 Lack of Motivation to Use Supplements

This theme comprise of three subthemes: (a) reasons of the lack of motivation, (b) poor practices regarding vitamin D Supplements, and (c) negative attitudes regarding vitamin D supplements. The participants described their lack of motivation to use vitamin D supplements as a personal challenge; they were not interested in using such supplements. Since participants' knowledge about vitamin D supplements might contribute to their lack of motivation in using supplements, it made sense to include knowledge about vitamin D supplements under this theme.

All of the participants had heard of supplements at some point, and they stated that clearly (Quote 61). However, even though the participants had heard about the

importance of supplementation, they demonstrated incomplete knowledge and understanding of the importance of vitamin D supplementation. For example, a few participants showed a lack of concern about following health recommendations—such as taking supplements every day—if they did not have any major health issues. If they did not have any major health problems, they did not take supplements just for prevention (Quote 62).

*‘I know they protect you from vitamin D deficiency, and I know that they are good for your health’.* (Quote 61)

*‘If I do not have any pain in my body and I feel fine, then I do not really listen [or] care about taking supplements or something like that’.* (Quote 62)

#### 4.3.3.1 Reasons for the Lack of Motivation for Using Vitamin D Supplements

During the interviews, the participants demonstrated that they had some knowledge about the importance of vitamin D supplements for human health, but they appeared unmotivated to adopt the supplementation practice. The participants were not interested in using supplements for several reasons, including: (a) difficulty taking them or poor acceptance (Quote 63), (b) lack of information (Quote 64), and (c) conflicting beliefs and practices (Quote 65).

*‘I don’t like to take supplements because I usually forget them anyway’.* (Quote 63)

*‘I think vitamins are not really in supplements. You get vitamins from fruits and vegetables. Fruits and vegetables [are] more important than supplements and other things’.* (Quote 64)

*'There is no doubt . . . natural foods, [have] every nutrient for the body . . . . We use supplements only for extra benefits, but the healthy food is more significant for the natural functions of the body . . . and drive the human to [a] healthy state'.*

(Quote 65)

Hardly any participants mentioned cost as a reason for not taking supplements (Quote 66 and 67). One participant specified that she would consider buying supplements wholesale to get a reasonable price and quantity; however, after several questions during the interview, she clarified that she did not intend to say that the cost was a barrier for her (Quote 68). One participant said that due to cost considerations, she prefers to buy supplements from grocery stores rather than drugstores or pharmacies (Quote 69).

*'I know the cost of those supplements is good; [it is] not expensive to buy them'.*

(Quote 66)

*'No, I haven't [thought] about the cost because I think [it does not] cost a lot'.*

(Quote 67)

*'One of the factors that I consider when buying vitamin D supplements is the price and the quantity of each container. That's why I buy from wholesale stores like Costco [with] a container that has 500 tablets with a very reasonable price'.*

(Quote 68)

*'Well, some of them are expensive, but maybe they are more expensive in [some] places than others, like some drugstores; they have higher prices than supermarkets. So, I think . . . the price is different from place to place, but, in general, I believe they have a good price for supplements. Actually, when it comes*

*to my health, I do not care about how much it costs me'. (Quote 69)*

Participants revealed a high level of trust toward healthcare professionals regarding the use of supplements, advice, and information about health matters in general (Quote 70 and 71).

*'I actually do not take any medicine unless I ask the doctor or the pharmacist . . . . I would ask the pharmacist, the physician what is the best medicine, what is the best company for supplements, then I [would] buy whatever they told me. I do not choose for myself. I talk with the pharmacists about what symptoms I have, and they will help'. (Quote 70)*

*'I usually listen to nutrition people. They know a lot about health, food, and stuff. Then I follow their recommendations advices. One of my friends [was] doing a research [project] on vitamin D and she always talked about vitamin D drops, so I bought them'. (Quote 71)*

For example, when we asked participants about which factors they considered important when buying vitamin supplements, almost all believed it was important to ask a healthcare professional before taking any supplements (Quote 72, 73, and 74).

*'When I want to buy any kind of supplements, especially vitamin D, I have to ask a pharmacist or even my doctor about the amount of—the adequate amount I consume every day'. (Quote 72)*

*'Just asking people, especially in nutrition and things, [to recommend] some type of supplement, and we buy it . . . because they know more than [we do] about supplements'. (Quote 73)*

*'I usually follow like the professional people, like if it's a skin professional*

*[who] knows more about the skin, then I will absolutely listen to what he said or what she said'. (Quote 74)*

Several participants believed that there might be some significant risks if they were to ignore healthcare advice (Quote 75 and 76).

*'We trusted them [health professionals]. They know what supplements is good [and] what is bad for the body. They [know] if the medicine has side effects . . . . If my doctor give me prescription, I would take it exactly as he said; otherwise, my health would be in danger'. (Quote 75)*

*'It might cause a problem for my skin, body, health if I take something without a nutritionist's advice . . . . I would . . . do what she told me to do, eat more vegetables, eat more fruits, drink more water, sleep well, take vitamins and other stuff'. (Quote 76)*

Participants believed that healthcare professionals would help them understand some of the physicians' difficult terminology (Quote 77).

*'Pharmacists read what doctors wrote in the description [sic] . . . . [laughs] . . . . I do not know medicine's words . . . . I have to ask for help to know what [the medical jargon means]'. (Quote 77)*

However, the minimal level of advice and recommendations given by health professionals was a concern mentioned by several participants, and they stated that it affected the degree to which they used vitamin D supplements. For example, the participant with deficiency in vitamin D had learnt some information about vitamin D supplements from her doctors, although the information she had received was limited.

When asked additional questions about where her other information came from,

the participant said that her physician did not give her enough information; he only told her about supplements (Quote 78). Further, another participant stated that many health professionals did not give her enough advice when she visited them (Quote 79).

*'I actually searched the Internet for . . . information about food that contains vitamin D. Not all of my information came from [a] physician or other healthcare professionals. Actually, the doctor did not give me any other information about food that contains vitamin D'.* (Quote 78)

*'Actually, doctors just give a prescription and send you to the pharmacy. They do not tell you to do things. I had a pain on my bones, back—like—a long time ago, and I do not remember the doctor talking about if it might be vitamin D deficiency or stuff like that. Just “get this prescription”'.* (Quote 79)

#### 4.3.3.2 Poor Practices Regarding Vitamin D Supplements

Having evidence about the significance of vitamin D supplements did not appear to encourage the participants to take vitamin D supplements regularly. Most of the participants specified that taking a supplement was difficult to maintain on a daily basis (Quote 80) and (Quote 81). The one participant who had vitamin D deficiency stated that she took supplements daily due to her condition, but she sometimes forgot (Quote 82).

*'I usually try to consume vitamin D as a supplement in the winter time because there is no sunlight, especially here in Saskatoon... not usually actually...'* (Quote 80)

*'Actually, I do not use any [supplements] daily . . . it is hard to remember'.*  
(Quote 81)

*I take [a] vitamin D supplement daily because I still have vitamin D deficiency. At the beginning, I took one bottle of vitamin D drops weekly and vitamin D tables once daily. . To be honest, with lots of responsibilities, I actually forget to take it most of the time'. (Quote 82)*

#### 4.3.3.3 Negative Attitudes toward Vitamin D Supplements

The majority of the participants discussed taking supplements, but most ended up declaring that they usually did not take them.

*I know supplements are excellent sources of vitamins and stuff, but usually I do not remember to take them. I am trying to, but it is really hard to remember . . . sometimes, even if I remember, I feel [too] lazy . . . to take one'. (Quote 83)*

*I have supplements at home such as vitamin D, calcium, [and] magnesium. They [are] really important, [but] . . . I do not like to use them every day. It is hard'. (Quote 84)*

*The problem [with supplements is that] I hate to do something every day, even [when] I know it is good for my body'. (Quote 85)*

Regarding the issue of whether or not Saudi women faced any difficulties buying vitamin D supplements in Canada, one participant mentioned that she bought supplements that were free from gelatins, since gelatin is sometimes derived from pork products (Quote 86).

*I'm looking for something that does not contain any gelatins, especially here in Canada'. (Quote 86)*

It came up that most participants' attitudes about taking vitamin supplements were formed during pregnancy (Quote 87). Also, nearly all participants who had



children said they offered their children vitamin D drops to prevent rickets. Even if they did not do this regularly, they tried to do so (Quote 88 and 89).

*'I took them when I was pregnant; the doctor said I need to take a lot of them . . . but I did not use them before'.* (Quote 87)

*'For my daughter, since we are living [in Saskatoon] and there's no sun exposure, they said she has to take vitamin D drops'.* (Quote 88)

*'I gave my children vitamin D drops every day. I am trying actually to give them every day . . . . It is important for children'.* (Quote 89)

Several participants expressed that they planned to start taking supplements in the future because they believed supplementation was essential (Quote 90).

*'I know I should get vitamin D [supplements] since I do not like exposure to the sun [laughs]. Also, I do not like supplements [laughs again]. I hope this thing changes in me. I should get more supplements soon'.* (Quote 90)

Several women voiced concerns related to their busy lifestyles, which they cited as a reason for their attitudes toward vitamin D supplements (Quote 91).

*'We all here [as] students, and mothers as well ... [we are] extremely busy... [There is] no time to take supplements. For me, I do not have time to think about my health [or] even eat well, or do sports...'.* (Quote 91)

Some participants said that their responsibilities related to pursuing advanced degrees and to raising healthy children affected their use of supplements more than any other aspects of their lives (Quote 92).

*'My attention is only on my daughter, to be honest. I give her supplements every day. She is more important to me than myself. I do not have time to take*

*supplements or to do other nutritious stuff. Studying takes all of my time...'*

(Quote 92)

To sum up, reflecting on the current results, the knowledge of vitamin D, the health benefits of vitamin D, and the dangers of vitamin D deficiency among Saudi women living in Canada is very poor. Therefore, it stands to reason that this lack of knowledge could play a role in the negative attitude toward and limited practice of vitamin D supplementation.

#### 4.4 Finding from Health Professionals' Interviews

Three major themes were generated from health professionals' interviews: (1) health professionals' assumptions about Saudi women's knowledge about vitamin D, (2) new knowledge about the importance of vitamin D, and (3) how to ensure that Saudi women get sufficient vitamin D.

##### 4.4.1 Health Professionals' Assumptions About Saudi Women's Knowledge

Health professionals assumed that Saudi women living in Canada have a lot of knowledge and information regarding vitamin D.

Both of the physicians assumed that Saudi women know at least the importance of vitamin D for a woman's body and a basic understanding of the requirements for vitamin D.

*"...Everyone should know about vitamins... the significance, especially this group [Saudi women living in Canada]... they should know about vitamin D, ...how it is necessary for human body...they should know... they need about 800- 1000 international units every day..."* Physician #1

*"...They should know the importance of the vitamin D... they should know the food that contained vitamin D..."* Physician #1

*"...Saudi women should know every things related to ... vitamin D, it is really important specially for women... girls need to take it every day... about 1000 units..."* Physician #2

Pharmacist #1 added that Saudi women living in Canada should realize that they have to take 600 international unit (IU) of vitamin D along with the calcium, if

they are less than 50 years old. If they are 50 years or older, they should increase the dose 800-1000 IU.

*“... First they should know that if they couldn't take adequate amount of vitamin D from sun exposure... they should have supplements of vitamin D and as I've told you if she's less than 50 years old she should take 400-600 international unit of vitamin D along with the calcium...and if she is 50 years old or more, she should increase the dose 800-1000 international unit...”*Pharmacist #1

The physicians assumed that Saudi women living in Canada know about the requirements of vitamin D that increases during women live. Also, Physician #1 stated that Saudi women living in Canada should maintain their vitamin D levels throughout their life, so they won't suffer later. They believed that Saudi women living in Canada should educate themselves and educate their families about the importance of vitamin D throughout their lives. Additionally, Pharmacist #1 and #2 expected that Saudi women living in Canada would know that women have a significant number of issues that affect their vitamin D level.

*“Specifically for women, because they have lots of things that affect their bones health.... Pregnancy and lactation affect bone health, and... women should be aware of how much ...vitamin D they are taking to maintain bone health and to prevent any possible osteoporosis or bone problems later on...”* Pharmacist #1

*“...The requirement of vitamin D...increased during child bearing especially pregnancy even after delivery with the lactation and all this things we [women] going to need vitamin D and also they [Saudi women] should know all of that... it is the most important knowledge that they should know”* Physician #2

*“... Vitamin D ... is one of the very important issue and we should not wait until we become elderly ... so we should maintain our vitamin D... we should educate our self and educate our family about the importance of the vitamin D ... for full integrity during the earlier in our life...” Physician #1*

These two physicians thought that Saudi women living in Canada know that consuming supplements is important, even if they might have some difficulty using the supplements regularly. Then one physician stated that from her experience with so many Saudi women living in Canada, she believed these women have an appropriate level of knowledge regarding vitamin D, and vitamin D supplements. Further, one pharmacist thought that Saudi women living in Canada understand the importance of taking supplements, and realize there are factors that might increase their risk of developing vitamin D deficiency. Also, this pharmacist believed that Saudi women recognize there is an association between vitamin D levels and pregnancy and breastfeeding.

