THE ASSOCIATION BETWEEN ACCULTURATION AND AWARENESS OF CANCER RISK FACTORS AMONG IRANIAN IMMIGRANTS IN GREATER VANCOUVER

by

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The association between acculturation and awareness of cancer risk factors among Iranian immigrants in Greater Vancouver

submitted by Narsi Afghari in partial fulfillment of the requirements for
the degree of Master of Science in Population and Public Health

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Abstract

Introduction: After immigration, cancer rates among immigrant populations shift to rates in the country of destination. Acculturation is one of the theories which can explain these changes in cancer rates. People who lived in a different environment for years start to live and adapt to the new culture in their country of destination. This process is called acculturation. This thesis investigates the association between acculturation with awareness of cancer risk factors and health behaviours among Iranian immigrants in the Greater Vancouver area.

Methods: This is a cross-sectional study on Iranian immigrants who were living in Greater Vancouver, born in Iran, aged 18 to 55 years, who had not been previously diagnosed with cancer, and were not pregnant at the time of the study. Voluntary and snowball sampling were used to reach a sample of 205 participants who completed an online survey for data collection. Participants were asked about their sociodemographic status, acculturation, cancer awareness, anthropometrics, smoking habits, drinking, physical activity level, fruit, vegetable, and red/processed meat intake. Bivariate and multivariable logistic regression were used to model the associations between acculturation with awareness of cancer risk factors and cancer behaviours.

Results: Iranian immigrants were highly aware of smoking as a cancer risk factor. The majority of participants were not aware that age, eating less than five servings of fruit and vegetables a day, eating red or processed meat once a day or more, getting sunburnt more than once as a child, and infection with HPV increases the chance of getting cancer. Acculturation was positively associated with being highly aware of cancer risk factors (AOR: 1.28, 95% CI: [1.09, 1.50]) Also, acculturation had a positive association with drinking (AOR 1.30 [95% CI: 1.14, 1.50]).

Conclusion: The awareness of cancer risk factors among Iranian immigrants in the Greater Vancouver area was low. More acculturated participants had a higher awareness of cancer risk factors. Also, acculturation was associated with higher likelihood of drinking alcohol. Launching tailored health education programs for Iranian immigrants is suggested. Continued research in this area, and translation into cancer prevention policies among immigrants is needed.
Lay Summary

Acculturation is a complicated cultural and psycho-social process. People who lived in a different environment for years start to live and adapt to the new culture in their country of destination. Previous studies concluded that acculturation is associated with health behaviours. This thesis aimed to investigate the association between acculturation with awareness of cancer risk factors and health behaviours including overweight, obesity, smoking, drinking, binge drinking, physical activity, and intake of fruit, vegetable, and red/processed meat. Also, it aimed to assess whether awareness of cancer risk factors mediates the association between acculturation and health behaviours. This analysis for the first time in North America targeted Iranian immigrants who are understudied. The results of this study will contribute to the current knowledge about Iranian immigrants’ health status and add to the body of literature on the association between acculturation and health behaviours. There is a clear need for further studies on this population.
Preface

This dissertation is an original intellectual product of the author, Narsis Afghari under the supervision of the thesis supervisory committee: Carolyn Gotay, PhD, Arminee Kazanjian, PhD, Rachel Murphy, PhD. This project approved by UBC Behavioural Research Ethics Board (Certificate number H17-03001).
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<tbody>
<tr>
<td>AICR</td>
<td>American Institute for Cancer Research</td>
</tr>
<tr>
<td>ANOVA</td>
<td>Analysis of Variance</td>
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<tr>
<td>AOR</td>
<td>Adjusted Odds Ratio</td>
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<tr>
<td>BC</td>
<td>British Columbia</td>
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<td>BMI</td>
<td>Body Mass Index</td>
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<tr>
<td>CAM</td>
<td>Cancer Awareness Measurement</td>
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<td>CCHS</td>
<td>Canadian Community Health Survey</td>
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<tr>
<td>CI</td>
<td>Confidence Interval</td>
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<td>DV</td>
<td>Dependent Variable</td>
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<td>FFQ</td>
<td>Food Frequency Questionnaire</td>
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<tr>
<td>IP</td>
<td>Internet Protocol</td>
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<tr>
<td>IQR</td>
<td>Interquartile Range</td>
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<tr>
<td>IV</td>
<td>Independent Variable</td>
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<tr>
<td>OR</td>
<td>Odds Ratio</td>
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<tr>
<td>PV</td>
<td>P-Value</td>
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<tr>
<td>ROS</td>
<td>Reactive Oxygen Species</td>
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<tr>
<td>SD</td>
<td>Standard Deviation</td>
</tr>
<tr>
<td>SFU</td>
<td>Simon Fraser University</td>
</tr>
<tr>
<td>STATCAN</td>
<td>Statistics Canada</td>
</tr>
<tr>
<td>UBC</td>
<td>University of British Columbia</td>
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<tr>
<td>US</td>
<td>United States</td>
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<tr>
<td>Abbreviation</td>
<td>Full Form</td>
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<tr>
<td>VIA</td>
<td>Vancouver Index of Acculturation</td>
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<tr>
<td>WCRF</td>
<td>World Cancer Research Fund</td>
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<td>WHO</td>
<td>World Health Organization</td>
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Glossary

Acculturation: Acculturation is defined as a cultural and psycho-social process in which a member of a group in the minority adapts to the culture, behaviours, and beliefs of another group in the majority.

Awareness: Awareness is defined as knowledge that something exists, or understanding of a situation or subject at the present time based on information or experience.

International immigration: International immigration is defined as a movement from a native country to a country of destination.

Healthy immigrant effect: The “healthy immigrant effect” is one such theory which argues that the better health situation among immigrants is related to the selective nature of international immigration at both individual and state levels.

Pull Motivation of Immigration: The pull motives are related to voluntary immigration and positive expectations about migration such as better economic status, more employment opportunities, and access to better education.

Push Motivation of Immigration: The push motives are related to forced or involuntary immigration and can cause negative expectations such as poverty, drought, political reasons, and religious activities.

Voluntary Migration/ Involuntary Migration: Voluntary/involuntary migration is defined as a situation in which the immigrant has a choice to migrate or not.
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I would like to extend my gratitude to all of the participants who allocated their time and energy to this study.

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Finally, today and as always, I would like to thank my partner Rouzbeh, my parents, and Neda and Hamed who supported me and encouraged me in every step. Who still stand by me to grow.
Dedication

This research is dedicated to all of my patients in Iran who survived or lost.
1. Chapter 1: Introduction

Background

Cancer is a generic term for a group of diseases that are related to abnormal cell growth in the body. Cancer is the second leading cause of death worldwide and the leading cause of death in Canada (Canadian Cancer Society, 2015; Plummer et al., 2016). Cancer is a multifactorial disease. 90-95% of cancer cases are associated with: 1) environmental and lifestyle risk factors such as physical agents (like radon), food contaminants (like aflatoxin), workplace exposures (like asbestos), infectious agents (like human papillomavirus), environmental pollutants (like powdered metallic cobalt and nickel), and 2) lifestyle factors such as unhealthy diet, obesity, smoking, physical inactivity, and alcohol consumption. Many cancer cases are preventable, with unhealthy lifestyle being responsible for almost 80% of deaths from cancer (Schottenfeld and Fraumeni Jr., 2006; Anand et al., 2008; Koochek, 2008; Brown et al., 2012; Varela-Rey et al., 2013; Cong et al., 2014; WHO, 2015; Ordóñez-Mena et al., 2016). Increased awareness has been shown to be related to adherence to preventive and health-seeking behaviours (Azubuike and Okwuokei, 2013; Smith et al., 2014; Lagerlund et al., 2015).

Currently, cancer rates in developing countries are lower than those in developed countries (Mousavi et al., 2010). People from a developing country may therefore immigrate to a developed country with higher cancer incidence rate. After immigration, the cancer incidence rate among immigrants shifts to the rate in the country of destination (Mousavi et al., 2010). Acculturation is theorized to contribute to this shift in cancer incidence rate among immigrants.

Acculturation is a cultural and psycho-social process. After immigration, a member of a group in the immigrants population adapts to the culture, behaviours, and beliefs of general population in the country of destination (Berry, 1997, 2003; Berry, 2005; Cole, 2017). It is thought that acculturation brings about behavioural changes related to cancer risk factors after immigration.
There is a growing body of evidences that demonstrates the association between acculturation and lifestyle choices such as tobacco use, dietary habits, physical activity patterns, and other health behaviours (Wiking, Johansson and Sundquist, 2004; Parvin Yavari et al., 2006; P Yavari et al., 2006; Hosper, Klazinga and Stronks, 2007; An et al., 2008; Constantine et al., 2010; Maria D. Thomson and Hoffman-Goetz, 2010; Gorman, Lariscy and Kaushik, 2014; Shah et al., 2015; Walker et al., 2015; Gotay et al., 2015; Guo et al., 2015; Nelson-Peterman et al., 2015; Ro and Bostean, 2015; Wu and Smith, 2016; Yi et al., 2016). Also, acculturation is associated with higher language proficiency in the country of destination and higher level of information and better communication with healthcare professionals (Kreps, 2003; Zhao, 2010; Guo, Juon and Lee, 2017). Previous studies have been shown that higher language proficiency in the country of destination is associated with higher chronic disease awareness among immigrants (Vadaparampil et al., 2006; Manne et al., 2015; Rodríguez et al., 2017).

The association between acculturation with health awareness and health behaviours among Iranian immigrants has not been reported prior to this research. Due to the Islamic revolution (1979), the war between Iran and Iraq (1980-1988), and the US sanctions against Iran (starting in 1984, revised in 1996, strengthened in 2013, and continuing at present), Iranians started to immigrate to developed countries (Shishehgar et al., 2015), with Canada being a top destination due to its largely welcoming attitude towards immigrants. Iranians comprise one of the largest communities of immigrants in the Greater Vancouver area (STATCAN, 2016). According to 2016 census data, 47,985 Iranians are living in BC, and almost 77% of them were born in Iran (STATCAN, 2016). Despite the increasing size of the Iranian community in North America and Canada, this is the first study on their acculturation, health awareness, and cancer risk factors.

This thesis aimed to:

**Objective 1:** Examine the association between acculturation and awareness of cancer risk factors among Iranian immigrants who live in Greater Vancouver;

**Objective 2:** Examine the association between acculturation and likelihood of exhibiting cancer risk factors (including overweight, obesity, smoking, alcohol consumption, binge drinking,
physical activity, fruit, vegetable, and red/processed meat intake) among Iranian immigrants who live in Greater Vancouver; and

**Objective 3:** Examine whether awareness of cancer risk factors mediates the association between acculturation and cancer behavioural risk factors (including overweight, obesity, smoking, alcohol consumption, binge drinking, physical activity, fruit, vegetable, and red/processed meat intake) among Iranian immigrants who live in Greater Vancouver.