*“I think they know a lot about vitamin D and from my experience of talking with Saudi women living in Canada, most of them are taking supplementation of vitamin D, however it’s probably not consistent... Most of the girls I know who are living in Canada take vitamin D and Calcium occasionally, but it’s not guaranteed... We assumed they know they should care about vitamin D deficiency.” Physician #2*

*“...For example, during pregnancy, a baby needs a lot of calcium, so he or she gets his or her calcium from what the mother is eating.... pregnant women should make sure that they are getting the recommended amounts of calcium and vitamin D.... Also, bone density can be affected while breastfeeding...”*

### Pharmacist #1

The pharmacists and one nurse emphasized the importance of checking vitamin D levels. They thought that Saudi women in Canada should not have any issues with the challenge of health care insurance, because they have two insurance cards. One insurance card from Saudi Arabia has a variety of features including a VIP class, hospital care coverage, and laboratory and diagnostic services. Their second one is from the province of Saskatchewan. Thus, for Saudi women who are living in Saskatoon, Canada, they can check their vitamin D level using either of these cards, and for other women in other parts of Canada, they can use their card from Saudi Arabia, if the one from Canada does not cover vitamin D blood testing.

*“... They have access to the health... like health system... they shouldn't have challenges, you know the only challenge that they have, that they can't be expose to sunlight... other than that, I think they are educated enough to find the important information about their like their health... they can go to the family physician and check like vitamins level or vitamin D level” Nurse #2*

One pharmacist mentioned Saudi women living in Canada should understand what the sufficient level of vitamin D is and also know the symptoms of vitamin D deficiency.

*“...They should know their normal level of vitamin D and by like get regular checkup ... to make sure that they are fine... and I think maybe they should know the symptoms of vitamin D deficiency...” Pharmacist #2*

Some of the health practitioners explained that people from the Middle East have dark colored skin, which decreases the absorption of the sun through the skin. In general,

women from the Middle East are more vitamin D deficient, so they need to know the importance of exposure to the sun.

*“...Especially because we [people from Middle East] are dark colored skin, not white, so the absorption of the sun through our skin would be less than the white man or the white Canadian... because we are not expose enough to the sun and in addition our dark skin will decrease the absorption of the sun like...so Saudi women should know the importance of vitamin D... and how they can maintain the basic requirement...” Physician #1*

Three practitioners pharmacist #1 and #2, and nurse #2 stated that Saudi women living in Canada know that the sun is the most important source of vitamin D and the limited sun exposure leads to vitamin D deficiency. Also, hijabs, which are typically worn by Saudi women, decrease the amount of sun exposure that these women receive.

*“In general...in Canada...there's limited chance for sun exposure ...so we don't have that so much sun exposure and that will lead to more deficiency in vitamin D and ...women [Saudi women] should know that the sun is the richest source of vitamin D...even exposure is kind of difficult ” Pharmacist #1*

*“...the Saudi woman...maybe they know that the sun is ... the most important source of vitamin D and ...we don't expose our skin that much towards the sun ...because we are like covering most of our body when we are going outside... so they know that they don't get that much vitamin D from the...” Pharmacist #2*

One nutritionist thought that Saudi women living in Canada know that taking supplements is a solution for vitamin D deficiency because winter and lack of sun exposure affect how much vitamin D they would receive. Then, she noted that the

majority of the Canadian population has had vitamin D deficiency, and Saudi women living in Canada are currently adapting to this problem.

*...I found that Canadians are always at risk of vitamin D deficiency, since they just have 6 months of exposure... that doesn't even enough to capital for the whole year. As a result, we [Saudi women living in Canada]... are in danger of being the same situation, because we are adapting to the same...weather and lifestyle...*” Nutritionist #1

One dietitian thought vitamin D deficiency is a common problem in men and women, and there several reasons that lead to it, not only wearing the hijab.

*“I realize that not only Saudi women also men are deficient in vitamin D...Some people are talking about hijab and wearing the veil I don't believe it's the main reason... because if this is the case [why deficiency] in both men and women?... there should be another factor ...”* Dietitian #1

Both pharmacists agreed on that because vitamin D is found in limited food sources, Saudi women living in Canada should know about other sources, mainly supplements and food fortification.

*“... Vitamin D is very limited in external resources... So, they should know we depend mainly on the supplements...”* Pharmacist #1

*“...They [Saudi women] should know about the sources of vitamin D and the food that they can eat...maybe...food that is fortified with vitamin D ...”*

Pharmacist #2

Both dietitians believed the general knowledge that Saudi women living in Canada should have about vitamin D includes the importance of eating fortified food.



*“... They should, eat food contain vitamin D, they know it comes from sun not from nutrition...there is limited food in fact... and I believe they consume fortified products of vitamin D...”* Dietitian #2

The two physicians also thought that Saudi women living in Canada understood that food contains vitamin D.

*“...As you know there is not so many choices of food continues vitamin D... but I think regarding that girls should know where is vitamin D...let's say for example milk, even it is not enough...they should know what other sources of vitamin D...”* Physician #2

Two practitioners, nurse #2 and nutritionist #2 assumed a lot about what Saudi women living in Canada know about vitamin D deficiency. They said Saudi women living in Canada should at minimum recognize the importance of vitamin D to decrease depression, to improve the body's natural functions, mental status and physical status significantly. Then, nurse #2 specified that Saudi women living in Canada should also recognize that vitamin D is the happiness vitamin.

*“...I think they know that it is important to all the body function like without taking vitamin D, it affects the body weight, it affects the like emotional status or psychological conditions, it affects the like metabolic rate, I think it's related to the body weight things it affects the hair growth it's related to many functions...”* Nurse #2.

*“...I think most of the girls...from the long winter ... struggle with depression ... they should know its link to vitamin D...”* Nutritionist #2

One practitioner nurse #1 stated that Saudi women outside of the health

professionals realm do not know much about vitamin D. During her interview, she noted that she studied nursing in Canada for about 5 years and had vitamin D deficiency. She mentioned that she also had a number of friends who also had the deficiency. While they were talking about that problem, she knew that they don't have enough knowledge about vitamin D. She noted that what happened to her and her friends was also happening to young Saudi women living in Canada. However, she assumed they might identify vitamin D food sources, and the benefits of sun exposure.

*“...I would say that they do not know a lot of things especially women out of the allied medical majors. They are probably not familiar with a lot of things in regards to health issues such as vitamin D deficiency... [but]...they should be familiar of vitamin D source like sun exposure...” Nurse #1*

#### 4.4.2.2 New Knowledge about The Importance of Vitamin D

Health professionals indicate that new knowledge has developed in recent years about the importance of vitamin D, such as its etiological role in various human cancers such as breast cancer, colon cancer, other physiological functions in depressive disorders, and how vitamin D influences immune system functions. They indicated that this information is new, and they did not expect young Saudi women to know it.

One practitioner physician #1's experience was quite specific to his field, because he was working as a medical oncology doctor, treating cancer patients using chemotherapy and hormonal therapy. He mentioned that the numerous discoveries that vitamin D is related to lots aspects of health beyond musculoskeletal health is very new. He concluded that a low level of vitamin D creates a higher risk of breast cancer. Vitamin D may play a role in controlling normal breast cell growth and may be able to stop breast

cancer cells from growing, according to the interview with this practitioner. He stated that most of that information regarding new studies about vitamin D are quite new, so he did not expect young Saudi women living in Canada to know.

*“I think during my practice ... we emphasized the importance of vitamin D...for the bone health... for women [following] menopause and especially when they are taking the hormonal pills for breast cancer, which work as an anti-estrogen, so we encourage them to take at least the basic requirement for vitamin D and calcium during their hormonal treating for breast cancers...as I worked in Saudi Arabia for 2 years” Physician #1*

*“... I haven't talked much about the need to increase the requirement for vitamin D as a result of some diseases or as a result of some psychological event cycle during pregnancy or during lactation since lots aspects of health related to vitamin D are quite new” Physician #1*

On the other hand, dietitian #2 specified that Saudi women should know that one of the new important symptoms of vitamin D deficiency is depression. She stated that the connection between vitamin D and depressive disorders is surprising information for most of the Saudi women living in Canada who are visiting her in the clinic.

*“One of the symptoms of vitamin D deficiency is depression and fatigue and on pain, they [Saudi women] usually got surprised when they know it's link to depression ... and they notice in incredible difference after the initiation of the treatment, of their usual...behavior and depression, yeah” Dietitian #2*

Dietitian #1 explained that not many Saudi women know about the functions of vitamin D on the immunological system since it might be new information even for some

professionals.

*“I think many of them [Saudi women in Canada] knows about its importance for calcium absorption and bone health but not that many knows about how it’s important also for other body functions like immunological and other health aspects of it... on cell immunity... some of them they think also it had zero in immunity”* Dietitian #1

#### 4.4.2.3 How to Ensure that Saudi Women Get Sufficient Vitamin D

Health professionals stated that getting vitamin D would be difficult for Saudi women living in Canada for several reasons, but there are some ways that might help them to have sufficient levels.

Both physicians offered similar strategies for getting sufficient vitamin D. First, promoting dietary sources of vitamin D, this would encourage Saudi women to drink milk every day, increasing their knowledge about food sources of vitamin D.

*“I would say the best way gain knowledge of vitamin D... food sources...”*

Physician #2

*“...So again, drinking milk, but as I told you, even if we drink milk every day, ...is not enough...so I think they should take vitamin D supplement...”* Physician #1

*“...You know if you have some guidelines about something; you would follow it easily... let say milk; ok; so If they have a guidelines about food sources of vitamin D, they would follow it, and that would help to increase vitamin D level*

... “Physician #1

Both the dietitians, and a pharmacist #1 noted that there are limited food sources for vitamin D however; there are appropriate ways for Saudi women to increase vitamin

D level such as fortified foods, and supplements.

*“...The best way for this problem, for improve vitamin D level, I believe... is knowing what foods are fortified... and vitamin D supplements...”* Dietitian #1

*“... Increasing knowledge and awareness of vitamin D, search for the correct and appropriate information about dairy products [that] they feel comfortable with and like ... [For example], vitamin D is in fatty fish, yah, so if they are allergic to fish or they have some kind of intolerance to milk, they need to know alternatives, such as soymilk... or just taking supplements”* Dietitian #1

*“...You need to increase the uptake of vitamin D; as I've told you, the food sources is very limited... maybe only fish ... but if you depend only on the dietary resources you might not get enough quantity... You have to take the supplement.... Vitamin D should be taken as a supplement...”* Pharmacist #1

Several practitioners stated that the best way for consuming sufficient vitamin D is by promoting vitamin D supplementation use and making it easy for Saudi women to take them every day. Also, physician #2 stated that as sun exposure is not the best way for Saudi women to get vitamin D due to their culture, so supplements would provide all that the women would need.

*“...I think if we can find a simple way...for example; by keeping supplements in front of them. Fore example, they can take it with their breakfast or when they are at work... find a way to remember to use it...”* Physician #2

*“ It hard to exposure with the hijabs, it is hard for all of us; even in Saudi Arabia; or in Canada it is hard... but I think supplementations, and food fortified would help them, would help all of us actually...exposure is challenging...”* Physician #2

*“The best way to promote vitamin D supplement is to begin to promote their use as early as during the high school years [in Saudi Arabia], so women will be aware of the symptoms of vitamin D deficiency, and they will be more careful to prevent their vitamin D level from reaching the point of deficiency” Nurse #1*

Both nurses thought promoting sun exposure is important in order to get vitamin D, but it is difficult at the same time for Saudi women.

*“...From religious and cultural perspectives, it is not easy to promote sunlight exposure unless if the Saudi women live in a big house with backyard or have somewhere they can sit and be exposed to the sun privately...” Nurse #2*

*“...if they can do outdoor activities with groups, friends, ... choose the correct time for exposure to the sun... All of that will help, so as I said that before exposure with hijabs is hard, but they should try as much as they can...” Dietitian #2*

Pharmacist #2 gave several suggestions for young Saudi women in order to get vitamin D.

*“...Online research for important information such as fortified food and sources of vitamin D...[and] asking their family physician for help; maybe also talk to dietitians if they have any concerns about the best ways to increase their vitamin D levels... check vitamin D level... also what is the best food sources of vitamin D are... and reading labels on food boxes to find out if the food is fortified” Pharmacist #2*

#### **4.5 Summary of Thematic Analysis of Interviews with Saudi Women and with Health Professionals**

Table 4.5: Summary of Thematic Analysis

<b>Saudi Women's themes</b>	<b>Health Professionals' themes</b>
1) Lack of awareness about vitamin D	1) Health professionals' assumptions about Saudi women's knowledge about vitamin D
2) Lack of sun exposure	2) New knowledge about the importance of vitamin D
3) Lack of motivation in using supplements	3) How to ensure that Saudi women get sufficient vitamin D

Table 4.5.1: comparing health professionals' assumptions with Saudi women's knowledge

<b>Health professionals' assumptions</b>	<b>Saudi women's knowledge</b>
<ul style="list-style-type: none"> <li>• Saudi women know the importance of vitamin D for a woman's body</li> </ul>	The women presented limited awareness of any benefits of vitamin D other than that it is necessary for bone health
<ul style="list-style-type: none"> <li>• Know the requirements for vitamin D</li> </ul>	×
<ul style="list-style-type: none"> <li>• Know the association between vitamin D levels and pregnancy and breastfeeding</li> </ul>	<ul style="list-style-type: none"> <li>• Taking supplements during pregnancy</li> <li>• Giving their children vitamin D supplements</li> </ul>
<ul style="list-style-type: none"> <li>• Women from the Middle East have dark colored skin, which decreases the absorption of the sun through the skin</li> </ul>	×

<ul style="list-style-type: none"> <li>• Know that vitamin D is found in limited food sources</li> </ul>	<ul style="list-style-type: none"> <li>• Not all of the women know that vitamin D can be obtained from foods</li> <li>• Some of them identified incorrect sources such as fruit and vegetables</li> <li>• Some indicated milk, eggs</li> <li>• A few believed seafood to be a good source of vitamin D, but, they were not certain if that information was correct or not</li> </ul>
<ul style="list-style-type: none"> <li>• Hijabs, decrease the amount of sun exposure</li> </ul>	<ul style="list-style-type: none"> <li>✓</li> </ul>



Table 4.5.2: comparing how to ensure that Saudi women get sufficient vitamin D theme with the lack of sun exposure, and the lack of motivation in using supplements themes

Health professionals	Saudi women	
<p><b>How to ensure that Saudi women get sufficient vitamin D theme</b></p>	<p>1. Vitamin D Supplements</p>	<p><b>Lack of motivation in using supplements theme</b></p> <p>Saudi women were not interested in using supplements for several reasons, including:</p> <ul style="list-style-type: none"> <li>• Difficulty taking them or poor acceptance</li> <li>• Lack of information</li> <li>• Conflicting beliefs and practices</li> </ul>
	<p>2. Food fortified with vitamin</p>	<ul style="list-style-type: none"> <li>○ Most of the Saudi women were not familiar with the phrase <i>food fortification</i></li> <li>○ No participants consumed any fortified food with vitamin D</li> </ul>
	<p>3. Sun exposure is challenging for Saudi women</p>	<p><b>Lack of sun exposure theme</b></p> <p>Receiving sun exposure was difficult for Saudi women due to the following:</p> <ul style="list-style-type: none"> <li>• Wearing a full hijab</li> <li>• Limited outdoor activities</li> <li>• Inconvenient weather</li> <li>• Concern about skin cancer</li> </ul>

## **Chapter 5**

### **Discussions**

In this chapter, the study's findings will be discussed and compared with other literature findings. Some of those findings confirmed those of the existing literature, while others contradict them.

#### **5.1 KAP of Saudi Women Living in Canada Regarding Vitamin D**

##### **5.1.1 Lack of Awareness of Vitamin D**

The assessment of the knowledge of Saudi women living in Canada has shown a lack of awareness concerning vitamin D and its benefits. Our findings are similar to those of several studies that explored different populations' knowledge of vitamin D (e.g. Bonevski et al., 2013; Christie & Mason, 2011; Habib, Al-Motairi, & Al-Mutairi, 2014; Vu et al., 2010; Kung & Lee, 2006). All of these studies found that their participants had limited basic knowledge and staggeringly low rates of awareness of the importance of vitamin D.

Christie and Mason (2011) conducted a qualitative study of female Saudi students living in Saudi Arabia and found that participants presented limited awareness about vitamin D and vitamin D deficiency. For example, when their subjects were asked what they knew about vitamin D, some of them responded that it comes from the sun and is necessary for bone health. However, none were aware of vitamin D's other roles in health effects (Christie & Mason, 2011). These results are similar to our findings. Our participants' knowledge about vitamin D sources was limited to the fact that it comes from the sun and can be found in natural sources, with milk being the most mentioned

source. In our study, one participant had been diagnosed with vitamin D deficiency, and she knew about the sources of vitamin D, fortification of food in Canada and in Saudi Arabia, and vitamin D's role in disease prevention. Similarly, Christie and Mason (2011) found that only those who had been diagnosed with vitamin D deficiency possessed more information about vitamin D.

Our findings are similar to those of Habib et al. (2014), who assessed the knowledge of and practices regarding vitamin D of 310 Saudi females. The authors established that the participants lacked knowledge about preventing vitamin D deficiency, and a large majority (85.8%) of the participants either had inaccurate or incomplete information about vitamin D (Habib et al., 2014). Further, only 19% consumed vitamin D supplements, 46% did not have daily exposure to the sun, and of those who did have daily sun exposure, 16.6% were exposed to the sun for less than 10 minutes (Habib et al., 2014).

A study conducted in Australia by Bonevski et al. (2013) explored the knowledge and practices of some groups at a high risk of vitamin D deficiency. Fifty-two participants (23 males, 29 females) participated in several focus groups, and the outcomes of their study showed low levels of vitamin D information (Bonevski et al., 2013). Most of their subjects knew less about vitamin D and its benefits than the little they knew about other vitamins. Several declared that they were not certain about the sun exposure time necessary for sufficient vitamin D as well (Bonevski et al., 2013).

Our outcomes were similar to a study of KAP in university medical students in China conducted by Zhou et al. (2016). In this research, the authors found a clear lack of awareness regarding vitamin D. The participants were asked about their intake of foods

rich in vitamin D, supplement use, and sun exposure. The results showed that some students avoided sun exposure simply because they did not want to get tanned, and most students used sunscreen. The intake of foods rich in vitamin D was limited, and some of the students reported taking vitamin D supplements (Zhou et al., 2016).

Regarding the KAP of sun exposure, as it is the main source of vitamin D, our participants were lacking in knowledge regarding the amount of recommended sun exposure, the length of time for exposure, and the extent of the body to be exposed. When we asked our participants about the duration of their exposure, their responses varied; the most significant factor governing the duration of exposure was the need to finish tasks outside.

Our results were similar to those of Vu et al. (2010), who found some confusion about sun exposure and vitamin D among urban office workers in Brisbane, Australia. They found that their participants had limited knowledge concerning vitamin D, with 18% of subjects being ill-informed about vitamin D's benefits for bone health and 40% stating benefits that have not been verified (Vu et al., 2010). About 50% of subjects specified that in summer more than 10 minutes of sun exposure were needed to reach adequate vitamin D levels; however, about 28% specified that in winter more than 20 minutes of sun exposure were needed (Vu et al., 2010).

In another study in China, Kung and Lee (2006) conducted a telephone survey of 50 women, and the results were that the participants showed lack of knowledge and confusion about the role of vitamin D and vitamin D sources. Approximately 30% of participants had not heard of vitamin D; of those who know vitamin D, only 32% could identify a function of vitamin D properly, and only about 38% could identify at least one

source of vitamin D. The participants' attitudes about sunlight were very poor, as most participants avoided sun exposure so that their skin would not tan (Kung & Lee, 2006). Moreover, our results showed that participants indicated a low level of familiarity regarding fortification of foods with vitamin D. Participants specified that fortification is not common in Saudi Arabia, so they did not know which foods were fortified with vitamin D in Canada. Vitamin D-fortified foods in Saudi Arabia include products such as milk, buttermilk, and yogurt. However, a study done in Saudi Arabia found that most of the frequently fortified foods that are assumed to be vitamin D-fortified actually contained no vitamin D or vitamin D in quantities less than what is recommended by guidelines set for the U.S. marketplace (Sadat-Ali et al., 2013).

Our findings regarding our participants' lack of knowledge about food fortified with vitamin D were similar to those of Christie and Mason's (2011) study in Saudi Arabia, where none of their participants had heard of fortification. More research needs to be done to increase public awareness about the importance of consuming foods fortified with vitamin D and the availability of such foods in the Canadian and Saudi marketplaces. The awareness and consumption of foods fortified with vitamin D might be encouraged through social media.

While previous findings have suggested that vitamin D production is affected by latitude, season, time of day, cloud cover, glass shielding, melanin content of the skin, use of sun blockers, and age (Garland et al., 2006; Holick, 2001, 2009), our participants indicated no knowledge of any of these factors. These results were similar to those of other studies in which researchers found that subjects lacked sufficient knowledge of factors that affect vitamin D production (Bonevski et al., 2013; Christie & Mason, 2011).

The lack of information about vitamin D was confirmed in the participants' use of sun protection products, which prevent UVB rays from being absorbed by the body (Holick, 2008). Our participants were worried about the risk of skin cancer. They realized that while sun exposure is beneficial to the human body, sun exposure can cause skin cancer as well (Holick, 2005, 2008).

Our results differed from the findings of Al-Mutairi and Nair (2012), who studied the knowledge of and attitude toward vitamin D and sun protection in the population in Kuwait. Their data established that about 80% of the participants knew that sun exposure is essential for providing vitamin D (Al-Mutairi & Nair, 2012). Also, subjects in that study were well informed about both the beneficial and harmful effects of sun exposure (Al-Mutairi & Nair, 2012). Kuwait is a small country and has a hot summer with temperature sometimes reaches 50°C. The cause for vitamin D deficiency in that study may be due to the high temperatures which is sometimes reaches 50°C, limited outdoor activities, and clothing that covers most of the body (Al-Mutairi & Nair, 2012). However Participants in this study have adequate knowledge, and are well aware about the useful as well as the harmful effects of sun exposure, the levels of vitamin D were found to be deficient in both sunscreen users and non-users (Al-Mutairi & Nair, 2012).

Our results also differed from those of Brand (2008), who found high levels of awareness about vitamin D and sun exposure in Australian women (Brand, 2008). Brand's (2008) results could be explained by the fact that the study was carried out as a response to a health promotion drive.

Our results also showed that participants lacked knowledge about any functions of vitamin D beyond its role in bone health, such as its role in disease prevention. This

finding paralleled those of other studies, such as Christie and Mason's (2011) investigation of female Saudi students.

A considerable body of literature has highlighted the significance of vitamin D for public health (Fuleihan, 2009; Holick, 2009; Mithal et al., 2009) and elucidated the role of vitamin D in the prevention of numerous diseases, like poor immunity (White & White, 2008), cancer (Hypponen, Laara, Reunanen, Jarvelin, & Virtanen, 2001), and cardiovascular disease (Giovannucci et al., 2008). However, our participants indicated a complete lack of awareness of this information. This finding might be attributable to the fact that the scientific community's understanding of the significance of vitamin D is still evolving, and people outside of the health profession may not know about it.

The health professionals who participated in this study were asked what they expected Saudi women living in Canada to know about vitamin D. They indicated that they did not expect anyone other than healthcare providers or those in health majors to know about new research regarding vitamin D, even though it is very important to public health, especially for women, who are considered at high risk for vitamin D deficiency. More education regarding the importance of vitamin D to public health and nutrition has to reach Saudi women living in Canada who are not health professionals or in health majors.

Given the findings discussed in the literature review, our conclusion that there was a limited awareness of vitamin D in Saudi women living in Canada was not unexpected. However, health professionals who participated in this study assumed Saudi women had significant awareness and knowledge and this finding is not consistent with other results, revealing a need for increased vitamin D knowledge and awareness for

everyone.

### 5.2.2 Limited Sun Exposure

Our results showed that getting sufficient exposure to sunlight is difficult for Saudi women living in Saskatoon, Canada. There were several barriers—for instance, wearing the hijab, the climate, and their busy lifestyle. Our findings were similar to other studies' findings (Al-Mogbel, 2012; Christie & Mason, 2011; Kung & Lee, 2006; Vu et al., 2010).

The primary barrier to sun exposure in our participants was their style of clothing. Most Saudi women living in Canada wear the “hijab” dictated by Islamic practice; the hijab covers most of the body, thus limiting sun exposure (Al-Mogbel, 2012; Holick, 2009, 2001; Garland et al., 2006). This style has variations that depend on women's preferences. Some women wear a long hijab that covers everything except the hands, while others wear a hijab that covers the full body but not the hands and face. Most Muslim women commonly wear a style of clothes that covers most of the body. This style of clothes can limit the opportunities women have to gain sun exposure (Al-Ghamdi, Lanham-New, & Kahn, 2012; Al-Mogbel, 2012). Our results were not surprising because wearing a hijab has been cited by other studies as a major barrier to sun exposure for Saudi women and other Muslim women. For example, the 2011 study by Christie and Mason found that, due to cultural reasons dictating the wearing of the hijab in Jeddah, Saudi Arabia, their subjects had limited sun exposure.

Another barrier preventing Saudi women living in Canada from gaining sun exposure was the climate. Al Faraj and Al Mutairi's (2003) work is among the many studies in the Middle East literature that have also found climate to be a major barrier to



sun exposure. In their study of the KAP of Saudi female students, Christie and Mason (2011) found that women perceived the hot climate in Saudi Arabia as a barrier to gaining exposure to the sun. The participants in our study indicated that the inconvenient cold winters and hot summers in Saskatoon, Canada were barriers to sun exposure. The winter in Canada can last from late October to March, and there are not sufficient UVB rays for the skin to make vitamin D because of the latitudinal location (Holick, 2007; Rucker, Allan, Fick, & Hanley, 2002). Together, the hijab and the climate have been cited by several studies as barriers connected to the lack of sun exposure and consequently to vitamin D deficiency (Al-Ghamdi et al., 2012; Al-Mogbel, 2012).