Figure 1: The simplified conceptual model
Literature Review

1.1.1. Cancer statistics in Canada versus Iran

According to the Canadian Cancer Society, 30.2% of deaths are caused by cancer, 40% of Canadians will be diagnosed with cancer in their lifetimes, and 25% will die from the disease (Canadian Cancer Society, 2015). According to the 2013 cancer statistics, there were 182,990 new cases, and the cancer incidence rate in Canada was 523.9 per 100,000 population (CANSIM, 2013). The incidence rate in males was 538.7 and in females 509.3 (CANSIM, 2013). In 2013 in British Columbia (BC), 23,940 new cancer cases were reported. Based on these figures, the incidence rate of cancer in BC in 2013 was 521.7 per 100,000 population (CANSIM, 2013). Prostate, breast, lung, and colorectal cancers comprise more than half of all new cancer cases (Canadian Cancer Society, 2015).

On a global scale, the burden of cancer is growing, mainly as a result of ageing and poor lifestyle choices (Jemal et al., 2011). However, cancer incidence rates and the most common cancers differ in developed countries compared to developing countries (Mousavi et al., 2010). Iran is an upper middle income developing country with a total population of 79,109,000 (World Health Organization, 2017b). Based on Iran’s cancer registry reports from 2004 to 2009, the cancer incidence rate in Iran was 113.46 per 100,000 in females and 125.6 per 100,000 in males (Enayatrad et al., 2016). This rate is much lower than in Canada, but the rate in Iran has been increasing especially in recent years (Vakili et al., 2014). The most common cancers among Iranian women are breast, colorectal, and stomach, and among men are stomach, bladder, and prostate (Mousavi et al., 2008). Data indicate that 30,000 people die from cancer in Iran every year, and cancer is the third leading cause of death in Iran (Amori et al., 2017).

The economic cost of cancer is significant worldwide, and these costs are continuing to grow (World Health Organization, 2017a). A number of studies in Canada have attempted to estimate cancer-related costs. In 2008, the Public Health Agency of Canada reported that $4.4 billion in economic costs are due to cancer, including the direct health care costs ($3.8 billion) related to
hospitals, treatment processes, physicians, and indirect costs ($586 million) related to premature death and inability to work after diagnosis (Canadian Cancer Society, 2016).

1.1.2. The impact of immigration on cancer rates

After immigration, cancer incidence rate among the first generation of immigrants have been shown to begin to shift to the rate in the country of destination (Mousavi et al., 2010), and by the second generation of immigrants, the incidence rate tend to have adapted to the rate in the country of destination (Hemminki et al., 2014). The precise reasons for this shift in cancer incidence rate among immigrants are not fully understood. Researchers have suggested that the shift in cancer incidence rate after immigration and particularly in the first generation of immigrants may be explained by differences in lifestyle, cancer exposures, cancer awareness, screening programs, and cancer registry systems (Yavari et al., 2006; Koochek et al., 2008; Sadjadi et al., 2009; Mousavi et al., 2010; Bashash, Hislop, et al., 2011; Bashash, Yavari, et al., 2011).

Lifestyle changes after immigration can be associated by acculturation, which is defined in section 1.2.7. of this thesis (Yavari, Hislop, et al., 2006). In particular, immigrants show an adaptation to cancer risk behaviours and exposures at rates that are similar to those in the destination country. The shift in cancer rates in the second generation of immigrants can be attributed to childhood environmental and lifestyle risk factors, which are as crucial as genotypes (Hemminki and Li, 2002; Hemminki et al., 2014). Previous literature reported the importance of the first two decades of life in cancer development patterns (Hemminki and Li, 2002).

There are other factors that affect the shift in cancer incidence rate after immigration. To explore theories about changes in cancer rates among immigrants, a definition of immigration and an understanding of immigration motivation is necessary. International immigration is defined as a movement from a native country to a country of destination, and the three main reasons for immigration are political, economic, and environmental. Immigration is classified as voluntary and involuntary (Richmond, 1988). The latter is associated with higher stress and problems after immigration. Reasons and motivations for immigration are categorized as either “push” or “pull”
(Berry, 1997). The push motives such as poverty, drought, political reasons, and religious activities are related to forced or involuntary immigration and can cause negative expectations (Berry, 1997). However, the pull motives such as better economic status, more employment opportunities, and access to better education are related to voluntary immigration and related to positive expectations about migration (Berry, 1997).

Both voluntary and involuntary immigration pose significant life challenges to immigrants and can affect their social, economic, and health status (Castañeda et al., 2015). Immigration is consequently recognized as a social determinant of health and well-being (Castañeda et al., 2015), which can result in health inequality, fewer behavioural and health-related choices available to immigrants, and higher health risks (Castañeda et al., 2015). In addition to the widely-cited role of environmental risk factors, social determinants of health affect immigrants’ behaviours and access to health-related knowledge and information, which in turn influence cancer rates (Hemminki et al., 2014). Hemminki and colleagues provided evidence in support of the association between social determinants of health among immigrants, and health behaviours and health knowledge. Immigrant cancer survival rates in Sweden showed that despite universal health-care coverage in Sweden, the social determinants of health affected cancer survival among immigrants by influencing on their access to the health care system, and health knowledge (Hemminki et al., 2014).

There are only limited data available specific to cancer incidence rates among Iranian immigrants. According to Mousavi et al. (2009), cancer incidence for the first generation of Iranian immigrants in Sweden was higher than Iranian residents, but lower than the native Swedish population (Mousavi et al., 2010). According to Yavari et al. (2006), the overall cancer incidence rate among Iranian immigrants in BC for females was 140.7 and for males was 83.4 per 100,000 (P Yavari et al., 2006). The three leading cancer types among Iranian immigrant women living in BC were breast, esophageal, and stomach, and among men were stomach, esophageal, and colorectal (P Yavari et al., 2006). A comparative analysis of age-standardized breast, gastric and esophageal cancer survival rates between the province of BC, Canada, and the province of Ardabil, Iran, showed that the overall 1-year survival rate in BC was significantly higher for gastric, esophageal, and breast cancers (Sadjadi et al., 2009; Bashash, Yavari, et al., 2011).
Figure 2: The impact of immigration on cancer rates
1.1.3. Cancer risk factors

At the beginning of the twentieth century, rates of non-communicable diseases such as cancer started to increase and began to be recognized as a public health threat (Schottenfeld and Fraumeni Jr., 2006). Public health scientists and non-communicable disease epidemiologists around the world during the past 150 years have focused on finding cancer causes (Schottenfeld and Fraumeni Jr., 2006). Identified risk factors now include internal, environmental, and lifestyle factors (Anand et al., 2008).

Internal cancer risk factors such as hormones, hereditary gene defects and mutations, and immune conditions are widely cited to be responsible for 5-10% of cancer cases (Anand et al., 2008). Environmental and lifestyle risk factors such as physical agents (e.g., radon), food contaminants (e.g., aflatoxin), workplace exposures (e.g., asbestos), infectious agents (e.g., human papillomavirus), environmental pollutants (e.g., powdered metallic cobalt and nickel), and lifestyle factors (e.g., unhealthy diet, obesity, smoking, physical inactivity, and alcohol consumption) account for the remaining 90-95% of cancer cases (Schottenfeld and Fraumeni Jr., 2006; Anand et al., 2008; Koochek, 2008; Brown et al., 2012; Varela-Rey et al., 2013; Cong et al., 2014; WHO, 2015; Ordóñez-Mena et al., 2016).

Based on these findings, it is clear that cancer is a preventable disease, and lifestyle modification can decrease the chance of cancer onset (Ruiz and Salinas Hernández, 2014). Many cancers are preventable, and an unhealthy lifestyle is responsible for almost 80% of deaths from cancer (Feizi et al., 2010).

1.1.3.1. Obesity

During the 1940s, a series of animal studies demonstrated an association between obesity and cancer (Brown et al., 2012; Berger, 2014). In the 1960s, the results of several studies on women detailed for the first time an association between obesity and endometrial cancer (Brown et al., 2012). A number of cohort studies during the 1990s showed an association between obesity and
increased risk of various types of cancer (Brown et al., 2012). In general, it is estimated that 20% of all cancers are caused by overweight and obesity (Wolin, Carson and Colditz, 2010; De Pergola and Silvestris, 2013). A US-based study reported that excess weight is responsible for 14% of cancer deaths among American men and 20% among American women (Calle et al., 2003; Berger, 2014). Other research showed that an increase in BMI among men is related to an increased risk of esophageal, thyroid, colon, kidney, and rectal cancers, melanoma, leukemia, and multiple myeloma. Also, a BMI increase among women is associated with endometrial, gallbladder, esophageal, kidney, thyroid, postmenopausal breast, pancreatic, and colon cancers, multiple myeloma, non-Hodgkin lymphoma, and leukemia (Brown et al., 2012). However, obesity may have a protective effect on some cancer types such as lung cancer, premenopausal breast cancer, and esophageal squamous cell carcinoma (Handelsman et al., 2013; Berger, 2014).

A comparison between the prevalence of obesity and overweight in Canada and Iran shows a moderate difference between the two countries, with Canadians more likely to be overweight and Iranians more likely to be obese. In 2017, Statistics Canada (STATCAN) reported that 36% are overweight, and 26.9% of Canadian adults are obese (STATCAN, 2017). In Iran, Jafari-Adli et al. recently published a systematic review of the prevalence of obesity and overweight in the country (Jafari-Adli et al., 2014). They reported that the prevalence of overweight was between 12.6% and 25.9%, and obesity was between 27% and 38.5% (Jafari-Adli et al., 2014).

1.1.3.2. Smoking

Over 1.3 billion of the world’s population currently smoke. Smoking is a leading cause of death globally and responsible for 5–6 million deaths per year (Huang and Chen, 2011). Each cigarette contains more than 5000 different chemical compounds in which there are more than 60 carcinogens such as N-nitrosamines (TSNAs), polycyclic aromatic hydrocarbons (PAH), aromatic amines, aldehydes, phenols, volatile hydrocarbons, and nitro compounds (Huang and Chen, 2011). Data show that almost 90% of lung cancer cases are related to smoking habits (Huang and Chen, 2011). Smoking is also significantly associated with head, neck, bladder, colorectal, gastric, pancreatic, breast, and prostate cancers (Huang and Chen, 2011; Ordóñez-Mena et al., 2016). The
data also support a direct association between the number of years after smoking cessation and reduction in cancer incidence and mortality (Ordóñez-Mena et al., 2016).