Despite wearing the hijab all the time in public places, many of our participants expressed that they do not expose themselves to the sun simply because they do not like it. This could be explained by the fact that women in Saudi Arabia get used to an indoor lifestyle. In Saudi Arabia, where the temperatures range between 45 °C to above 50 °C in the summer months, the hot climate does not allow people to stay outside on many sunny days (Sedrani, Elidrissy, & El Arabi, 2002). Consequently, women in Saudi Arabia rarely get the opportunity for sun exposure before they come to Canada. After they came to Canada, they still refrain from exposing themselves to the sun, because they simply are not accustomed to it. Moreover, since they wear the hijab, which in summer is very hot because it involves many layers of fabric, they avoid being in the sun. Air conditioners are to be found everywhere in Saudi Arabia—in cars, houses, and malls—and so people are accustomed to staying in the cool, comfortable air (Sedrani et al., 2002). Several of our participants did spend time in the sun to relax, but all were concerned about feeling too hot under the sun, which they indicated they did not like. They cared more about

being comfortable and not sweating.

The extremely busy lifestyle of the participants is a factor in their sun exposure, as they are working or studying. These findings are similar to those of Bonevski et al. (2013) in their study in Australia, where the weather and work denied opportunities for their subjects to go outside and get sun exposure for sufficient vitamin D (Bonevski et al., 2013).

Incidental exposure during the day while walking to the bus or shopping was the most common type of sun exposure reported by our participants. This type of sun exposure may not be sufficient for getting vitamin D, because the recommendation is to spend at least 10 minutes outside. This time is based on estimates of the sunlight and clear sky, factors that may not link to typical outdoor activities (Diffey, 2010).

Studies have been carried out to establish how much vitamin D the skin can produce in the summer, fall, spring and winter, at what times of the day, and how much of the body should be exposed. Alamri et al. (2015), carried out a study to define the best time for sun exposure in north, south, west and east areas of Saudi Arabia. The outcomes showed that the geographic location and the time of the day have a main impact in vitamin D production. The optimal sun exposure for vitamin D<sub>3</sub> in Saudi Arabia during the summer in the north, south, and west is between 8:30 AM to 10:30 AM, and also 2:00 PM to 4:00 PM. In Dammam, it is from 8:30 AM to 10:00 AM, and also 1:00 PM to 2:30 PM (Alamri et al., 2015). More available guidelines about the ideal sun exposure times for different parts of the world would be helpful in preventing vitamin D deficiency.

In other studies' findings, there was a connection between the amount of sun exposure and the level of education (Fuleihan, 2009). However, it was likely that all of

our participants had a high level of education, particularly since most of them were students. Despite this presumed high level of education, they had limited sun exposure. More research is needed with a broader sample would help to clarify this connection.

One of our inclusion criteria was that participants must be not being studying health or have a close family member who was a health professional. The aim behind that was to explore the KAP of Saudi women outside of the health-related disciplines to establish their level of knowledge about vitamin D. However, it is possible that Saudi women living in Canada who participated in this study had a level of awareness and knowledge regarding vitamin D and vitamin D deficiency that was better than that of other groups, even if this inclusion criterion was met.

Socioeconomic status has been connected to vitamin D deficiency in the Middle East (Siddiqui, 2007; Fuleihan, 2009); these studies found that vitamin D deficiency was found in women in Saudi Arabia who lived in small houses where sunlight did not enter. Our results are different than these studies. Most of our participants live in Saskatoon, Canada, in large houses with private backyards, areas where they can gain exposure to the sun without the hijab. However, some of them stated that they do not get sun exposure even in their own backyards. They simply do not like the sun or the feeling of being hot under the sun, and they do not have time to pay attention to sun exposure.

Therefore, our results did not show any link between socioeconomic status and vitamin D deficiency involving sun exposure.

Cosmetic reasons have been cited as a barrier to sun exposure in other studies (Kung & Lee, 2006; Zhou et al., 2016; Siddiqui, 2007). In China, researchers explored participants' KAP about vitamin D and showed that some participants avoided sun

exposure simply because they did not want to get tan and that most students used sunscreen to avoid sun exposure and to protect against harmful rays (Zhou et al., 2016). This was not viewed as a barrier among our participants. Our results are similar to Christie and Mason's (2011) results that cosmetic reasons may not be important to women living in Saudi Arabia. The explanation also might be that most Saudi women are already covered with layers of clothes, so the only parts that would be exposed to the sun would be their hands and faces. None of our Saudi participants mentioned that they purposely avoided sun exposure for fear of getting darker skin or for any other cosmetic reason. Additionally, none of the participants said they spent time in the sun for tanning purposes.

### 5.2.3 Lack of Motivation for Using Supplements

Our results showed that the motivation for vitamin D supplementation among Saudi women living in Canada needs to be increased. In fact, consuming vitamin D supplements is uncommon among Saudi women in Saudi Arabia (Tuffaha et al., 2015). Consequently, our participants in Canada lacked motivation for using vitamin D supplements, even though they recognized the importance of vitamin D for their health. Few of our participants used vitamin D supplements regularly; most did not, stating it was hard to incorporate supplements into their daily routines. A study done in Saudi Arabia using the Saudi Health Interview Survey (CHIS), a cross-sectional, national, multistage survey of individuals aged 15 years and above, found that of the 10,735 subjects who completed a health questionnaire, 62.65% of female Saudis are deficient in vitamin D, and less than 2% consume vitamin D supplements (Tuffaha et al., 2015). This result parallels ours for Saudi women living in Canada, who had a poor attitude toward

vitamin D supplements. People in Saudi Arabia typically do not use supplements, unless they are prescribed by physicians in some of the public hospitals (Al-Faris, 2016; Tuffaha et al., 2015). Our participants stated that if there was no health concern, consuming vitamin D supplements was not important. These findings support those of the literature.

Our finding that participants were not comfortable using vitamin D supplements without consulting a healthcare professional is similar to the findings of other researchers who investigated KAP regarding the use of vitamin D supplements (e.g., Christie & Mason, 2011). In these studies, subjects preferred to ask healthcare professionals before consuming any supplements, and some subjects worried about health effects if the supplements were not recommended by healthcare professionals.

These results indicate the importance of the role of healthcare professionals, as our participants assigned a high level of trust to them. Participants were not comfortable taking supplements without consulting their physicians or other healthcare professionals. Healthcare professionals function as gatekeepers of knowledge, and our participants reported that they often sought guidance and information about vitamin D supplements from healthcare professionals. This finding was expected as other studies have cited similar results. A survey conducted in 2008 revealed that 40% of participants obtained knowledge about supplements and nutrition from family physicians or other healthcare professionals (Tracking Nutrition Trends VII: August 2008, 2008). However, according to Khalsa (2009), some healthcare professionals are not totally aware of vitamin D's importance to public health. Brand et al.'s (2008) study showed the importance of increasing awareness among healthcare professionals. Further evidence has reinforced the need for educating healthcare professionals so that they can efficiently transfer this

information to the public (Brand et al., 2008).

Saudi women living in Canada stated that their knowledge regarding vitamin D came from different sources, but the two main sources were the Internet, particularly social media such as Facebook and Instagram, and the secondary sources were health professionals. However, social or mass media has been informally used to date, and health news has been accused of misrepresenting the vitamin D issue (Kemp, Eagle, & Verne, 2011). Therefore, healthcare professionals should be the primary sources of information. Physicians, in particular, commonly need to manage the interaction risks and benefits of treatments (Politi, Han, & Col, 2007). Also, evidence supports the significance of physician-negotiated knowledge translation, because people gave a high rate of purpose to use vitamin D when they were informed of the benefits by physicians (Engles et al., 2001). However, our results in this study indicate that the participants' family physicians were not telling the patients about their vitamin D status. Other research suggests that this may be due to the low levels of knowledge of vitamin D among doctors (Bonevski et al., 2013).

Comparing our participants' sources of information on vitamin D with those of the subjects in other KAP studies, we can conclude that the subjects' primary sources of information were media and health professionals. Clearly, further work on educating both the social media and health professionals about vitamin D is needed, as the present knowledge in the health professions may be less than ideal (Brand et al., 2008; Khalsa, 2009; Zipitis, Elazabi, & Samanta, 2011).

We had recruited 10 healthcare professionals from different health and nutrition fields who had experience in both Canada and Saudi Arabia to gain an additional

understanding of Saudi women's KAP regarding vitamin D. It was expected that the health professionals would be informed beforehand about the evidence that the current recommended daily allowance (RDA) for vitamin D intake for these women is too low. In 2010, the Institute of Medicine announced a report revising the DRIs for vitamin D. The recommended intake of vitamin D increased for all DRI ages and sex groups (Ross et al., 2011). It would be helpful if clarity could be attained on what the specific RDA should be; more research in this area is needed (Holick, 2006, 2007, 2009; Fuleihan, 2009). However, there may be a need to inform healthcare professionals as well of these new findings.

One study done by Brand (2008) found that the cost of vitamin supplements was a barrier to participants' use. Although none of the Saudi women living in Canada in our study expressed concerns about cost, it is quite possible that this was due to their high socioeconomic status. This finding was similar to that of Christie and Mason (2011), who stated the cost of supplements did not appear to be a barrier for Saudi females to take supplements of vitamin D in Saudi Arabia. However, the cost of vitamin D supplements has been stated to be a barrier for other groups living in Canada with low incomes (Whiting et al., 2010). More research is needed to investigate whether the cost of vitamin D supplements is a barrier for other Saudi women groups, as this study had a limitation in its small sample size.

One concern mentioned by our participants was the presence of pork-derived gelatin in vitamin D supplements. While the labels of some products indicate they contain gelatin, they do not necessarily identify the gelatin's source. This is an issue because Muslims do not consume anything containing pork, and our participants were all

Muslims. Regarding the literature review, this was not mentioned as a barrier to Muslims' use of vitamin D supplements. No study specifically mentioned the importance of specifying the sources of the gelatin. More research on the availability of pork gelatin-free supplements is needed for the benefit of both Muslims and non-Muslims. It would be advantageous if the labels could be standardized to provide information on the gelatin source in order to facilitate consumer choices.

Our results also showed that almost all of our participants who were mothers were knowledgeable about supplementing their children's diets with vitamin D drops, and they stated that they started taking supplements during their pregnancy in Canada. However, some of them forgot sometimes, especially after pregnancy. Our findings were different from what Christie and Manson (2011) discussed in their KAP study about the poor knowledge of mothers who participated in their study regarding the significance of consuming vitamin D during pregnancy, especially with the limited sun exposure for Saudi females in their study.

Our finding that Saudi women living in Canada have a positive attitude toward taking vitamin D supplements during pregnancy and giving vitamin D drops to children was different from what was stated in another study that concluded Muslim mothers and infants, both in Ireland and Saudi Arabia, were practicing limited vitamin D supplementation (Kearney et al., 2015).

Our result might be attributable to the health education that the Saudi women living in Canada received during their pregnancies in Canada, as our participants stated that, during routine appointments, their doctors told them to take vitamin D supplements. That health education can also come, for example, from nurses during a baby's



immunization appointments. This finding has been stated in a study that explored knowledge, practices, and beliefs about vitamin D supplementation among immigrants and Canadians. The findings suggested that current public health education on vitamin D supplementation in Canada, whether delivered by any health educators, is effective for Canadian and non-Canadian-born parents (Moffat et al., 2014). Our results are in agreement with these findings. Saudi women had good knowledge about vitamin D supplementation for babies. This might indicate that improving knowledge is one of the successful approaches to improving practice.

### **5.3 Study Strengths**

This qualitative study is one of the first exploratory studies studying the knowledge, attitude, and practice (KAP) of groups at high risk for vitamin D deficiency among Saudi women living in Canada. Some strengths of the study are as follows:

#### **5.3.1 Participation of Research Supervisor During Themes Identification**

The research supervisor participated during the process of theme identification, reducing potential investigator bias in interpreting the findings.

#### **5.3.2 Interviewing, Transcribing, and Translating done by the Researcher**

One of the strengths of this study is that the researcher, like the participants, is a Saudi woman living in Canada. Any differences between the researcher and participants might affect the level of trust between participants and the researcher (Green, & Thorogood, 2013). However, the Saudi women living in Canada who participated in this study were comfortable and able to share and talk freely about their experiences during the interviews. While some studies on qualitative research have established that

differences can increase levels of trust and rapport between the researcher and participants (Green, & Thorogood, 2013), in this study, the similarities between the researcher and participants did not appear to negatively affect the level of trust and sharing. Thus, the study findings appear unaffected as well.

### 5.3.3 Inclusion of Groups at Higher Risk for Vitamin D Deficiency

All eight participants were originally from Saudi Arabia and now live in Saskatoon, Canada.

### 5.3.4 Participation of Health Professionals from Diverse Disciplines

The diverse disciplines of the 10 health professionals participating in this study were also one of its major strengths. All 10 professionals, at the time of the study, had three to seven years of experience and had experience both in Saudi Arabia and Canada.

## **5.4 Study Limitations**

This study was not without specific limitations. The key potential limitations are as follows:

### 5.4.1 Generalizability

Due to the qualitative design, the results cannot be broadly generalized to other groups encompassing different cultures, lifestyles, or environmental difficulties. The sample consisted of only eight Saudi women living in Saskatoon, Canada. This group might not be representative of the entire population of Saudi women living in Canada. Thus, the results could have been more broadly generalized if participants had consisted of Saudi women from all over Canada with varying lifestyles and who face different environmental difficulties and weather. Additional limitations in this study related to qualitative research include potential researcher bias and time limitations (Richards &

Morse, 2007).

#### 5.4.2 Use of Interviews as Sole Research Method

During this study, interviews were the sole research method. One-on-one interviews were used with the group of Saudi women living in Canada, and telephone interviews were used with the health professionals. Using multiple research methods might have increased reliability. For example, adding focus groups following the one-to-one interviews with Saudi women would have increased the reliability of the results by adding a deeper level of thoughts, ideas, and valuable data to the study.

A focus group was not ideal given the research design and other factors. First, the main focus of this research was to explore knowledge, attitudes, and practices. Second, one participant had previously been diagnosed with vitamin D deficiency and was well informed about the condition. Thus, the participant's input during a focus group would have affected the results. While, on the one hand, researchers look for stability by having sufficient differences between participants, on the other, those differences cannot be so great that participants defer to those who they perceive as more experienced or better educated. Ultimately, the mix of participants in this study would not have been conducive to open sharing as some participants may have had limited knowledge and felt uncomfortable sharing when a more knowledgeable participant was talking.

#### 5.4.3 Researcher's similarity to participants

All interviews were conducted by the researcher, a Saudi woman, and the researcher's similarities and connections to participants may have influenced the discussions and participants' ability to talk freely during data collection. However, for this research, the questions were focused on vitamin D deficiency and related topics,

which are not intimate subjects. Thus, participants were seemingly open in their answers.

#### 5.4.4 Limitations of Phone Interviews

Relying solely on telephone interviews with health professionals might have affected their comfort level to freely talk about and share their own experiences as health care providers. However, due to limitations on travel and access, telephone interviews were the only logistically viable and convenient interview option for this hard-to-reach population.

### **5.5 Data Trustworthiness**

Richards and Morse (2007) state that validity and reliability are terms that are regularly linked with quantitative studies rather than with qualitative studies (2007). Specifically, validity refers to how well the results reflect what was supposed to be studied, while reliability is the degree to which the same outcomes would be discovered during a repeat of the study. Validity and reliability are often quite difficult to establish in a qualitative study because the data collected must be clarified, interpreted, and understood, which makes accurate duplication of the study difficult.

During this study, one-to-one interviews were performed with a group of Saudi women living in Canada. These interviews were followed by telephone interviews with a varied group of health professionals who were included as key informants. Though 9 of the health professionals were women and only one was male, both the Saudi women and health professionals enhanced the quality and strength of the data that was received.

This research used only one method, interviewing, and if multiple research methods had been used, the reliability of the study would have been enhanced. The use of two methods, such as focus groups following the one-to-one interviews with the Saudi

women, might have helped to increase reliability by adding additional thoughts, ideas, and valuable data to the study. Commonly, in designing a focus group, researchers must look for balance as far as sufficient differentiation between participants is concerned. However, the group of participants should not be too differentiated, because participants may defer to others who have more experience and are better educated. For instance, during a thorough analysis of the interviews, it was found that one participant had been diagnosed with vitamin D deficiency and had done some research, so she was well informed about this issue. A strongly differentiated mix of participants would not work well in this situation because the one participant who has experience with vitamin D deficiency might affect other participants. Other participants might feel that they do not want to share their limited knowledge when the more knowledgeable participant is talking.

Following the interviews, the research supervisor reviewed the first draft of the transcripts, which contains only the answers from each participant for each question, to ensure that the interpretations of the transcripts were accurate. Then, the research supervisor was involved in the development of themes. Furthermore, the health professionals were emailed a copy of their transcripts after their interviews. They reviewed the transcript release forms and had the opportunity to review, add, alter, or delete information from their transcripts as appropriate. They were asked to identify whether the transcript correctly reflected the interview that took place. All health professionals specified that the transcripts were correct.

All the details of this research process, such as consent forms, data collection, and data analysis, were documented and kept in a secure location. Moreover, to guarantee

credibility, participants were asked for more explanation during the interview process to clarify that their replies were totally understandable. Notes were taken during the interview to increase the credibility of the research (Lincoln & Guba, 1985). Transcripts were checked to avoid mistakes for dependability (Polit & Beck, 2012). Interviews and informal discussions were used to provide a more thorough understanding of the discussion, which was done to offer conformability (Thorne, 2008; Polit & Beck, 2012).

### **5.6 Recommendations**

Based on the study's findings, the following recommendations are suggested.

1) For Saudi Muslim women, generally there are very few opportunities to uncover their faces or their bodies and to expose themselves to outdoor sunlight. These women need more areas where they can uncover freely such as private gym as part of the recommended strategy of preventing vitamin D deficiency. Supplements and fortified foods are also recommended for preventing vitamin D deficiency.

2) The study found that Saudi women have limited knowledge about vitamin D, but many are eager to follow guidelines about how to prevent vitamin D deficiency. Websites that allow social interaction, such as social networking sites Facebook and Twitter and the video site YouTube, as well as web based learning, can teach Saudi women about the importance of vitamin D.

3) The study found that the outdoor activities of young Saudi women living in Canada were also limited, which decreased their opportunities for sun exposure. Promoting vitamin D intake can be done through the Saudi Cultural Bureau (SCB) because the potential and needs of Saudi women living in Canada differ regarding social and cultural procedures. Saudi women can benefit from SCB in Ottawa, a non-profit

organization that was established informally to help Saudi students, and families adapt to their new environment. It was recommended through this organization that the following steps be taken: increase the awareness about vitamin D deficiency of Saudi women living in Canada by organizing some workshops, social events, and weekly meetings. Provide some private areas for Saudi women for exposure to the sun and organize and support some outdoor activities privately for women to increase sun exposure. Encourage Saudi health professionals living in Canada to support Saudi women to make healthier choices and promote dietary sources of vitamin D by providing information about food fortification and food rich in vitamin D; distribute this information through emails and handouts to Saudi women living in Canada. Support and distribution can be facilitated through one of the Saudi dietitians or nutritionists with some health promotion providers.

### **5.7 Future Work**

Future work may involve expanding the study to assess KAP regarding vitamin D deficiency through a mixed-methods study, which combines the two methods, a qualitative method for getting in-depth answers, and a quantitative part, which would provide the statistical data that will help in understanding the subject matter more broadly. Saudi women participants from all over Canada should be recruited to generalize the results, and that can be done through a survey, using, for example, an email survey to reach representative participants.

Future work would also involve comparing KAP in Saudi women living in different parts of the world, such as Canada, Saudi Arabia, and Australia to investigate whether the KAP regarding vitamin D and vitamin D deficiency is the same as in Saudi Arabia or different; to understand the problem more deeply; and to provide nutrition

education and public health messages based on the results.

Future work would also involve creating web-based learning programs, webcasts, and learning modules to provide education and a basic understanding of vitamin D's importance for Saudi women.

Future work would also involve doing -observation methods -for several locations, which are different from each other in the geographical, environmental, and culture aspects, and observing Saudi women's KAP regarding vitamin D. As this might take time, several research assistants can be involved in doing that in several locations such as Canada, US, UK, and Saudi Arabia, as each of these locations are different from each other.

Building a collaborative interdisciplinary research team can benefit the research significantly. Future work can involve collaborative research such as a nutrition education team conducting workshops and posters presentations to increase awareness of the importance of vitamin D. Then, with a health practitioner partner determining vitamin D status through a blood test of 25-hydroxyvitamin D, other partners can form a health promotion practice, and with the support of some governmental organization, take action on the infrastructure of houses in Saudi Arabia so women can get enough sun exposure. Getting a civil engineer's help to develop new housing infrastructure would be a good place to start.

## **5.8 Conclusion**

Previous studies have identified several causes for the prevalence of vitamin D deficiency worldwide. In particular, some findings from other studies have investigated the Middle East's characteristics that even increased the prevalence of vitamin D



deficiency in some locations and describe it as worrying. Saudi Arabia—a hot and sunny country—has one of the highest rates of vitamin D deficiency, in women more so than men. Other studies have showed a lack of knowledge regarding vitamin D in Saudi women, a high-risk population, who seems to have certain features that make sun exposure challenging. In other parts of the world, northern countries like Canada are also one of the countries that have a high rate of vitamin D deficiency. Saudi women living in Canada are one of the high risk-populations that are facing different environmental, geographical, and cultural differences than Saudi Arabia.

This study explored the KAP of Saudi women living in Canada regarding vitamin D, and 10 health professionals acted as key informants. Using Exploratory Qualitative Descriptive Design, data were collected through one-on-one interviews with Saudi women, and using telephone interviews with the 10 healthcare professionals. Audiotapes were transcribed and analyzed using thematic analysis to identify emergent themes. The results of this study found a lack in Saudi women' knowledge, with a lack of sun exposure, and a lack of motivation in using supplements, which might be a barrier to the prevention of vitamin D deficiency. However, this work had some limitations, but it also provided descriptive information about Saudi women, providing an assessment of their knowledge, attitudes, and practices regarding vitamin D and the risks of vitamin D deficiency. It has been recommended that more research be conducted on this population to generalize the results. Moreover, based on the findings of this research, some recommendations have been provided to increase awareness around vitamin D for Saudi women living in Canada.

## References

- Abiaka, C., Delghandi, M., Kaur, M., & Al-Saleh, M. (2013). Vitamin D status and anthropometric indices of an Omani study population. *Sultan Qaboos University Medical Journal*, *13*(2), 224.
- Al Faraj, S., & Al Mutairi, K. (2003). Vitamin D deficiency and chronic low back pain in Saudi Arabia. *Spine*, *28*(2), 177-179.
- Al-Faris, N. A. (2016). High Prevalence of Vitamin D Deficiency among Pregnant Saudi Women. *Nutrients*, *8*(2), 77.
- Al-Ghamdi, M. A., Lanham-New, S. A., & Kahn, J. A. (2012). Differences in vitamin D status and calcium metabolism in Saudi Arabian boys and girls aged 6 to 18 years: effects of age, gender, extent of veiling and physical activity with concomitant implications for bone health. *Public health nutrition*, *15*(10), 1845-1853.
- Al-Mutairi, N., Issa, B. I., & Nair, V. (2012). Photoprotection and vitamin D status: a study on awareness, knowledge and attitude towards sun protection in general population from Kuwait, and its relation with vitamin D levels. *Indian Journal of Dermatology, Venereology, and Leprology*, *78*(3), 342.
- Al-Turki, H. A., Sadat-Ali, M., Al-Elq, A. H., Al-Mulhim, F. A., & Al-Ali, A. K. (2008). 25-Hydroxyvitamin D levels among healthy Saudi Arabian women. *Saudi Medical Journal*, *29*(12), 1765–1768.
- Al-Zoughool, M., AlShehri, A., Alqarni, A., Alarfaj, A., & Tamimi, W. (2015). Vitamin D Status of Patients Visiting Health Care Centers in the Coastal and Inland

- Cities of Saudi Arabia. *Journal of Public Health in Developing Countries*, 1(1), 14-21.
- Alamri, F., Alshahrani, F., Al-Saleh, Y., Saeedi, M. Y., Almalki, M. H., Al-Daghri, N., ... & Ibrahim, A. K. (2015). Optimum Sun Exposure Times for Vitamin D Status Correction in Saudi Arabia. *European Journal of Preventive Medicine*, 3(5), 147-154.
- AlBuhairan, F. S., Tamim, H., Al Dubayee, M., AlDhukair, S., Al Shehri, S., Tamimi, W., ... & Al Alwan, I. (2015). Time for an Adolescent Health Surveillance System in Saudi Arabia: Findings From "Jeeluna". *Journal of Adolescent Health*, 57(3), 263-269.
- Alfawaz, H., Tamim, H., Alharbi, S., Aljaser, S., & Tamimi, W. (2014). Vitamin D status among patients visiting a tertiary care center in Riyadh, Saudi Arabia: a retrospective review of 3475 cases. *BMC public health*, 14(1), 1.
- Almogbel, E. S. (2012). Vitamin D status among adult Saudi Females visiting primary health care clinics. *International journal of health sciences*, 6(2).
- Aloia, J. F., Patel, M., DiMaano, R., Li-Ng, M., Talwar, S. A., Mikhail, M., ... & Yeh, J. K. (2008). Vitamin D intake to attain a desired serum 25-hydroxyvitamin D concentration. *The American journal of clinical nutrition*, 87(6), 1952-1958.
- Alsuwaida, A. O., Farag, Y. M., Al Sayyari, A. A., Mousa, D. H., Alhejaili, F. F., Al-Harib, A. S., ... & Singh, A. K. (2013). Prevalence of vitamin D deficiency in Saudi adults. *Saudi medical journal*, 34(8), 814-818.
- Aucoin, M., Weaver, R., Thomas, R., & Jones, L. (2013). Vitamin D status of