A comparison between the prevalence of smoking among Iranians and Canadians shows the smoking prevalence among Iranian men and Canadian men to be similar. However, the prevalence of smoking among Iranian women is significantly lower than Canadian women (Moosazadeh et al., 2013; STATCAN, 2017). According to this report, the overall smoking prevalence was 16.2% in Canada in 2017 (STATCAN, 2017). Moosazadeh et al. (2013) published a meta-analysis of 274,992 Iranian adults. They reported that the prevalence of smoking among men varied between 12.3% and 38.5% and that among women was between 0.6% and 9.8% (Moosazadeh et al., 2013). The variation in the prevalence of smoking among Iranians was due to various provinces and regions of Iran (Moosazadeh et al., 2013).

1.1.3.3. Alcohol consumption

According to the World Health Organization (WHO) alcohol consumption is related to more than 60 medical conditions and 1.8 million deaths worldwide annually, including 3.5 percent of all cancer-related deaths (Varela-Rey et al., 2013). Alcohol use is associated with oral cavity, pharynx, larynx, esophageal, liver, colorectal, and breast cancers (Varela-Rey et al., 2013). Oxidative stress and epigenetic alterations via DNA methylation/demethylation are the most commonly cited mechanisms for alcohol effects on cancer risk. However, alcohol consumption is also associated with low folate levels in plasma due to poorer folate absorption (Varela-Rey et al., 2013). Consequently, plasma folate levels in heavy drinkers are significantly lower than in healthy subjects. A lower plasma level of folate has been associated with a higher risk of cancer (Varela-Rey et al., 2013).

World Cancer Research Fund/American Institute for Cancer Research (WCRF/AICR) recommends men and women who choose to drink alcohol to limit their consumption to two drinks and one drink per day, respectively (WCRF/AICR, 2018). According to a WHO report, total alcohol consumption in Canada per capita (aged 15 years+) was 13.2 litres of pure alcohol in 2010 (WHO, 2014) with women having lower alcohol consumption than men (WHO, 2014). Precisely,
the total alcohol consumption per capita (aged 15 years +) was 18.8 and 7.4 litres of pure alcohol in men and women respectively (WHO, 2014). The prevalence of heavy episodic drinking, which is defined as the consumption of at least 60 grams or more of pure alcohol on at least one occasion in the past 30 days, was 17.8% in the Canadian population (WHO, 2014). The prevalence of heavy episodic drinking among Canadian men was 25% and in Canadian women was 10.9% (WHO, 2014). Similar figures are not available for Iran as alcohol consumption is illegal in the country.

1.1.3.4. Physical inactivity

The WCRF/AICR have advised adults to get more than 150 minutes of moderate, or 75 minutes of vigorous, physical activity each week (WCRF/AICR, 2018). Physical activity is defined as any body movement and muscle contractions that require energy expenditure. (Sanchis-Gomar et al., 2015; WHO, 2015). A sedentary lifestyle has a different meaning than physical inactivity (lack of physical activity). The former is characterized by long-term sitting or lying in the absence of body movement (Cong et al., 2014). Sedentary lifestyle and physical inactivity are both directly associated with obesity and are independent risk factors for health problems including various types of cancer (Brown et al., 2012; Cong et al., 2014). According to a WHO report, physical inactivity and a sedentary lifestyle are associated with almost 3.2 million deaths worldwide annually (Koochek, 2008; WHO, 2015). It is estimated that physical inactivity contributes to more than 10% of the colon and breast cancer burden (Lee et al., 2012; Sanchis-Gomar et al., 2015). Canadian research, published in 2012, has estimated that physical inactivity resulted in more than $2.4 billion in direct health care costs in 2009 (Janssen, 2012). The research estimated that the indirect and total health care costs were $4.3 billion and $6.7 billion, respectively (Janssen, 2012).

The prevalence of physical inactivity in Canada and Iran are both high. STATCANC showed that 58.5% of Canadian adults engaged in 150 minutes of moderate to vigorous physical activity per week (STATCAN, 2017). Fakhrzadeh et al. (2016) published a systematic review of the prevalence of physical inactivity in Iran. They reported that the prevalence of physical inactivity varied between 30% and 70% (Fakhrzadeh et al., 2016).
1.1.3.5. Diet

It is estimated that almost 35% of cancer risk factors are related to diet (Ruiz and Salinas Hernández, 2014). Nutrients and foods influence signals and metabolic pathways including P450, MAP-kinase, IGF-1, NF-kB, and reactive oxygen species (ROS) and can thus cause cancer onset (Ruiz and Salinas Hernández, 2014). Nonetheless, after years of studying the effects of nutrition on cancer risk, epidemiologists believe that because of interactions between nutrients, a comprehensive model should be used and dietary patterns should be studied instead of examining individual factors or nutrients (Ruiz and Salinas Hernández, 2014). Various studies have presented different dietary patterns that are associated with cancer risk (Ruiz and Salinas Hernández, 2014). However, most researchers have accepted a general definition of these dietary patterns (Ruiz and Salinas Hernández, 2014). A healthy pattern is a diet with a high intake of vegetable, fruit, whole grains, fish, and poultry, and low intake of animal fat and red meat (Ruiz and Salinas Hernández, 2014). An unhealthy diet, which is mostly referred as the westernized dietary pattern, is a diet with high intake of red/processed meat, refined carbohydrates, and fat, and lower intake of dietary fibre sources and complex carbohydrate (Ruiz and Salinas Hernández, 2014).

The dietary pattern changed after the industrialization of societies (Boutron. M C, Wilpart. M, 1991). Specifically, in industrialized societies, the ratio of energy intake to energy expenditure has increased and the dietary characteristics have changed to a high-fat dietary pattern with increased intake of saturated, trans, and n-6 polyunsaturated fatty acid, higher intake of refined carbohydrates and red/processed meat, and lower intake of whole grains, legumes, fruit, vegetable, fiber, and antioxidants (Boutron and Wilpart, 1991; Kwan et al., 2015). These dietary patterns are cited to be related to the increased rate of cancer incidence (Ruiz and Salinas Hernández, 2014; Kwan et al., 2015).

To prevent cancer, the WCRF/AICR recommends avoiding sugary drinks and processed meat, limiting red meat, fat, and salty foods, consuming more vegetables, fruits, whole grains, and legumes (WCRF/AICR, 2018). Fruit and vegetable are the source of antioxidants and have a vital role in deactivating free radicals before they cause a health effect (Pem and Jeewon, 2015). A daily
intake of at least five serving of fruit and vegetable has been suggested to prevent cancer and other chronic diseases (Pem and Jeewon, 2015).

The prevalence of daily intake of five servings or more of fruit and vegetable among Canadian adults is significantly higher than Iranians. According to CCHS in 2017, the prevalence of daily intake of 5 servings or more of fruit and vegetable among Canadians was 28.6% (STATCAN, 2017). Esteghamati et al. reported the prevalence of daily intake of 5 servings or more of fruits and vegetable among Iranians to be 12.5% (Esteghamati et al., 2012).

1.1.4. Cancer awareness

Awareness is defined as knowledge that something exists, or understanding of a situation or subject at the present time based on information or experience (Cambridge English Dictionary, 2018). The “cancer awareness” concept was first presented in the 1950’s (Robb et al., 2009). Cancer awareness refers to public knowledge about cancer prevention, such as knowledge about cancer risk factors and the role of a healthy lifestyle such as physical activity and healthy diet in relation to cancer (Ramirez et al., 2013).

Lifestyle improvements can reduce the chance of getting cancer. Cancer awareness is a necessary, but not sufficient factor to change behaviours (Lagerlund et al., 2015). Increased awareness has been shown to be related to adherence to preventive and health-seeking behaviours (Azubuike and Okwuokei, 2013; Lagerlund et al., 2015). A number of research studies show that late diagnosis, poor outcomes, and higher mortality rates are partially related to lower public awareness about cancer risk factors (Macleod et al., 2009; Robb et al., 2009a; Al-Azri et al., 2014, 2015). Public awareness assessment enables researchers to identify areas of awareness that need to be improved (Lagerlund et al., 2015).

Previous studies compared awareness levels between immigrant populations and native populations, and factors impacting immigrants’ awareness of chronic diseases’ prevention. Gholizadeh et al. reported that Iranian immigrants in Australia had a low level of awareness about
heart disease risk factors (Gholizadeh et al., 2009). These differences in awareness levels between immigrant and native populations could be explained by a variety of reasons. Lower awareness about cancer, and low primary and secondary cancer prevention behaviours are often associated with factors likely to disproportionately affect immigrants such as lower income, housing issues, unemployment, other stressors, and different health beliefs (Remennick, 2006; Dunn et al., 2017). In addition, language barriers and poor communication are also cited as potential causes of lower cancer awareness among immigrants (Dunn et al., 2017).

There are few current data on Canadians’ public awareness about cancer and cancer risk factors. Research in Canada was mostly focused on secondary cancer prevention awareness including awareness about cancer screening and early cancer signs, or other chronic diseases prevention. According to those studies, Canadians had a relatively high knowledge of primary cancer signs. The mean number of primary cancer symptoms recognized by Canadians was 8.7 out of 11. However, only 13% of Canadians were aware of age as a cancer risk factor (Forbes et al., 2013). Research in other diseases has also reported a significant lack of public awareness and a number of misconceptions related to cardiovascular disease, stroke, and hypertension (Petrella and Campbell, 2005; Chow et al., 2008). While no recent national surveys of Canadian adults have been reported, available data indicate that many Canadians are not fully aware of cancer risk factors.

A number of studies have examined public awareness about cancer among Iranians (Feizi et al., 2010; Tazhibi and Feizi, 2014). In general, Iranians have a low level of cancer awareness. Feizi et al. (2010) investigated public awareness about cancer risk factors among the Iranian population in Tehran, Iran. A total of 2500 individuals, 18 years or older, participated in this study. Participants were asked about their socioeconomic status, health history, knowledge about cancer, environmental and lifestyle risk factors, nutrition, smoking, and drinking, previous exposure to carcinogens, knowledge about primary cancer symptoms, protective behaviours, and screening tests. 54.6% of participants reported that they were informed about cancer before this study and they declared mass media, self-study, and friends as the most common sources of information. The level of information was similar among women and men (Feizi et al., 2010).
Tazhibi et al. (2014) studied public awareness about breast cancer among 2250 women in Esfahan, Iran. Women were asked to complete a self-administered questionnaire on personal and family history of breast problems, marital status, attending the screening and public educational programs, knowledge about breast cancer risk factors, knowledge about breast cancer's primary signs and symptoms, knowledge about breast cancer screening methods, and knowledge about breast cancer treatment methods. The results showed that only one-third of women had a high level of awareness about cancer risk factors (Tazhibi and Feizi, 2014).

Overall, being middle-aged, female, more highly educated, having a family history of cancer and past attendance of public education and screening programs have been shown to be associated with higher cancer awareness among Iranians (Feizi et al., 2010; Tazhibi and Feizi, 2014).