- refugees arriving in Canada Findings from the Calgary Refugee Health Program. *Canadian Family Physician*, 59(4), e188-e194.
- Azhar, W. (2009). A Determination of Vitamin D Status and Intake of Pregnant and Non-Pregnant Saudi Arabian Women in Mecca, Saudi Arabia.
- Bandeira, F., Griz, L., Dreyer, P., Eufrazino, C., Bandeira, C., & Freese, E. (2006). Vitamin D deficiency: a global perspective. *Arquivos Brasileiros de Endocrinologia & Metabologia*, 50(4), 640-646.
- Batieha, A., Khader, Y., Jaddou, H., Hyassat, D., Batieha, Z., Khateeb, M. . . . Ajlouni, K. (2011). Vitamin D status in Jordan: Dress style and gender discrepancies. *Annals of Nutrition and Metabolism*, 58(1), 10–18.
- Bonevski, B., Bryant, J., Lambert, S., Brozek, I., & Rock, V. (2013). The ABC of Vitamin D: a qualitative study of the knowledge and attitudes regarding vitamin D deficiency amongst selected population groups. *Nutrients*, 5(3), 915-927.
- Bonevski, B., Girgis, A., Magin, P., Horton, G., Brozek, I., & Armstrong, B. (2012). Prescribing sunshine: A cross-sectional survey of 500 Australian general practitioners' practices and attitudes about vitamin D. *International Journal of Cancer*, 130(9), 2138-2145.
- Borra, S. T., & Earl, R. (2000). THE ART AND SCIENCE OF HEALTH PROMOTION: Using Focus Groups to Create Diet and Health Messages That Consumers Will Believe. *Nutrition Today*, 35(2), 47-52.
- Boyatzis, R. E. (1998). *Transforming qualitative information: Thematic analysis and*

- code development*. Thousand Oaks, CA, London,: Sage.
- Brand, C. A., Abi, H. Y., Couch, D. E., Vindigni, A., & Wark, J. D. (2008). Vitamin D deficiency: a study of community beliefs among dark skinned and veiled people. *International Journal of Rheumatic Diseases, 11*(1), 15-23.
- Brannon, P. M., Yetley, E. A., Bailey, R. L., & Picciano, M. F. (2008). Overview of the conference “Vitamin D and Health in the 21st Century: an Update”. *The American journal of clinical nutrition, 88*(2), 483S-490S.
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative research in psychology, 3*(2), 77-101.
- Burgaz, A., Akesson, A., Oster, A., Michaelsson, K., & Wolk, A. (2007). Associations of diet, supplement use, and ultraviolet B radiation exposure with vitamin D status in Swedish women during winter. *American Journal of Clinical Nutrition, 86*(5), 1399–1404.
- Calvo, M. S., Whiting, S. J., & Barton, C. N. (2004). Vitamin D fortification in the United States and Canada: current status and data needs. *The American journal of clinical nutrition, 80*(6), 1710S-1716S.
- Christie, F., & Mason, L. (2011). Knowledge, attitude and practice regarding vitamin D deficiency among female students in Saudi Arabia: A qualitative exploration. *International Journal of Rheumatic Diseases, 14*(22), 1–8. doi: 10.1111/j.1756-185X.2011.01624.
- Coyne, I. T. (1997). Sampling in qualitative research. Purposeful and theoretical

- sampling; merging or clear boundaries?. *Journal of advanced nursing*, 26(3), 623-630.
- Cranney, A., Horsley, T., O'Donnell, S., Weiler, H., Puil, L., Ooi, D. . . . Mamaladze, V. (2007). Effectiveness and safety of vitamin D in relation to bone health. *Evidence Report – Technology Assessment (Full Rep)* (158), 1–235.
- Creswell, J. W. (2007). *Qualitative inquiry and research design: Choosing among five approaches*
- DeLuca H. F. (2004). Overview of general physiologic features and functions of vitamin D. *American Journal of Clinical Nutrition*, 80, S1689–S1696.
- DeLuca, H. F. (2008). Evolution of our understanding of vitamin D. *Nutrition reviews*, 66(suppl 2), S73-S87.
- Denzin, N. K., & Lincoln, Y. S. (1994). *Handbook of qualitative research*. Thousand Oaks, CA: Sage.
- Diffey, B. L. (2010). Is casual exposure to summer sunlight effective at maintaining adequate vitamin D status?. *Photodermatology, photoimmunology & photomedicine*, 26(4), 172-176.
- Dror, D. K., & Allen, L. H. (2010). Vitamin D inadequacy in pregnancy: biology, outcomes, and interventions. *Nutrition Reviews*, 68(8), 465-477.
- Elsammak, M. Y., Al-Wossaibi, A. A., Al-Howeish, A., & Alsaeed, J. (2011). High prevalence of vitamin D deficiency in the sunny Eastern region of Saudi Arabia: A hospital-based study. *Eastern Mediterranean Health Journal*, 17(4), 317–322.

- Elshafie, D. E., Al-Khashan, H. I., & Mishriky, A. M. (2012). Comparison of vitamin D deficiency in Saudi married couples. *American Journal of Clinical Nutrition*, 66(6), 742–745. doi: 710.1038/ejcn.2012.1029. Epub 2012 Mar 1014.
- Forrest, K. Y., & Stuhldreher, W. L. (2011). Prevalence and correlates of vitamin D deficiency in US adults. *Nutrition research*, 31(1), 48-54.
- Fuleihan, G. E. H. (2009). Vitamin D deficiency in the Middle East and its health consequences for children and adults. *Clinical Reviews in Bone and Mineral Metabolism*, 7(1), 77-93.
- Garland, C. F., Garland, F. C., Gorham, E. D., Lipkin, M., Newmark, H., Mohr, S. B., & Holick, M. F. (2006). The role of vitamin D in cancer prevention. *American journal of public health*, 96(2), 252-261.
- Garland, C. F., Gorham, E. D., Mohr, S. B., & Garland, F. C. (2009). Vitamin D for cancer prevention: global perspective. *Annals of epidemiology*, 19(7), 468-483.
- Giovannucci, E., Liu, Y., Hollis, B. W., & Rimm, E. B. (2008). 25-hydroxyvitamin D and risk of myocardial infarction in men: a prospective study. *Archives of internal medicine*, 168(11), 1174-1180.
- Gorham, E. D., Garland, C. F., Garland, F. C., Grant, W. B., Mohr, S. B., Lipkin, M., ... & Holick, M. F. (2007). Optimal vitamin D status for colorectal cancer prevention: a quantitative meta analysis. *American journal of preventive medicine*, 32(3), 210-216.
- Goutille, F. (2009). *Knowledge, Attitudes and Practices for Risk Education: How to Implement KAP Surveys: Guideline for KAP Survey Manager*. Handicap

- international.
- Gozdzik, A., Barta, J. L., Wu, H., Wagner, D., Cole, D. E., Vieth, R., ... & Parra, E. J. (2008). Low wintertime vitamin D levels in a sample of healthy young adults of diverse ancestry living in the Toronto area: associations with vitamin D intake and skin pigmentation. *BMC Public Health*, *8*(1), 336.
- Green, J., & Thorogood, N. (2013). *Qualitative methods for health research*. Sage.
- Greene-Finestone, L., Little, J., Hidiroglou, N., & Whiting, S. (2010). *Vitamin D status of Canadians as measured in the 2007 to 2009 Canadian Health Measures Survey*. Ottawa: Statistics Canada.
- Grove, S. K., Burns, N., & Gray, J. (2012). *The practice of nursing research: Appraisal, synthesis, and generation of evidence*. Elsevier Health Sciences.
- Guest, G., Bunce, A., & Johnson, L. (2006). How many interviews are enough? An experiment with data saturation and variability. *Field methods*, *18*(1), 59-82.
- Guzel, R., Kozanoglu, E., Guler-Uysal, F., Soyupak, S., & Sarpel, T. (2001). Vitamin D status and bone mineral density of veiled and unveiled Turkish women. *Journal of Women's Health & Gender-based Medicine*, *10*(8), 765–770.
- Habib, F. M., Al-Motairi, W. A., & Al-Mutairi, W. M. (2014). Vitamin D Deficiency: Knowledge and Practice among Adult Saudi Females. *Global Advanced Research Journal of Medicine and Medical Sciences*, *3*(5), 095-101.
- Hancock, B., Ockleford, E., & Windridge, K. (1998). *An introduction to qualitative research*. Nottingham: Trent focus group.



- Hill, C. E., Knox, S., Thompson, B. J., Williams, E. N., Hess, S. A., & Ladany, N. (2005). Consensual qualitative research: An update. *Journal of counseling psychology, 52*(2), 196.
- Hoepfl, M. C. (1997). Choosing qualitative research: A primer for technology education researchers.
- Holick, M. F. (1995). Environmental factors that influence the cutaneous production of vitamin D. *American Journal of Clinical Nutrition, 61*(3), 638S–645S.
- Holick, M. F. (1996). Vitamin D and bone health. *Journal of Nutrition, 126*(4 Suppl), 1159S.
- Holick, M. F. (2003). Vitamin D: A millennium perspective. *Journal of Cellular Biochemistry, 88*(2), 296–307.
- Holick, M. F. (2004a). Sunlight and vitamin D for bone health and prevention of autoimmune diseases, cancers, and cardiovascular disease. *American Journal of Clinical Nutrition, 80*(6 Suppl), 1678S–1688S.
- Holick, M. F. (2004b). Vitamin D: importance in the prevention of cancers, type 1 diabetes, heart disease, and osteoporosis. *The American journal of clinical nutrition, 79*(3), 362-371.
- Holick, M. F. (2005). The vitamin D epidemic and its health consequences. *Journal of Nutrition, 135*, 2739S–2748S.
- Holick, M. F. (2006). High prevalence of vitamin D inadequacy and implications for health. In *Mayo Clinic Proceedings* (Vol. 81, No. 3, pp. 353-373). Elsevier.

Holick, M. F. (2007). Vitamin D deficiency. *New England Journal of Medicine*, 357(3), 266-281.

Holick, M. F. (2008). Vitamin D: a D-lightful health perspective. *Nutrition Review*, 66(10 Suppl 2), S182–194. doi: 110.1111/j.1753-4887.2008.00104.x.

Holick, M. F. (2009). Vitamin D status: measurement, interpretation, and clinical application. *Annals of epidemiology*, 19(2), 73-78.

Holick, M. F., & Chen, T. C. (2008). Vitamin D deficiency: A worldwide problem with health consequences. *American Journal of Clinical Nutrition*, 87(4), 1080S–1086S.

Holick, M. F., Chen, T. C., Lu, Z., & Sauter, E. (2007). Vitamin D and Skin Physiology: AD-Lightful Story. *Journal of Bone and Mineral Research*, 22(S2), V28-V33.

Holick, M. F., Siris, E. S., Binkley, N., Beard, M. K., Khan, A., Katzer, J. T., ... & de Papp, A. E. (2005). Prevalence of vitamin D inadequacy among postmenopausal North American women receiving osteoporosis therapy. *The Journal of Clinical Endocrinology & Metabolism*, 90(6), 3215-3224.

Houser, J. (2013). *Nursing research: Reading, using and creating evidence*. Jones & Bartlett Publishers.

Hyppönen, E., Läärä, E., Reunanen, A., Järvelin, M. R., & Virtanen, S. M. (2001). Intake of vitamin D and risk of type 1 diabetes: a birth-cohort study. *The Lancet*, 358(9292), 1500-1503.

- Institute of Medicine, Food, and Nutrition Board. (2010). *Dietary Reference Intakes for Calcium and Vitamin D*. Washington, DC: National Academy Press.
- Janda, M., Youl, P., Bolz, K., Niland, C., & Kimlin, M. (2010). Knowledge about health benefits of vitamin D in Queensland Australia. *Preventive medicine, 50*(4), 215-216.
- Jolliffe, D. A., Hanifa, Y., Witt, K. D., Venton, T. R., Rowe, M., Timms, P. M., ... & Martineau, A. R. (2016). Environmental and genetic determinants of vitamin D status among older adults in London, UK. *The Journal of steroid biochemistry and molecular biology*.
- Kaliyaperumal, K. (2004). Guideline for conducting a knowledge, attitude, and practice (KAP) study. *A ECS Illumination, 4*, 7–9.
- Kanan, R. M., Al Saleh, Y. M., Fakhoury, H. M., Adham, M., Aljaser, S., & Tamimi, W. (2013). Year-round vitamin D deficiency among Saudi female out-patients. *Public Health Nutrition, 16*(03), 544-548.
- Kearney, J. M., Khadrawi, I., Harastani, R., & Stack, M. (2015). Vitamin D Supplementation Practices in Pregnancy and during Infancy and other Behaviors related to Vitamin D Status among a Sample of Muslim Women in Ireland and Saudi Arabia. *J. Nutr, 2*, 11-26.
- Kemp, G. A., Eagle, L., & Verne, J. (2011). Mass media barriers to social marketing interventions: the example of sun protection in the UK. *Health promotion international, 26*(1), 37-45.
- Khalsa, K. (2009). *The Vitamin D revolution: How the power of this*

- amazing vitamin can change your life*. New York, NY: Hay House.
- Khuri-Bulos, N., Lang, R. D., Blevins, M., Kudyba, K., Lawrence, L., Davidson, M., ... & Halasa, N. B. (2014). Vitamin D deficiency among newborns in Amman, Jordan. *Global journal of health science*, 6(1), 162.
- Kimlin, M. G. (2008). Geographic location and vitamin D synthesis. *Molecular aspects of medicine*, 29(6), 453-461.
- Krueger, R. A., & Casey, M. A. (2009). *Focus groups: A practical guide for applied research* (4th ed.). Thousand Oaks, CA: Sage.
- Kung, A. W., & Lee, K. K. (2006). Knowledge of vitamin D and perceptions and attitudes toward sunlight among Chinese middle-aged and elderly women: a population survey in Hong Kong. *BMC Public Health*, 6(1), 1.
- Langlois, K., Green-Finestone, L., Little, J., Hidiroglou, N., & Whiting, S. (2010). Vitamin D status of Canadians as measured in the 2007 to 2009 Canadian Health Measures Survey. *Health Reports*, 21(1).
- Launiala, A. (2009). How much can a KAP survey tell us about people's knowledge, attitudes and practices? Some observations from medical anthropology research on malaria in pregnancy in Malawi. *Anthropology Matters*, 11(1).
- Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry* (Vol. 75). Sage.
- Lips, P. (2001). Vitamin D deficiency and secondary hyperparathyroidism in the elderly: Consequences for bone loss and fractures and therapeutic implications. *Endocrine Reviews*, 22(4), 477-501.