1.1.5. **Acculturation**

Culture is one of the most critical factors influencing behaviour and health beliefs (Berry, 2003; Vahabi, 2010). Scientists in the field of cross-cultural psychology have identified various effects of cultural factors, and immigration in particular, on individuals’ behaviours (Berry, 1997). Several studies examined whether individuals follow their previous behaviours during adaptation to their new cultural setting, change them to be more appropriate in the new cultural context, or some complex combination of the two (Berry, 1997).

Acculturation is defined as a cultural and psychological process in which a member of a group in the minority adapts to the culture, behaviours, and beliefs of another group in the majority. Higher adaptation has been shown to be related to higher self-esteem, life satisfaction, school adjustment, and fewer psychological and behavioural problems (Berry, 2005).

After immigration, people who lived in a different cultural context for years are required to live in a new culture in their country of destination (Berry, 2003). In this scenario, cultural adaptation can take place across both short and long periods of time (Berry, 1997). The term “acculturation” was used for the first time in 1880, by J.W. Powel and later in 1936. Redfield. Linton, and Herskovits
presented the classic description of acculturation: “acculturation comprehends those phenomena which result when groups of individuals having different cultures come into continuous first-hand contact with subsequent changes in the original culture patterns of either or both groups” (Redfield, Linton, and Herskovits, 1936). In 1954, the Social Science Research Council presented a different definition for acculturation: “culture change that is initiated by the conjunction of two or more autonomous cultural systems. Acculturative change may be the consequence of direct cultural transmission; it may be derived from non-cultural causes, such as ecological or demographic modification induced by an impinging culture; it may be delayed, as with internal adjustments following upon the acceptance of alien traits or patterns; or it may be a reactive adaptation of traditional modes of life” (Social Science Research Council, 1954).

A literature review on the acculturation concept identified two main models: unidimensional and bi-dimensional (Ryder et al., 2000). The unidimensional model is based on the assumption that cultural identity changes occur along a single continuum over time (Ryder et al., 2000). As a result, acculturation can involve a relinquishing of the attitudes, values, and behaviours of the heritage culture (Ryder et al., 2000; Lee, Sobal and Frongillo, 2003). In contrast, the bi-dimensional model claims that during acculturation, the culture of origin and the mainstream culture should be seen as a single dimension and immigrants might vary in their acceptance and adherence to both their original and the mainstream culture (Ryder et al., 2000). Consequently, people may adapt to the mainstream attitudes, values, and behaviours of their new setting without giving up on their culture of origin (Ryder et al., 2000; Lee, Sobal and Frongillo, 2003). According to Berry’s model, not all immigrants have the same experience, people engage in acculturation in different ways, and acculturation is a unique experience for every individual (Berry, 1997; Berry, 2005).

Personal variables like age, gender, education level, migration motivation, expectations, language, religion, and personality variables such as flexibility moderate acculturation (Berry, 1997). The acculturation process is smoother in younger than older people. This smoothness can be related to the higher flexibility and adaptability of young people (Berry, 1997). Women are also more likely to experience more problems than men during acculturation (Berry, 1997). Immigrants with higher levels of education may experience less acculturative stress, which may be correlated with their higher access to social resources, higher income, better professional position, and social support
Push motivations such as involuntary and forced immigration are linked to negative expectations, lower adaptation, and more acculturative stress (Berry, 1997). Conversely, pull motivations like voluntary immigration, are associated with positive expectations, higher adaptation, and less acculturative stress (Berry, 1997). The greater cultural distance between the origin and destination countries, such as differences in language and religion, is associated with less adaptation and more problems in acculturation for immigrants (Berry, 1997). Furthermore, language fluency, birthplace, and the number of years spent in the adopted country are other factors influencing acculturation.

Behavioural shifts are one of the outcomes of acculturation and can occur rather easily or be problematic. Three sub-processes - cultural shedding, cultural learning, and cultural conflict - are involved in the behavioural shifts among immigrants (Berry, 2005). Cultural shedding and cultural learning involve carefully-selected behavioural replacements along with adaptive changes to fit in with the dominant culture in the country of destination (Berry, 2005). These selective adjustments are made with minimal difficulty, and are mostly non-problematic (Berry, 2005). Acculturative stress is an adverse reaction caused by the acculturation process (Berry, 2005). In assimilation, an immigrant begins to interact with the cultural norms of the dominant group, which may result in cultural conflicts (Berry, 2005). These cultural conflicts may induce acculturative stress mainly because the immigrant may have difficulties in maintaining inter-cultural contacts with other immigrants who cannot easily adapt to these new norms (Berry, 2005).

In the later stages of acculturation, immigrants gradually adapt to the culture in the country of destination and also develop good relationships with other immigrants and others native to the culture in the country of destination. Adaptation is defined as immigrants’ attempts to cope with cultural differences and make relatively stable changes (Berry, 2005). Adaptation includes psychological and sociocultural aspects (Berry, 2005). The psychological aspect refers to the physical and psychological well being, and the sociocultural aspect concerns immigrants’ ability to manage their daily lives in the new cultural context (Berry, 2005). Personal variables, social support, and life events also affect the psychological aspect of adaptation. In addition, cultural knowledge, being in contact with others, and positive intergroup attitudes influence the sociocultural aspect of adaptation (Berry, 2005). According to Berry’s model, those immigrants
who use the integration strategy achieve better adaptation, those immigrants who follow the marginalization strategy have the lowest success at adapting, and immigrants who adhere to the assimilation and separation strategies have an intermediate level of adaptation to the new cultural context (Berry, 2005).

1.1.6. The association between cancer risk factor awareness and acculturation

Migration brings together people with different health beliefs, health behaviours, and health values within a particular destination country (Zhao, 2010). As a result of this diversity, immigrants may experience unique health challenges in their adopted country (Zhao, 2010). Studies have shown immigrants to have better health status just after their immigration in comparison with the native population. However, as time passes living in the country of destination, immigrants’ health status becomes more similar to that of the native population (Zhao, 2010; Wang and Hu, 2013). There are various theories to explain the differences in health status between immigrants and the native population (Zhao, 2010).

The “healthy immigrant effect” is one such theory which argues that the better health situation among immigrants is related to the selective nature of international immigration at both individual and state levels (Vang et al., 2015). At the state level, the country of destination accepts healthier immigrants and aims to minimize the chance of less healthy individuals settling in the country. At the individual level, people who are healthier or have better socioeconomic status are more likely to emigrate to another country (Zhao, 2010; Wang and Hu, 2013; Vang et al., 2015).

However, after immigration, lower access to the healthcare system, behavioural changes, a new lifestyle adaptation, and ageing can explain some of the changes in immigrants’ health status and its shift to the health status of the native population (Zhao, 2010). Cultural barriers may hinder immigrant access to the primary health care system, which can also limit their health awareness (Zhao, 2010; Wang and Hu, 2013). Having a higher level of information and better communication with healthcare professions are associated with healthier lifestyle, reduced cancer risk, improved
cancer prevention, higher participation in cancer screening programs, and better public health outcomes in the long-term (Kreps, 2003; Zhao, 2010; Guo, Juon and Lee, 2017). However, it is unclear whether, and to what extent, immigrants have the health-related knowledge and access to health information, particularly that related to cancer (Zhao, 2010).

There are a limited number of studies on the association between acculturation and awareness about primary and/or secondary cancer prevention. Vadaparampil et al.’s study of 4,313 Hispanic adults in the US showed that acculturation and ability to speak English were directly associated with awareness about cancer preventive genetic tests (Vadaparampil et al., 2006). Manne et al.’s study of foreign-born South Asians in the Metropolitan New York/New Jersey area showed that individuals who lived in the US for a long time and spoke English more often were more likely to have had a colorectal cancer screening test (Manne et al., 2015). Low acculturated Latinos in the US have been shown to have a lower level of knowledge and awareness about skin cancer risk factors and prevention methods (Rodríguez et al., 2017). This study also suggested that linguistic acculturation might be associated with the ability of Latinos to read and understand received skin cancer prevention messages and also the chemical contents of skin products (Rodríguez et al., 2017). Low acculturated Latinos also had different perceptions of skin cancer and were more doubtful about prevention methods such as sunscreens and lotions (Rodríguez et al., 2017). Studies in Canada have shown similar results. Higher acculturation was associated with higher health knowledge among Spanish and Korean immigrants in Canada (Thomson and Hoffman-Goetz, 2010; Oh et al., 2013).

**1.1.7. The association between health behaviours and acculturation**

Environmental, cultural, economic, and social factors affect immigrants’ behaviours (Azar et al., 2013; Joshi et al., 2014). Acculturation has been shown to be strongly associated with lifestyle choices such as tobacco use, dietary habits, physical activity patterns, and other health behaviours (Wiking, Johansson and Sundquist, 2004; P Yavari et al., 2006; Parvin Yavari et al., 2006; Hosper, Klazinga and Stronks, 2007; An et al., 2008; Constantine et al., 2010; Thomson and Hoffman-Goetz, 2010; Gorman, Lariscy and Kaushik, 2014; Ro and Bostean, 2015; Shah et al., 2015;
Walker et al., 2015; Gotay et al., 2015; Guo et al., 2015; Nelson-Peterman et al., 2015; Wu and Smith, 2016; Yi et al., 2016). Overall, most studies on immigrants’ acculturation and cancer risk factors were conducted on Hispanic populations.

This literature review first focused on studies of the Iranian population. Given few studies in Iranian immigrants, the literature search was extended to other Middle East populations because of their similarities in political, cultural, ecological, and economic characteristics and cancer statistics (Galal, 2003), and then to Asian immigrants. As detailed above, smoking, obesity, physical activity, and alcohol consumption are the most critical lifestyle risk factors for cancer. The associations between each of these risk factors and acculturation in these immigrant populations are discussed separately below.

1.1.7.1. Association between obesity and acculturation

Wu et al. (2016) showed higher acculturation was associated with higher BMI in both male and female Chinese students (Wu and Smith, 2016). Guo et al.’s study among Asian immigrants in Australia (2015), Ro et al.’s research on Asian immigrants in the US (2015), and Shah et al.’s study of Asian immigrants in the UAE (2015) showed the same results (Guo et al., 2015; Ro and Bostean, 2015; Shah et al., 2015). However, Delavari et al. (2015) found that acculturation in Iranian immigrants in Australia was not associated with BMI or dietary habits (Delavari et al., 2015a).

1.1.7.2. Association between smoking and acculturation

The literature review on the relationship between smoking habits and acculturation showed that smoking prevalence among immigrants is related to acculturation. For example, a review by Gotay et al. (2015) indicated that acculturation was associated with smoking among Chinese immigrants. However, gender played a vital role in the effect of acculturation. Men with higher acculturation scores had lower smoking prevalence than less-acculturated men. The results among women were opposite. More acculturated women smoked more in comparison with less acculturated women (Gotay et al., 2015). Constantine et al.’s study of Southeast Asian immigrants in the US (2010)
and An et al.’s study of Asian immigrants in the US (2007) showed the same gender-specific effects of acculturation on smoking (An et al., 2008; Constantine et al., 2010). Guo et al.’s study of Asian immigrants in Australia (2015) and Gorman et al.’s work among Asian immigrants in the US (2014) showed that more years of staying in a country of destination, which is one acculturation indicator, was associated with a higher prevalence of smoking (Gorman, Lariscy and Kaushik, 2014; Guo et al., 2015). However, Gorman et al. (2014) reported higher English proficiency, another indicator of higher acculturation, was associated with a lower frequency of smoking (Gorman, Lariscy and Kaushik, 2014).

1.1.7.3. Association between acculturation and alcohol consumption

Tran et al. (2015) found that a higher acculturation score was related to lower alcohol consumption among Vietnamese immigrants in Australia. However, the results were not statistically significant (Tran et al., 2015).

1.1.7.4. Association between diet and acculturation

Delavari et al.’s study (2015) on 152 Iranian immigrants in Australia found no significant association between food habits and acculturation. However, food habits were related to household income in this study. Iranian immigrants from middle-income households were found to have an obesogenic diet in comparison to Iranians from high and low household incomes (Delavari et al., 2015).

1.1.7.5. Association between acculturation and physical activity

Walker et al. (2015) found no statistically significant relationship between light leisure-time physical activity and acculturation among South Asian immigrants in Canada. However, vigorous leisure-time physical activity had a strong positive association with acculturation (Walker et al., 2015). Yi et al.’s study of Chinese immigrants in the US (2016), Nelson-Peterman et al.’s examination of Cambodian refugees and immigrants in the US (2015), Guo et al.’s study of Northeast Asian-born immigrants in Australia (2015), and Hosper et al.’s study on Turkish
immigrants in the Netherlands (2007) all showed that physical activity level was positively associated with acculturation (Hosper, Klazinga and Stronks, 2007; Guo et al., 2015; Nelson-Peterman et al., 2015; Yi et al., 2016). Hosper et al. found that the association was stronger for people without children, living in an attractive neighbourhood, and with no professional activity (Hosper, Klazinga and Stronks, 2007). However, Koca et al. (2014) found that acculturation was not associated with physical activity level among Turkish immigrants in Europe (Koca and Lapa, 2014). Delavari et al. (2015) also found that acculturation was not associated with physical activity level among Iranian immigrants in Australia (Delavari et al., 2015).

1.1.8. Mediation effect

The mediator is a variable that interferes in the association between dependent and independent variables. In the mediation model instead of a direct association between the independent and dependent variable, independent variable affects the mediator and mediator affects the dependent variable (Baron and Kenny, 1986; MacKinnon, Fairchild and Fritz, 2007). A single-mediator model has been shown in Figure 3. The mediation effect might seem very simple. However, considering the third variable mediating the main association could lead to complicated results and interpretations (MacKinnon, Fairchild and Fritz, 2007).

![Figure 3: The single-mediator model](image)

If the mediator accounts for all of the observed association between the independent and dependent variable, the mediation effect will be called full mediation (MacKinnon, Fairchild and Fritz, 2007; Rucker et al., 2011). If the mediator accounts for some of the observed association, it would be
called partial mediation (MacKinnon, Fairchild and Fritz, 2007; Rucker et al., 2011). In full mediation, one mediator variable is responsible for the mediation effect (MacKinnon, Fairchild and Fritz, 2007; Rucker et al., 2011). However, in partial mediation, multiple variables should be examined as a mediator (MacKinnon, Fairchild and Fritz, 2007; Rucker et al., 2011). Mediation analysis refers to a series of analyses to understand the association between dependent and independent variables in the presence of the mediator (Baron and Kenny, 1986; Hayes, 2009). The causal steps approach outlined based on Baron and Kenney’s work is widely cited method to assess mediation effects (Baron and Kenny, 1986; MacKinnon, Fairchild and Fritz, 2007).

**Purpose**

Canada is one of the world’s most welcoming countries for immigrants. After Iran’s revolution in 1979, a large number of Iranians started to emigrate to Canada and other western countries (P Yavari et al., 2006). According to 2016 census data, 47,985 Iranians are living in BC, and almost 77% of them were born in Iran (STATCAN, 2016).

There are virtually no data on Iranian immigrants in Canada and North America and the effects of acculturation on their awareness of cancer risk factors. The growing number of Iranian immigrants in Canada and the limited number of studies on this population support the importance of this study.

This study aimed to fill the evidence gap on the effects of acculturation on health awareness among Iranian immigrants. The results could be used to improve healthcare policies for low-acculturated immigrants to increase their health awareness and educate them about cancer risk factors. The current study also examined the prevalence of obesity, smoking, alcohol consumption, physical inactivity, red/processed meat intake, and fruit and vegetable intake among Iranian immigrants in the Greater Vancouver area. The association between acculturation and cancer risk factors among Iranian immigrants was also investigated.

**Study goals and objectives**
The primary hypothesis of this study is that the level of acculturation among Iranian immigrants is associated with their awareness of cancer risk factors and likelihood of exhibiting cancer behavioural risk factors that are more prevalent in Canada than in Iran including fruit and vegetable intake, and red/processed meat intake, smoking, physical activity, and alcohol consumption.

Specifically, it is hypothesized that acculturation is positively associated with awareness of cancer risk factors, and positively correlated with healthy behaviours (i.e., less overweight, obesity, smoking, alcohol consumption, and red/processed meat intake, and more physical activity, and fruit and vegetable intake).

Based on these hypotheses, the three objectives for this study are:

• To understand the relationship between acculturation and cancer awareness among Iranian immigrants who live in Greater Vancouver.

• To understand the relationship between acculturation and likelihood of exhibiting cancer risk factors (including overweight, obesity, smoking, alcohol consumption, binge drinking, low physical activity, low fruit and vegetable intake, and high red/processed meat intake) among Iranian immigrants who live in Greater Vancouver.

• To examine whether awareness of cancer risk factors mediates the association between acculturation and cancer behavioural risk factors (including overweight, obesity, smoking, alcohol consumption, binge drinking, physical activity, fruit, vegetable, and red/processed meat intake) among Iranian immigrants who live in Greater Vancouver.
Table 1.1: A summary of the literature review

<table>
<thead>
<tr>
<th>Variable name</th>
<th>Variable role</th>
<th>Concept</th>
<th>Source/Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acculturation</td>
<td>Main explanatory</td>
<td>Acculturation is defined as a cultural and psychological process in which a member of a group in the minority adapts to the culture, behaviours, and beliefs of another group in the majority.</td>
<td>Berry/1997</td>
</tr>
<tr>
<td>Awareness of cancer risk factors</td>
<td>Outcome</td>
<td>Cancer awareness refers to public knowledge about cancer prevention, such as knowledge about cancer risk factors and the role of a healthy lifestyle such as physical activity and healthy diet in relation to cancer.</td>
<td>Stubbings/2009 Ramirez/2013</td>
</tr>
<tr>
<td>Cancer risk behaviours</td>
<td>Outcome</td>
<td>Cancer is a preventable disease, and an unhealthy lifestyle is responsible for almost 80% of deaths from cancer. The unhealthy lifestyle characteristics including overweight, obesity, smoking, alcohol consumption, binge drinking, physical activity, daily intake of less than five servings of fruit and vegetable, and daily intake of red/processed meat increased the chance of cancer.</td>
<td>Schottenfeld/2006 Anand/2008 Koochek/2008 Brown/2012 Varela-Rey/2013 Cong/2014 WHO/2015 Ordóñez-Mena/2016</td>
</tr>
<tr>
<td>Sociodemographic variables</td>
<td>Exploratory</td>
<td>The sample characteristics including age, gender, education level, marital status, and current job were associated with acculturation, awareness of cancer risk factors, and lifestyle choices.</td>
<td>Wiking/2004 Wong/2009</td>
</tr>
</tbody>
</table>
2. Chapter 2: Methods

Study design and participants

This is a cross-sectional study of non-pregnant Iranian immigrants living in Greater Vancouver, born in Iran, aged 18 to 55, without a prior diagnosis of cancer. Iranian immigrants were reached through voluntary and snowball sampling techniques. Invitations were sent from 22 January 2018 till March 12th in a weekly base via email, Facebook, and other messaging apps such as WhatsApp and Telegram. Also, invitations were distributed in Iranian restaurants, markets, pharmacies, mosques, Iranian societies at UBC and SFU, and other venues where Iranian immigrants are found. To improve the recruitment process, influencers in the Iranian population in BC were contacted in person. The aspects of the study and the benefits for Iranian immigrants were discussed with them. They agreed to share the study’s information with their network. Also, administrators of Facebook pages and Telegram channels for Iranian immigrants in the Greater Vancouver area were contacted, and the details were sent to them and invited to share the information with their users. Information about the study was also tweeted frequently (see Appendices1).

Upon acceptance of the invitation, participants received an electronic questionnaire that included items on demographics, cancer awareness, acculturation, as well as behavioural assessments. The questionnaire was created in UBC Qualtrics. IP addresses were not collected in this survey and the information provided in the database was not linked to the survey responses for privacy.

Translation and back-translation methods were used to provide the Farsi version of questionnaires. Based on this method, the questionnaire was translated into Farsi and then back-translated into English by two different native Iranian researchers who could speak English fluently, and the translation was reviewed by a third person. Each participant had this option to choose which language he/she wanted to use.
This is the first study of the association between acculturation and cancer awareness among Iranian immigrants in Canada and North America, so there were no previous data to be used as a basis for a sample size calculation. This study aimed to achieve the same sample size as a previous study in Iranian immigrants. Delavari et al. aimed to reach 200 Iranian immigrants in Australia, and 152 Iranians agreed to participate in the study (Delavari et al., 2015).

Variables

2.1.1. Outcome variable: Awareness about cancer risk factors

The validated Cancer Awareness Measurement (CAM) questionnaire was used to assess participants’ awareness of cancer risk factors. The CAM was validated by Stubbings et al. in three steps. In the first step, internal reliability was checked through a test-retest process. Cronbach's α was equal to 0.77 for the whole questionnaire. In the second step, the construct validity was established by the known-groups method. Specifically, scientists used the CAM to assess the cancer awareness of 12 cancer experts and 21 non-medical academics. The awareness score, as measured by the CAM, was significantly different between these two groups. For the third step, the researchers checked the sensitivity of the questionnaire by measuring CAM scores before and after a brief educational intervention designed to increase cancer awareness. The results showed that CAM was a valid and reliable questionnaire, and was also sensitive to increased awareness after an awareness improvement intervention (Stubbings et al., 2009).