- Lips, P. (2006). Vitamin D physiology. *Progress in biophysics and molecular biology*, 92(1), 4-8.
- Lips, P., Hosking, D., Lippuner, K., Norquist, J. M., Wehren, L., Maalouf, G. . . . Chandler, J. (2006). The prevalence of vitamin D inadequacy amongst women with osteoporosis: An international epidemiological investigation. *Journal of Internal Medicine*, 260(3), 245–254.
- Lofland, J., & Lofland, L. H. (1984). Analyzing social settings: a guide to qualitative observational research. *Wadsworth, Belmont*.
- Mansour, M. M., & Alhadidi, K. M. (2012). Vitamin D deficiency in children living in Jeddah, Saudi Arabia. *Indian journal of endocrinology and metabolism*, 16(2), 263.
- Marshall, M. N. (1996). Sampling for qualitative research. *Family practice*, 13(6), 522-526.
- Masood, S. H., & Iqbal, M. P. (2008). Prevalence of vitamin D deficiency in South Asia. *angiogenesis*, 1(11), 12.
- Matsuoka, L. Y., IDE, L., WORTSMAN, J., MACLAUGHLIN, J. A., & HOLICK, M. F. (1987). Sunscreens Suppress Cutaneous Vitamin D<sub>3</sub> Synthesis\*. *The Journal of Clinical Endocrinology & Metabolism*, 64(6), 1165-1168.
- Matsuoka, L. Y., Wortsman, J. A. C. O. B., Dannenberg, M. J., Hollis, B. W., Lu, Z. H. I. R. E. N., & Holick, M. F. (1992). Clothing prevents ultraviolet-B radiation-dependent photosynthesis of vitamin D<sub>3</sub>. *The Journal of Clinical Endocrinology*

- & *Metabolism*, 75(4), 1099-1103.
- Mishal, A. A. (2001). Effects of different dress styles on vitamin D levels in healthy young Jordanian women. *Osteoporosis International*, 12(11), 931–935.
- Mithal, A., Wahl, D. A., Bonjour, J. P., Burckhardt, P., Dawson-Hughes, B., Eisman, J. A., ... & IOF Committee of Scientific Advisors (CSA) Nutrition Working Group. (2009). Global vitamin D status and determinants of hypovitaminosis D. *Osteoporosis International*, 20(11), 1807-1820.
- Moffat, T., Sellen, D., Wilson, W., Anderson, L., Chadwick, S., & Amarra, S. (2014). Comparison of Infant Vitamin D Supplement Use Among Canadian-Born, Immigrant, and Refugee Mothers. *Journal of Transcultural Nursing*, 1043659614531793.
- Morse, J., & Richards, L. (2002). Read me first for a user's guide to qualitative research. CA, US: Sage Publications Thousand Oaks.
- Mullin, G. E., & Dobs, A. (2007). Vitamin D and its role in cancer and immunity: a prescription for sunlight. *Nutrition in Clinical Practice*, 22(3), 305-322.
- Naeem, Z. (2010). Vitamin d deficiency-an ignored epidemic. *International journal of health sciences*, 4(1), V.
- Offredy, M., & Vickers, P. (2013). *Developing a healthcare research proposal: An interactive student guide*. John Wiley & Sons.
- Ojah, R. C., & Welch, J. M. (2012). Vitamin D and musculoskeletal status in Nova Scotian women who wear concealing clothing. *Nutrients*, 4(5), 399-412.

- Omdahl, J. L., Morris, H. A., & May, B. K. (2002). Hydroxylase enzymes of the vitamin D pathway: expression, function, and regulation. *Annual review of nutrition*, 22(1), 139-166.
- Opdenakker, R. (2006, September). Advantages and disadvantages of four interview techniques in qualitative research. In *Forum Qualitative Sozialforschung/Forum: Qualitative Social Research* (Vol. 7, No. 4).
- Otten, J. J., Hellwig, J. P., & Meyers, L. D. (Eds.). (2006). *Dietary reference intakes: the essential guide to nutrient requirements*. National Academies Press.
- Parlak, M., Kalay, S., Kalay, Z., Kirecci, A., Guney, O., & Koklu, E. (2015). Severe vitamin D deficiency among pregnant women and their newborns in Turkey. *The Journal of Maternal-Fetal & Neonatal Medicine*, 28(5), 548-551.
- Patton, M. Q. (1990). *Qualitative evaluation and research methods*. SAGE Publications, inc.
- Patton, M. Q. (1999). Enhancing the quality and credibility of qualitative analysis. *Health services research*, 34(5 Pt 2), 1189.
- Polit, D. F., & Beck, C. T. (2008). *Nursing research: Generating and assessing evidence for nursing practice*. Lippincott Williams & Wilkins.
- Politi, M. C., Han, P. K., & Col, N. F. (2007). Communicating the uncertainty of harms and benefits of medical interventions. *Medical Decision Making*, 27(5), 681-695.
- Polkinghorne, D. E. (1989). Phenomenological research methods. In *Existential-phenomenological perspectives in psychology* (pp. 41-60). Springer US.

- Prosser, D. E., & Jones, G. (2004). Enzymes involved in the activation and inactivation of vitamin D. *Trends in biochemical sciences*, 29(12), 664-673.
- Reichrath, J. (Ed.). (2008). *Sunlight, vitamin D and skin cancer*. Springer Science+ Business Media.
- Richards, L., & Morse, J. M. (2007). *User's Guide to Qualitative Methods* (2nd ed.). Thousand Oaks, CA: Sage Publications, Inc.
- Ross, A. C., Taylor, C. L., Yaktine, A. L., & Del Valle, H. B. (Eds.). (2011). *Dietary reference intakes for calcium and vitamin D*. National Academies Press.
- Rucker, D., Allan, J. A., Fick, G. H., & Hanley, D. A. (2002). Vitamin D insufficiency in a population of healthy western Canadians. *Canadian Medical Association Journal*, 166(12), 1517–1524.
- Sadat-Ali, M., & AlElq, A. (2006). Osteoporosis among male Saudi Arabs: a pilot study. *Annals of Saudi medicine*, 26(6), 450.
- Sadat-Ali, M., Al Elq, A., Al-Farhan, M., & Sadat, N. A. (2013). Fortification with vitamin D: Comparative study in the Saudi Arabian and US markets. *Journal of Family and Community Medicine*, 20(1), 49.
- Sadat-Ali, M., AlElq, A., Al-Turki, H., Al-Mulhim, F., & Al-Ali, A. (2009). Vitamin D levels in healthy men in eastern Saudi Arabia. *Annals of Saudi medicine*, 29(5), 378.
- Saldaña, J. (2015). *The coding manual for qualitative researchers*. Sage.
- Sandelowski, M. (1986). The problem of rigor in qualitative research. *Advances in*



- Nursing Science*, 8(3), 27–37.
- Sandelowski, M. (1995). Sample size in qualitative research. *Research in nursing & health*, 18(2), 179-183.
- Sandelowski, M. (2000). Focus on research methods-whatever happened to qualitative description?. *Research in nursing and health*, 23(4), 334-340.
- Siddiqui, A. (2007). Prevalence of vitamin D deficiency rickets in adolescent school girls in Western region, Saudi Arabia. *Saudi Medical Journal*, 28, 441–444.
- Siddiqui, A. M., & Kamfar, H. Z. (2007). Prevalence of vitamin D deficiency rickets in adolescent school girls in Western region, Saudi Arabia. *Saudi medical journal*, 28(3), 441-444.
- Sofaer, S. (1999). Qualitative methods: what are they and why use them?. *Health services research*, 34(5 Pt 2), 1101.
- Song, S. J., Zhou, L., Si, S., Liu, J., Zhou, J., Feng, K., ... & Zhang, W. (2013). The high prevalence of vitamin D deficiency and its related maternal factors in pregnant women in Beijing. *PloS one*, 8(12), e85081.
- Sullivan-Bolyai, S., Bova, C., & Harper, D. (2005). Developing and refining interventions in persons with health disparities: The use of qualitative description. *Nursing outlook*, 53(3), 127-133.
- Tangpricha, V., Pearce, E. N., Chen, T. C., & Holick, M. F. (2002). Vitamin D insufficiency among free-living healthy young adults. *American Journal of Medicine*, 112(8), 659.

- Thorne, S. (2008). *Interpretive description*. Walnut Creek, CA: Left Coast Press.
- Toher, C., Lindsay, K., McKenna, M., Kilbane, M., Curran, S., Harrington, L., ... & McAuliffe, F. M. (2014). Relationship between vitamin D knowledge and 25-hydroxyvitamin D levels amongst pregnant women. *Journal of Human Nutrition and Dietetics*, 27(3), 261-269.
- Tracking Nutrition Trends VII: August 2008. (2008). Canadian Council for Food and Nutrition.
- Tsiaras, W. G., & Weinstock, M. A. (2011). Factors influencing vitamin D status. *Acta dermato-venereologica*, 91(2), 115-124.
- Tuffaha, M., El Bcheraoui, C., Daoud, F., Al Hussaini, H. A., Alamri, F., Al Saeedi, M., ... & Mokdad, A. H. (2015). Deficiencies under plenty of sun: Vitamin D status among adults in the kingdom of Saudi Arabia, 2013. *North American journal of medical sciences*, 7(10), 467.
- Turner III, D. W. (2010). Qualitative interview design: A practical guide for novice investigators. *The qualitative report*, 15(3), 754.
- Van den Hoonaard, D. K. (2012). *Qualitative research in action: A Canadian primer*. Oxford University Press Canada.
- Vandamme, E. (2009). Concepts and challenges in the use of knowledge-attitude-practice surveys: Literature review. *Department of Animal Health. Institute of Tropical Medicine. Antwerp, Belgium*.
- Vatanparast, H., Calvo, M. S., Green, T. J., & Whiting, S. J. (2010). Despite mandatory

- fortification of staple foods, vitamin D intakes of Canadian children and adults are inadequate. *Journal of Steroid Biochemistry and Molecular Biology*, 121(1–2), 301.
- Vatanparast, H., Nisbet, C., & Gushulak, B. (2013). Vitamin D insufficiency and bone mineral status in a population of newcomer children in Canada. *Nutrients*,5(5), 1561-1572.
- Vieth, R. (2006). Critique of the considerations for establishing the tolerable upper intake level for vitamin D: critical need for revision upwards. *The Journal of nutrition*, 136(4), 1117-1122.
- Vieth, R., Bischoff-Ferrari, H., Boucher, B. J., Dawson-Hughes, B., Garland, C. F., Heaney, R. P., ... & Norman, A. W. (2007). The urgent need to recommend an intake of vitamin D that is effective. *The American journal of clinical nutrition*, 85(3), 649-650.
- Vu, L. H., van der Pols, J. C., Whiteman, D. C., Kimlin, M. G., & Neale, R. E. (2010). Knowledge and attitudes about vitamin D and impact on sun protection practices among urban office workers in Brisbane, Australia. *Cancer Epidemiology Biomarkers & Prevention*, 1055-9965.
- Webb, A. R., Kline, L., & Holick, M. F. (1988). Influence of Season and Latitude on the Cutaneous Synthesis of Vitamin D<sub>3</sub>: Exposure to Winter Sunlight in Boston and Edmonton Will Not Promote Vitamin D<sub>3</sub> Synthesis in Human Skin\*. *The Journal of Clinical Endocrinology & Metabolism*, 67(2), 373-378.
- White, J. H. (2008). Vitamin D signaling, infectious diseases, and regulation of innate

- immunity. *Infection and immunity*, 76(9), 3837-3843.
- Whiting, S. J., & Calvo, M. S. (2005). Dietary recommendations for vitamin D: A critical need for functional end points to establish an estimated average requirement. *Journal of Nutrition*, 135(2), 304–309.
- Whiting, S. J., Langlois, K. A., Vatanparast, H., & Greene-Finestone, L. S. (2011). The vitamin D status of Canadians relative to the 2011 Dietary Reference Intakes: an examination in children and adults with and without supplement use. *The American journal of clinical nutrition*, ajcn-013268.
- Whiting, SJ, Calvo MS (2012). Current Understanding of Vitamin D Metabolism, Nutritional Status and Role in Disease Prevention, in Coulston A, Carol J. Boushey & MG Ferruzzi. Nutrition in the Prevention & Treatment of Disease 3<sup>rd</sup> Edition Elsevier, Inc. Chapter 43, pp 811-838
- World Health Organization. (2008). Advocacy, communication and social mobilization for TB control: a guide to developing knowledge, attitude and practice surveys.
- Youl, P. H., Janda, M., & Kimlin, M. (2009). Vitamin D and sun protection: the impact of mixed public health messages in Australia. *International Journal of Cancer*, 124(8), 1963-1970.
- Yousef, F. M., Jacobs, E. T., Kang, P. T., Hakim, I. A., Going, S., Yousef, J. M., ... & Thomson, C. A. (2013). Vitamin D status and breast cancer in Saudi Arabian women: case-control study. *The American journal of clinical nutrition*, 98(1), 105-110.
- Zhou, M., Zhuang, W., Yuan, Y., Li, Z., & Cai, Y. (2016). Investigation on vitamin

D knowledge, attitude and practice of university students in Nanjing, China. *Public health nutrition*, 19(01), 78-82.