The 47-item CAM consists of seven sections that assess awareness of cancer risk factors, screening tests, initial signs and symptoms, help-seeking, barriers to help-seeking, the association between age and cancer, and common cancers. The section on “awareness of risk factors” in CAM includes two questions. The first question is an open-ended question which asks participants to describe what factors affect a person’s chance of getting cancer. The second question is a closed-ended question that asks participants to say how much they agree with each factor affecting a person’s chance of getting cancer (see Appendices2). Both of these questions were used to assess the awareness of cancer risk factors among Iranian immigrants in this study.
2.1.2. Outcome variable: Health Behaviours

The questions about health behaviours were selected from the Canadian Community Health Survey (CCHS) questionnaire (CCHS, 2016). These questions covered body weight, past and current smoking habits, alcohol consumption, and binge drinking. Since 2007, CCHS were collected yearly, and these items have been tested and used in about 65,000 Canadians for public health recommendations (STATCAN, 2015b).

A short dietary instrument was used to assess fruit, and vegetable intake (Yaroch et al., 2012; Cook et al., 2015). Previous studies examined the internal reliability of the short dietary instrument and it was 0.70 (Yaroch et al., 2012). The direction and strength of agreement between the short dietary instrument with the food frequency questionnaire (FFQ) and 24-hour dietary recall were determined. Results showed that the short dietary instrument could replace the longer FFQ (correlation coefficient > 0.5) for estimation of population intakes and adequacy screening, but regarding the low correlation between the short dietary instrument with 24-hour recall (correlation coefficient = 0.27) it is not recommended for assessing precise intake levels (Yaroch et al., 2012; Cook et al., 2015). Participants were also asked about the frequency of their red/processed meat intake. This question was added to the questionnaire by the researcher.

A single-item physical activity questionnaire was used to evaluate the level of physical activity (Gill et al., 2012). The reliability of the single-item physical activity questionnaire was examined by test-retest reliability, and the validity was assessed in a sample of 159 individuals. Results showed the reliability of the questionnaire was 0.75, and the validity was 0.31 (Gill et al., 2012).

Participants were also asked if they had changed their health behaviours after immigration. Questions about changes in behaviours after immigration were added to the questionnaire as exploratory items (see Appendices2).
2.1.3. **Main explanatory variable: Acculturation**

Despite extensive research, there is no consensus on the best method to measure acculturation. A large number of studies have used proxy measure to measure acculturation: number of years lived in an adopted country, language preference at home, and second language fluency (Arcia et al., 2001; An et al., 2008; Ellison, Jandorf and Duhamel, 2011; Menon, Szalacha and Prabhughate, 2012; Bharmal, Hays and McCarthy, 2014; Gorman, Lariscy and Kaushik, 2014; Ro and Bostean, 2015). The proxy measurement method has been shown to predict health outcomes (Carter-Pokras et al., 2008)(Ellison, Jandorf and Duhamel, 2011).

The validity and reliability of proxy measures were evaluated among Hispanic immigrants in the US (Cruz et al., 2008). Validity was measured based on the correlation between the results of proxy measures (the number of years lived in the US, overall language preference, and language preference at interview) and the 12-item National Alcohol Survey (NAS) acculturation scale (Cruz et al., 2008). The results showed that proxy measures have high validity and reliability ($r = 0.8$, Cronbach’s alpha = 0.79) (Cruz et al., 2008). Other studies have used other acculturation scales such as the Vancouver Index of Acculturation (VIA) questionnaire (Delavari et al., 2015a; Walker et al., 2015). The VIA questionnaire includes 20 questions and participants answer each of them by indicating the degree of their agreement or disagreement. In this study, based on the demonstrated usefulness of proxy measures and with consideration of limiting the total number of survey questions, the proxy measurement method was used.

Based on existing proxy measure methods to calculate the acculturation score, the following process was used: The language preference of participants in the study (Score 0: Farsi, Score 1: English), length of stay in Canada (Score 0: 5 years or less, Score 1: 6–15 years, and Score 2: 16 or more years), language preference (Score 1: if the preferred language is English, Score 0: if the preferred language is Farsi), and English language fluency (Score 0: not fluent, Score 1: somewhat fluent, and Score 2: extremely fluent), the language that they speak more often (Score 0: only in Farsi, Score 1: more in Farsi than English, Score 2: both Farsi and English equally, Score 3: more in English than Farsi, and Score 4: only in English), the frequency of reading newspapers,
magazines, or books in Farsi (Score 0: very often, Score 1: somewhat often, Score 2: neither often nor rarely, Score 3: somewhat rarely, and Score 4: very rarely), the frequency of eating Persian foods (Score 0: very often, Score 1: somewhat often, Score 2: neither often nor rarely, Score 3: somewhat rarely, and Score 4: very rarely), and being open to marrying outside of the cultural group (Score 0: strongly against, Score 1: moderately against, Score 2: neither open or against, Score 3: moderately open, and Score 4: very open) (see Appendices2) (Wong et al., 2009; Delavari et al., 2015a; Bharmal, Hays and McCarthy, no date). These items were summed to calculate a total acculturation score that ranged from 0 to 22.

2.1.4. Exploratory explanatory variables: Socioeconomic variables

Based on previous research on the association between acculturation and health behaviours, the following sociodemographic factors were chosen: age, gender, education level, marital status, and current job (see Appendices2) (Wiking, Johansson and Sundquist, 2004; Wong et al., 2009).

Statistical analysis

2.1.5. Quantitative analyses

The data were downloaded and cleaned in Microsoft Excel 2016. The statistical analysis was performed in R version 3.4.3, an open source analytics software. Data visualization and Tukey’s method were used to examine outliers. Outliers and inaccurate data were excluded from the data. Mean substitution technic was used for handling the missing data (Kang, 2013). The acculturation scores and awareness scores were calculated for each participant. Histogram and Q-Q plots were used to examine distributions of quantitative data, skewness, and to detect potential outliers for age, acculturation score, and awareness score. The mean, median, ranges, variance, and standard deviation are reported for age, acculturation score, and awareness score. Counts and frequencies were calculated for categorical variables including gender, family history of cancer, education level, marital status, current job, working in the field of health, immigration status, the primary reason for the immigration, BMI, smoking, drinking, binge drinking, self-described physical
activity levels, daily intake of fruit and vegetables, weekly intake of red and processed meat, and changes in these behaviours after immigration. In addition, graphs were used to visualize the data.

The reliability of acculturation and awareness measures was also examined by calculating Cronbach’s alpha.

The acculturation score was categorized. Individuals with an acculturation score of 0 to 6 were categorized as low acculturated, 7 to 14 as moderately acculturated, and 15 to 22 as highly acculturated. The cancer risk factor awareness score was categorized and reported in three levels: low aware (scores 0-14), moderately aware (scores 15-29), and highly aware. (scores 30 to 44).

Participants were asked about their weight and height. BMI was calculated for each participant and categorized into four levels. Individuals with a BMI of less than 18.5 were categorized as “Under Weight”, between 18.5 to 24.9 as “Normal Weight”, between 25 to less than 30 as “Over Weight”, and BMI more than or equal to 30 as “Obese”. Also, participants were asked if their weight had changed after immigration. Their answers were categorized into three levels including “Weight increased after immigration”, “Weight decreased after immigration”, and “Weight did not change after immigration.”

Participants were asked about their current smoking habits. Individuals who reported daily or occasional smoking were categorized as “Smoking: Yes” and individuals who reported that they did not smoke at all were categorized as “Smoking: No”. Also, participants were asked if their smoking status had changed after immigration. Their answers were categorized into five levels including “Quit after immigration”, “Smoking less after immigration”, “Smoking more after immigration”, “Smoking started after immigration”, and “Did not smoke in Iran or Canada”.

Participants were asked about their drinking habits during the past 12 months. Individuals were categorized into two drinking levels: “Drinkers” and “Non-drinkers”. Non-drinkers were those individuals who didn’t drink any alcoholic beverages during the previous year. Participants who were reported drinking during the past 12 months were also asked if they drank five or more drinks on one occasion during the past month. Based on their answers, individuals were categorized into two levels: “Binge drinkers” and “Not Binge drinkers”. Also, participants were asked if their
drinking habit changed after immigration. Their answers were categorized into six levels including “Stopped drinking after immigration”, “Drinking less after immigration”, “Drinking more after immigration”, “Drinking started after immigration”, “Drinking the same amount after immigration”, and “Did not drink in Iran or Canada”.

Participants were asked to describe their physical activity levels. Individuals described themselves as low physically active, moderately physically active, or vigorously physically active. Each level of physical activity was defined for participants (See Appendices2). Participants were also asked if their physical activity had changed after immigration. Their answers were categorized into three levels: “Physical activity increased after immigration”, “Physical activity decreased after immigration”, and “Physical activity did not change after immigration”.

Participants were also asked to report the number of daily servings of fruit consumed. Their answers were categorized into four levels, including daily intake of one serving or less of fruit, daily intake of 1.5 servings of fruit, daily intake of 2-3 servings of fruit, intake of 3.5 servings of fruit or more of fruit.

Participants were also asked to report the number of servings of vegetables. Their answers were categorized into four levels, including daily intake of one serving or less of vegetables, daily intake of 1.5 servings of vegetables, daily intake of 2-3 servings of vegetables, daily intake of 3.5 servings of vegetables or more. Also, participants were asked if their fruit and vegetable intake changed after immigration. Their answers were categorized into 3 levels including “Fruit and vegetable intake increased after immigration”, “Fruit and vegetable intake decreased after immigration”, and “Fruit and vegetable intake did not change after immigration”.

Participants were asked to report how often they ate red/processed meat during the past week. Their answers were categorized into four levels, including none in the last week, three times or less, four to six times, and once or twice a day. Also, participants were asked if their red or processed meat intake changed after immigration. Their answers were categorized into three levels including “Red or processed meat intake increased after immigration”, “Red or processed meat intake decreased after immigration”, and “Red or processed meat intake did not change after immigration”.

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intake decreased after immigration”, and “Red or processed meat intake did not change after immigration”.

Bivariate analysis methods including t-tests, ANOVA, Chi-squared tests, and simple regression models were used to evaluate the associations between variables. Simple logistic regression and multinomial logistic regression models were used to calculate unadjusted odds for different levels of acculturation and awareness of cancer risk factors. The variables that were statistically significant in the bivariate analyses (p<0.05) were examined for inclusion in the multiple multinomial logistic regression models.

To examine the associations between acculturation and cancer risk factor awareness and health behaviours, a series of explanatory models were fitted using simple and multiple multinomial logistic regression methods. A manual forward selection process was used to select the best fitting multivariable model. The best fitting model was chosen based on lower Akaike Information Criterion (AIC). The unadjusted and adjusted odds ratios (OR and AOR) with 95% confidence intervals (95% CI) are reported in the results section.

A causal steps approach was used to examine whether awareness mediates the association between acculturation and health behaviours. In the first step, the association between acculturation (IV) and each health behaviour (DV) was examined by the simple regression model. In the second step, the association between acculturation (IV) and awareness of cancer risk factors (mediator) was assessed. In the third step, the association between acculturation (IV) and health behaviour (DV) was examined in the presence of cancer awareness (mediator) via a multiple regression model. If the association was attenuated, a mediation effect for awareness was possible and bootstrapping was used for significance testing (MacKinnon, Fairchild and Fritz, 2007; Rejeski et al., 2012).

2.1.6. Qualitative analyses:

Participants were also asked to name at least three risk factors for cancer. This question focused on participants’ knowledge about cancer risk factors. Thematic analysis was used to analyze the
data for this open-ended question. NVivo Pro 11 was used to organize, analyze, and summarize the data. The thematic analysis method involved six phases including data familiarization, creating an initial set of codes, theme generation based on the initial code list, reviewing themes, naming themes, and producing a final set of themes. In this method, the transcripts were coded into labels, and then the data were compiled, sorted, and summarized. A list of codes was generated by using both pre-set and open methods.

In the beginning, the answers from the first 50 participants were read and mapped out to general categories, and the primary list of codes was generated and named as a “start list”. The start list was revised during the remainder of the analysis. In accordance with the open method, the start list was refined during the analysis and the codes were collapsed, broken down to sub-codes, or new codes were added to the start list to ensure the codes fit the data. The final codes were reviewed several times, and themes were created based on the revised and final codes. Final themes and the total number of responses per theme, and percentages for each theme are reported in the results chapter. The codes and interpretations were reviewed by an external researcher.
3. Chapter 3: Results

Scales’ psychometrics

Cronbach’s alpha for the acculturation scale, and awareness measure in this study was 0.67, and 0.76 respectively. Results showed lower than optimal internal consistency for the acculturation scale. The awareness measure had acceptable reliability.

Descriptive analysis

A total of 205 Iranian immigrants participated in this study. 5 records had missing values. An outlier value was detected for BMI (BMI=70) that was subsequently treated as missing. The number of missing values were less than 5%. Mean substitution technique was used to handle missing quantitative values. Missing categorical values were replaced by the most frequent value. Participants were aged between 20 and 55 years old. 170 individuals completed the survey in English, and 35 individuals preferred the Farsi version. The mean age was 39.3 years, and the median was 39 years. As seen in Table 1, almost three-quarters were female, and almost all had at least a college education. Four out of five had held a job in the past 12 months, with nearly one in five working in health-related fields. Two-thirds were married, and 83% were either Canadian citizens or permanent residents. The most common reason for immigration was to study, cited by one-third of participants.
<table>
<thead>
<tr>
<th>Table 3.1: Sociodemographic Variables</th>
<th>N (N=205)</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>150</td>
<td>73%</td>
</tr>
<tr>
<td>Male</td>
<td>55</td>
<td>27%</td>
</tr>
<tr>
<td><strong>Marital status</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>135</td>
<td>66%</td>
</tr>
<tr>
<td>Single</td>
<td>46</td>
<td>22%</td>
</tr>
<tr>
<td>Divorced</td>
<td>15</td>
<td>7%</td>
</tr>
<tr>
<td>Living common law</td>
<td>5</td>
<td>4%</td>
</tr>
<tr>
<td>Widowed</td>
<td>1</td>
<td>1%</td>
</tr>
<tr>
<td><strong>Education level</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than college</td>
<td>9</td>
<td>4%</td>
</tr>
<tr>
<td>College/university degree</td>
<td>81</td>
<td>40%</td>
</tr>
<tr>
<td>Post-bachelor degree</td>
<td>115</td>
<td>56%</td>
</tr>
<tr>
<td><strong>Current employment</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>167</td>
<td>81%</td>
</tr>
<tr>
<td>No</td>
<td>38</td>
<td>19%</td>
</tr>
<tr>
<td><strong>Working in the field of health</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>39</td>
<td>19%</td>
</tr>
<tr>
<td>No</td>
<td>166</td>
<td>81%</td>
</tr>
<tr>
<td><strong>The main reason for immigration</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Study</td>
<td>66</td>
<td>33%</td>
</tr>
<tr>
<td>Work</td>
<td>20</td>
<td>10%</td>
</tr>
<tr>
<td>Instability</td>
<td>30</td>
<td>15%</td>
</tr>
<tr>
<td>Refugee</td>
<td>3</td>
<td>1%</td>
</tr>
<tr>
<td>Poverty</td>
<td>2</td>
<td>1%</td>
</tr>
<tr>
<td>Other</td>
<td>81</td>
<td>40%</td>
</tr>
<tr>
<td><strong>Immigration status</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Citizen</td>
<td>90</td>
<td>44%</td>
</tr>
<tr>
<td>Permanent resident</td>
<td>70</td>
<td>39%</td>
</tr>
<tr>
<td>With a permit</td>
<td>35</td>
<td>17%</td>
</tr>
</tbody>
</table>
The mean age for women (mean of age= 40.1) was significantly higher than that for men (mean of age= 37.2). The mean age was not significantly different according to education or current employment status.

There was no significant association between gender and level of education (p-value = 0.80) or being employed (p-value = 0.27).

Acculturation scores were between 2 and 20. The mean acculturation score was 9.80 (sd= 3.4) and the median was 9. 17% of participants were categorized as low acculturated, 72% were moderately acculturated, and 11% were highly acculturated. As seen in Table 2, almost half of the participants were living in Canada for five years or less, and nearly all of them were speaking Farsi at home. 51% of participants were mostly or only speaking in Farsi. Almost one-third described their English fluency as extremely fluent. The majority were reading books and magazines in Farsi and ate Persian foods regularly. 61% mentioned that they are moderately or very open regarding marriage outside of the cultural group.

The bivariate analyses results showed statistically significant associations between being highly acculturated and age (OR: 0.92, 95% CI: [0.86, 0.98]), being married (OR: 0.14, 95% CI: [0.04, 0.48]), being a Canadian citizen (OR: 6.61, 95% CI: [1.13, 38.70]), and younger at the time of arrival (OR: 0.92, 95% CI: [0.81, 0.92]).
<table>
<thead>
<tr>
<th>Table 3.2: Acculturation</th>
<th>N (N=205)</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>The length of stay in Canada</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 years or less</td>
<td>105</td>
<td>51%</td>
</tr>
<tr>
<td>6-15 years</td>
<td>70</td>
<td>34%</td>
</tr>
<tr>
<td>16 years or more</td>
<td>30</td>
<td>15%</td>
</tr>
<tr>
<td><strong>The language participants usually speak at home</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Farsi</td>
<td>197</td>
<td>96%</td>
</tr>
<tr>
<td>English</td>
<td>8</td>
<td>4%</td>
</tr>
<tr>
<td><strong>The language participants speak more</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Only Farsi</td>
<td>12</td>
<td>6%</td>
</tr>
<tr>
<td>More Farsi</td>
<td>92</td>
<td>45%</td>
</tr>
<tr>
<td>Both English and Farsi Equally</td>
<td>76</td>
<td>37%</td>
</tr>
<tr>
<td>More English</td>
<td>25</td>
<td>12%</td>
</tr>
<tr>
<td><strong>English language fluency</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not fluent</td>
<td>18</td>
<td>9%</td>
</tr>
<tr>
<td>Somewhat fluent</td>
<td>109</td>
<td>53%</td>
</tr>
<tr>
<td>Extremely fluent</td>
<td>78</td>
<td>38%</td>
</tr>
<tr>
<td><strong>Reading newspapers, magazines, or books in Farsi</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Very often</td>
<td>40</td>
<td>20%</td>
</tr>
<tr>
<td>Somewhat often</td>
<td>46</td>
<td>23%</td>
</tr>
<tr>
<td>Neither often, nor rarely</td>
<td>36</td>
<td>17%</td>
</tr>
<tr>
<td>Somewhat rarely</td>
<td>45</td>
<td>22%</td>
</tr>
<tr>
<td>Very rarely</td>
<td>38</td>
<td>18%</td>
</tr>
<tr>
<td><strong>Eating Persian food</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Very often</td>
<td>118</td>
<td>58%</td>
</tr>
<tr>
<td>Somewhat often</td>
<td>50</td>
<td>24%</td>
</tr>
<tr>
<td>Neither often, nor rarely</td>
<td>29</td>
<td>14%</td>
</tr>
<tr>
<td>Somewhat rarely</td>
<td>8</td>
<td>4%</td>
</tr>
<tr>
<td><strong>Openness to marrying outside of the cultural group</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strongly against</td>
<td>6</td>
<td>3%</td>
</tr>
<tr>
<td>Moderately against</td>
<td>19</td>
<td>10%</td>
</tr>
<tr>
<td>Neither open or against</td>
<td>54</td>
<td>26%</td>
</tr>
<tr>
<td>Moderately open</td>
<td>50</td>
<td>24%</td>
</tr>
<tr>
<td>Very open</td>
<td>76</td>
<td>37%</td>
</tr>
</tbody>
</table>
The association between awareness and acculturation

Participants in this study were asked to name at least three cancer risk factors. 190 individuals answered this question. Responses were categorized into themes including diet and nutrition-related risk factors, genetic and family history of cancer, smoking, stress, environmental factors and air pollution, drinking, sedentary lifestyle, lifestyle, emotional, exposure to radiation and chemicals, sunburn, cell phones, cosmetics, cultural differences, economy, low level of information, sleep problems, hygiene, and occupation. The mean theme number which were suggested by each participant was 2.78. The maximum number of themes which were suggested by one participant was six. The frequency and the proportion of people who cite each theme out of the number who provide at least one answer are summarized in Table 3.