Zipitis, C. S., Elazabi, A., & Samanta, S. (2011). Vitamin D deficiency and guideline awareness. *Archives of Disease in Childhood-Fetal and Neonatal Edition*, fetalneonatal207977.

(Appendix A)

Poster For Young Saudi Women



**PARTICIPANTS NEEDED FOR RESEARCH IN**

**Assessing The Risk For Vitamin D Deficiency In  
Young Saudi Women Living In Canada Using  
Qualitative Methodology**

We are looking for volunteers to take part in this study

- ✓ Female
- ✓ Between 18- 45 years old
- ✓ Not in health professional areas
- ✓ No more than five years in Canada

*As a participant in this study, you would be asked to join in interview. Your participation would involve **one session**, which is approximately (60) minutes.*

*In appreciation for your time, you will receive \$10 gift card from superstore*

**For more information about this study, or to volunteer for this study,  
Please contact: Reem Alomari  
College of Pharmacy and Nutrition  
Email: raa914@usask.ca**

**This study has been reviewed by, and received approval through the  
Research Ethics Office, University of Saskatchewan.**

## **(Appendix B)**

### **Invitation To Participate In A Research Study For Health Professionals**

I am currently a M.Sc. candidate at the University of Saskatchewan College of pharmacy and Nutrition in Saskatoon, Saskatchewan, Canada. I am recruiting Saudi Health professionals to participate in this research project, “Assessing The Risk For Vitamin D Deficiency In Young Saudi Women Living In Canada Using Qualitative Methodology”. As the researcher, I will conduct telephone interviews that are expected to last half an hour.

The main purpose of this study is assessing the risk for vitamin D deficiency in a sample of young Saudi women living in Canada by exploring the knowledge, attitudes and practices (KAP).

Participation is voluntary. Participants should answer only the questions they are comfortable with, and they can ask to have the recording device turned off at any time. Withdrawing from the study at any time is possible with no penalty for participants. In that case, participants’ data will be destroyed and not be included in the study. However, if participants withdraw after data analysis, removing that data from the analysis will not be possible.

My research supervisor is Dr. Susan Whiting, College of Pharmacy and Nutrition, University of Saskatchewan. She can be contacted at [susan.whiting@usask.ca](mailto:susan.whiting@usask.ca).

If you are willing to be interviewed or have questions about participating in this study, please contact Reem Alomari cell phone number (306) 881-8430, or e-mail

raa914@mail.usask.ca.

This study has been approved by the University of Saskatchewan Research Ethics Board Behavioral on ----- . Any questions regarding participants' rights in the project can be addressed through the Research Ethics Office by e-mailing [ethics.office@usask.ca](mailto:ethics.office@usask.ca) or calling +1(306) 966-2975.

**Interview Guide:**

- In your opinion what is the general knowledge that young Saudi women living in Canada should have about vitamin D?
- What is the gap between knowledge and practice regarding vitamin D?
- From your experience what is the usual attitude that patients (clients) have about vitamin D?
- What is your opinion of promoting diet, supplement, and sun exposure?
- What experience, if any, have you had with young Saudi women about vitamin D? If yes, can you talk about it?
- What are the challenges that face young Saudi women living in Canada regarding vitamin D?

**Thank you so much**

**Reem Alomari**



**(Appendix C1)**

**Young Saudi Women Participant Consent Form**

**Project Title:** Assessing The Risk For Vitamin D Deficiency In Young Saudi Women Living In Canada Using Qualitative Methodology

**Researcher:** Reem Alomari, M.Sc. student, College of Pharmacy and Nutrition, University of Saskatchewan, phone number +1(306) 8818430, raa914 @mail.usask.ca

**Supervisor:** Dr. Susan Whiting, College of Pharmacy and Nutrition, University of Saskatchewan, 110 Science Place, Saskatoon SK S7N 5C9, phone number + (306) 9665837, susan.whiting@usask.ca

**Purpose(s) and Objective(s) of the Research:** The purpose of this study will be assessing the risk for vitamin D deficiency in a sample of young Saudi women living in Canada by exploring their knowledge, attitudes and practices (KAP). Topics related to the understanding of vitamin D sources (supplementation, fortification, and exposure to the sun), to attitudes indicating feelings regarding the importance of vitamin D, and to practices indicating how the knowledge and attitude are put into actions.

**Procedures:** Face to face interviews that will last for an hour between each participant and the student researcher. We will book a room at a convenient location that they agree on. Interviews will be audio-taped.

**Funded by:** The study is funded by the Ministry of Higher Education in Saudi Arabia through the Saudi Cultural Bureau in Ottawa.

**Potential Risks:** there are no known risks to participating in this study.

**Potential Benefits:** Information gained from this study will increase the awareness of vitamin D.

**Compensation:** young Saudi women will receive \$10 gift certificate for showing up at a focus group. It will not be tied to participating in the focus group.

**Confidentiality:** Participants' identities shall remain anonymous and their data will be confidential. Code names will be used on all interviews transcripts. Consent forms will be stored separately from the data collected and the transcripts. Anonymity of participants will be maintained by code names on the transcripts and if the researcher plans to use their direct quotes.

**Storage of Data:** Files will be stored on password-protected computer files and in a locked drawer.

**Right to Withdraw:** Your participation is voluntary and you can answer only those questions that you are comfortable with. You may withdraw from the research project for any reason, at any time without explanation or penalty of any sort. At any stage, if participants wish to withdraw, their data will be destroyed and not included in the study. But if they withdraw after dissemination of findings, removing their data from the analysis would not be possible.

**Follow up.** Dissemination of the study result will be distributed to you through an invitation to Research Day to view a poster. Also, study result will be distributed among participants.

**Questions or Concerns:** The researcher's contact information is provided at the top of the first page. This research project has been approved by the University of Saskatchewan Research Ethics Board. Any questions regarding your rights as a participant may be addressed to that committee through the Research Ethics Office [ethics.office@usask.ca](mailto:ethics.office@usask.ca)

(306) 966-2975. Out of town participants may call toll free (888) 966-2975.

**Signed Consent** Your signature below indicates that you have read and understand the description provided; I have had an opportunity to ask questions and my/our questions have been answered. I consent to participate in the research project. A copy of this Consent Form has been given to me for my records.

I grant permission to be audio taped:

Yes: \_\_\_ No: \_\_\_

\_\_\_\_\_

Name of participant

\_\_\_\_\_

Signature

\_\_\_\_\_

Researcher's Signature

\_\_\_\_\_

Date

A copy of this consent will be left with you, and the researcher will take a copy.

(Appendix C 2)

**Health Professionals Consent Form**

**Project Title:** Assessing The Risk For Vitamin D Deficiency In Young Saudi Women Living In Canada Using Qualitative Methodology

**Researcher:** Reem Alomari, M.Sc. student, College of Pharmacy and Nutrition, University of Saskatchewan, phone number +1(306) 8818430, raa914 @mail.usask.ca

**Supervisor:** Dr. Susan Whiting, College of Pharmacy and Nutrition, University of Saskatchewan, 110 Science Place, Saskatoon SK S7N 5C9, phone number + (306) 9665837, susan.whiting@usask.ca

**Purpose(s) and Objective(s) of the Research:** The purpose of this study will be assessing the risk for vitamin D deficiency in a sample of young Saudi women living in Canada by exploring their knowledge, attitudes and practices (KAP). Topics related to the understanding of vitamin D sources (supplementation, fortification, and exposure to the sun), to attitudes indicating feelings regarding the importance of vitamin D, and to practices indicating how the knowledge and attitude are put into actions.

**Procedures:** The study will be conducted in Canada. The in depth interviews will be conducted by telephone with health professionals from different provinces in Canada.

**Funded by:** The study is funded by the Ministry of Higher Education in Saudi Arabia through the Saudi Cultural Bureau in Ottawa.

**Potential Risks:** there are no known risks to participating in this study

**Potential Benefits:** Information gained from this study will increase the awareness of

vitamin D.

**Compensation:** They will not receive compensation.

**Confidentiality:** Participants' identities will remain anonymous, and confidentiality of their data will be maintained. In written records, all names will be deleted. Anonymity of participants will be maintained when the researcher uses direct quotes by assigning code names on the transcripts. They will signed the transcript release form and have the opportunity to review transcripts, to add, alter, and delete information from the transcript as appropriate. Although the data from this research project will be published and presented at conferences, the data will be reported in aggregate form, so that it will not be possible to identify individuals. Moreover, the Consent Forms will be stored separately from the (materials used), so that it will not be possible to associate a name with any given set of responses. After the study has been completed, participants' contact information and other data will be destroyed. Consent forms will be separated from other files and kept in a secured cabinet. However, data will be stored for at least five years following publication of the results.

**Storage of Data:** Files will be stored on password-protected computer files and in a locked drawer.

**Right to Withdraw:** Your participation is voluntary and you can answer only those questions that you are comfortable with. You have the option to have the recording device turned off at any time. You may withdraw from the research project for any reason, at any time without explanation or penalty of any sort. At any stage, if you wish to withdraw, the data will be destroyed and not included in the study. But if you withdraw after dissemination of findings, removing their data from the analysis would not be possible.

**Follow up.** Dissemination of the study results will be distributed to you through a PDF of the final report.

**Questions or Concerns:** The researcher’s contact information is provided at the top of the first page. This research project has been approved by the University of Saskatchewan Research Ethics Board. Any questions regarding your rights as a participant may be addressed to that committee through the Research Ethics Office [ethics.office@usask.ca](mailto:ethics.office@usask.ca) (306) 966-2975. Out of town participants may call toll free (888) 966-2975.

**Signed Consent** Your signature below indicates that you have read and understand the description provided; I have had an opportunity to ask questions and my questions have been answered. I consent to participate in the research project. A copy of this Consent Form has been given to me for my records.

I grant permission to be audio taped:

Yes: \_\_\_ No: \_\_\_

\_\_\_\_\_

Name of participant

\_\_\_\_\_

Signature

\_\_\_\_\_

Researcher’s Signature

\_\_\_\_\_

Date

A copy of this consent will be left with you, and the researcher will take a copy.

## **(Appendix D)**

### **Interviews Guide For Young Saudi Women Living In Canada**

Adapted from Christie & Mason, 2011 and Kung & Lee, 2006

- What do you know about vitamin D?
- Where did this information on vitamin D come from?
- What advice, if any, have you received about how to prevent vitamin D deficiency?
- What are some food sources of vitamin D?
- Tell me what you know about vitamin supplements?
- What factors would you consider important when buying vitamin supplements?
- Tell me what you know, if anything, about food fortification?
- Vitamin D is synthesized in the skin upon exposure to sunlight. What do you think are the best times of the day to be exposed to the sun?
- Please tell me how much time you spend in the sun at different times of the year (probe for each season – in spring, summer, fall, winter)
- When you spend time in the sun, which parts of your body are usually uncovered? Can you explain why?
- How do you feel about sun exposure? Do you like going into the sun? Can you explain why? Or why not?
- Can you tell me what things would help you to follow guidelines about how to prevent vitamin D deficiency?





## **(Appendix E)**

### **Interview Guide For Health Professionals**

- What experience, if any, have you had in discussing vitamin D status with young Saudi women? Tell me more...
- What can you tell me about what young Saudi women living in Canada know about vitamin D?
- What do you think is the general knowledge that young Saudi women living in Canada should have about vitamin D?
- What do you think are the best way to 1) promote dietary sources of vitamin D, 2) promote vitamin D supplement use , and 3) promote sun exposure in young Saudi women?
- What are the challenges that young Saudi women living in Canada face regarding ensuring they have adequate vitamin D levels?

**(Appendix F)**

**Transcript Release Form**

Assessing The Risk For Vitamin D Deficiency In Young Saudi Women Living In Canada  
Using Qualitative Methodology

I, \_\_\_\_\_, have reviewed the complete transcript of my personal interview in this study, and have been provided with the opportunity to add, alter, and delete information from the transcript as appropriate. I acknowledge that the transcript accurately reflects what I said in my personal interview with [Reem Alomari]. I hereby authorize the release of this transcript to [Reem Alomari] to be used in the manner described in the Consent Form. I have received a copy of this Data/Transcript Release Form for my own records.

\_\_\_\_\_  
Name of Participant Date

\_\_\_\_\_  
Signature of Participant Signature of researcher