The top five suggested themes were diet and food-related risk factors, genetic and family history of cancer, smoking, stress, and environmental factors and air pollution.
| Table 3.3: the frequency and proportion of cancer risk factors named by participants |
|-----------------------------------------------|--------|--------|
| Diet and food-related risk factors           | 145    | 0.76   |
| Genetic and family history of cancer         | 88     | 0.46   |
| Smoking                                       | 82     | 0.43   |
| Stress                                        | 77     | 0.41   |
| Environmental factors and air pollution       | 49     | 0.26   |
| Drinking                                     | 31     | 0.16   |
| Sedentary Lifestyle                           | 23     | 0.12   |
| Lifestyle                                     | 16     | 0.08   |
| Emotional                                    | 15     | 0.08   |
| Exposure to radiation                         | 14     | 0.07   |
| Exposure to chemicals                         | 14     | 0.07   |
| Obesity                                       | 11     | 0.06   |
| Sunburn                                       | 6      | 0.03   |
| Cellphones                                    | 3      | 0.01   |
| Cosmetics                                     | 2      | 0.01   |
| Cultural differences                          | 2      | 0.01   |
| Economy                                       | 2      | 0.01   |
| Low level of information                      | 2      | 0.01   |
| Sleep problems                                | 2      | 0.01   |
| Hygiene                                       | 1      | 0.01   |
| Occupation                                    | 1      | 0.01   |

In another question, participants were asked to say how much they agree with each factor affecting a person’s chance of getting cancer. Total awareness score and the awareness score for each cancer risk is reported. The total awareness scores were between 10 and 44. The mean awareness score was 28.3 (sd= 5.7), and the median was 28 (IQR= 25-32). The mean awareness score for each cancer risk factor among Iranian immigrants in this study is summarized in Table 4. The score for each risk factor is between 0 and 4. Participants in this study were highly aware of smoking as a
cancer risk factor. Awareness that the risk of cancer increased with age was low. The majority of participants in this study were not aware that eating less than five portions of fruit and vegetable a day, eating red or processed meat once a day or more, getting sunburnt more than once as a child, and infection with HPV increase the chance of getting cancer.

<table>
<thead>
<tr>
<th>Table 3.4: Awareness of cancer risk factors</th>
<th>n (%)</th>
<th>Mean (sd)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smoking any cigarettes at all</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strongly disagree</td>
<td>17 (8%)</td>
<td>3.16(1.20)</td>
</tr>
<tr>
<td>Disagree</td>
<td>7 (3%)</td>
<td></td>
</tr>
<tr>
<td>Not sure</td>
<td>10 (5%)</td>
<td></td>
</tr>
<tr>
<td>Agree</td>
<td>65 (32%)</td>
<td></td>
</tr>
<tr>
<td>Strongly agree</td>
<td>106 (52%)</td>
<td></td>
</tr>
<tr>
<td>Exposure to another person’s cigarette smoke</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strongly disagree</td>
<td>15 (7%)</td>
<td>2.96(1.12)</td>
</tr>
<tr>
<td>Disagree</td>
<td>6 (3%)</td>
<td></td>
</tr>
<tr>
<td>Not sure</td>
<td>28 (14%)</td>
<td></td>
</tr>
<tr>
<td>Agree</td>
<td>82 (40%)</td>
<td></td>
</tr>
<tr>
<td>Strongly agree</td>
<td>74 (36%)</td>
<td></td>
</tr>
<tr>
<td>Drinking more than 1 unit of alcohol a day</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strongly disagree</td>
<td>9 (4%)</td>
<td>2.63(0.98)</td>
</tr>
<tr>
<td>Disagree</td>
<td>12 (6%)</td>
<td></td>
</tr>
<tr>
<td>Not sure</td>
<td>61 (30%)</td>
<td></td>
</tr>
<tr>
<td>Agree</td>
<td>87 (43%)</td>
<td></td>
</tr>
<tr>
<td>Strongly agree</td>
<td>36 (17%)</td>
<td></td>
</tr>
<tr>
<td>Eating less than 5 portions of fruit and vegetable a day</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strongly disagree</td>
<td>6 (3%)</td>
<td>2.28(0.87)</td>
</tr>
<tr>
<td>Disagree</td>
<td>26 (13%)</td>
<td></td>
</tr>
<tr>
<td>Not sure</td>
<td>90 (44%)</td>
<td></td>
</tr>
<tr>
<td>Agree</td>
<td>70 (34%)</td>
<td></td>
</tr>
<tr>
<td>Strongly agree</td>
<td>13 (6%)</td>
<td></td>
</tr>
<tr>
<td>Eating red or processed meat once a day or more</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strongly disagree</td>
<td>3 (2%)</td>
<td>2.41(0.93)</td>
</tr>
<tr>
<td>Disagree</td>
<td>29 (14%)</td>
<td></td>
</tr>
<tr>
<td>Not sure</td>
<td>80 (39%)</td>
<td></td>
</tr>
<tr>
<td>Risk Factor</td>
<td>Agree</td>
<td>Strongly agree</td>
</tr>
<tr>
<td>------------------------------------------------</td>
<td>----------------</td>
<td>----------------</td>
</tr>
<tr>
<td>Being overweight (BMI over 25)</td>
<td>67 (33%)</td>
<td>26 (12%)</td>
</tr>
<tr>
<td>Getting sunburnt more than once as a child</td>
<td>5 (3%)</td>
<td>18 (9%)</td>
</tr>
<tr>
<td>Being over 70 years old</td>
<td>12 (6%)</td>
<td>53 (26%)</td>
</tr>
<tr>
<td>Having a close relative with cancer</td>
<td>5 (3%)</td>
<td>6 (3%)</td>
</tr>
<tr>
<td>Infection with HPV (Human Papillomavirus)</td>
<td>5 (3%)</td>
<td>10 (5%)</td>
</tr>
<tr>
<td>Doing less than 30 minutes of moderate physical activity 5 times a week</td>
<td>2 (1%)</td>
<td>18 (9%)</td>
</tr>
</tbody>
</table>
The association between different levels of awareness of cancer risk factors and acculturation (p-value <0.05) was statistically significant. The odds of being highly aware of cancer risk factors were positively associated with acculturation (OR: 1.14, 95% CI: [1.01, 1.29]).

In addition to analyzing the data regarding the thesis hypotheses, the following bivariate exploratory analyses between awareness and sociodemographic variables were conducted. Results showed the association between different levels of awareness about cancer risk factors and working in the health field (OR: 6.93, 95% CI: [2.32, 20.71]).

The multinomial logistic regression models were fitted to evaluate the association between different levels of awareness of cancer risk factors and acculturation. The results were adjusted for personal variables. There was a small and non-significant association between acculturation and being moderately aware of cancer risk factors (AOR: 1.10, 95% CI: [0.99, 1.23]). For every one unit increase in acculturation score, the odds of being highly aware of cancer risk factors were 1.28 times the odds of being highly aware of cancer risk factors for somebody who had an acculturation score of one unit lower, adjusting for other variables (AOR: 1.28, 95% CI: [1.09, 1.50]).

<table>
<thead>
<tr>
<th></th>
<th>Odds Ratio</th>
<th>Confidence Interval (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adjusted odds of moderate awareness</td>
<td>1.10</td>
<td>(0.99, 1.23)</td>
</tr>
<tr>
<td>Adjusted odds of high awareness</td>
<td>1.28 *</td>
<td>(1.09, 1.50)</td>
</tr>
</tbody>
</table>

Table 3.5: The adjusted odds of different levels of awareness score with acculturation score

CI = Confidence Interval
*p ≤ 0.05
The association between health behaviours and acculturation

In this section, the association between acculturation and likelihood of exhibiting cancer risk factors (including overweight, obesity, smoking, alcohol consumption, binge drinking, physical activity, fruit, vegetable, and red/processed meat intake) among Iranian immigrants who live in Greater Vancouver is reported.

Participants were asked to report the changes in their health behaviour after immigration. Their answers are summarized in Table 6. The majority of participants experienced an increase in their weight after immigration. Four out of five did not smoke in Iran or Canada. 40% started to drink or drank more after immigration. Almost 50% of participants experienced an increase in their physical activity level after immigration. The amount of fruit, vegetable, and red meat intake did not change after immigration in almost half of the participants.

<table>
<thead>
<tr>
<th>Table 3.6: Changes in Behaviour after immigration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Changes in weight</td>
</tr>
<tr>
<td>Increase after immigration</td>
</tr>
<tr>
<td>No changes</td>
</tr>
<tr>
<td>Decreased after immigration</td>
</tr>
<tr>
<td>Changes in smoking</td>
</tr>
<tr>
<td>Started after immigration</td>
</tr>
<tr>
<td>Increase after immigration</td>
</tr>
<tr>
<td>Decreased after immigration</td>
</tr>
<tr>
<td>Quit after immigration</td>
</tr>
<tr>
<td>Changes in drinking</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>---------------------------</td>
</tr>
<tr>
<td>Increase after immigration</td>
</tr>
<tr>
<td>No changes</td>
</tr>
<tr>
<td>Decreased after immigration</td>
</tr>
<tr>
<td>Quit after immigration</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Physical activity</th>
<th>Increase after immigration</th>
<th>91</th>
<th>45%</th>
</tr>
</thead>
<tbody>
<tr>
<td>No changes</td>
<td></td>
<td>55</td>
<td>27%</td>
</tr>
<tr>
<td>Decreased after immigration</td>
<td></td>
<td>57</td>
<td>28%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fruit and vegetable intake</th>
<th>Increase after immigration</th>
<th>66</th>
<th>32%</th>
</tr>
</thead>
<tbody>
<tr>
<td>No changes</td>
<td></td>
<td>94</td>
<td>46%</td>
</tr>
<tr>
<td>Decreased after immigration</td>
<td></td>
<td>43</td>
<td>21%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Red/processed meat intake</th>
<th>Increase after immigration</th>
<th>24</th>
<th>12%</th>
</tr>
</thead>
<tbody>
<tr>
<td>No changes</td>
<td></td>
<td>109</td>
<td>53%</td>
</tr>
<tr>
<td>Decreased after immigration</td>
<td></td>
<td>70</td>
<td>35%</td>
</tr>
</tbody>
</table>

### 3.1.1. The association between obesity and acculturation

Participants’ BMI was between 19.3 and 33.4. The mean BMI was 25.1, and the standard deviation was 4.00. 4% of participants were underweight, 53% were of normal weight, 30% were overweight, and 13% were obese.
The bivariate analyses did not show a significant association between acculturation and being overweight or obese (p-value = 0.07).

In addition to analyzing the data regarding the thesis hypotheses, the following bivariate exploratory analyses between being overweight or obese and sociodemographic variables were conducted. The results showed there was a significant association between having a BMI more than 25 and age (OR: 1.05, 95% CI: [1.01, 1.09]), and being male (OR: 2.95, 95% CI: [1.45, 6.00]).

A multivariable multinomial model was fitted, and the adjusted odds are reported in Table 7. Multivariable analyses showed the association between acculturation and being overweight or obese was not statistically significant.

3.1.2. The association between smoking and acculturation

87% of participants reported that they do not smoke, 10% reported occasionally smoking, and 3% reported daily smoking. Data were relevelled, and participants who reported daily or occasionally smoking were categorized as smokers. 33% of daily smokers and 70% of occasional smokers were female.

The bivariate analyses did not show a significant association between smoking and acculturation (p-value = 0.42).

In addition to analyzing the data regarding the thesis hypotheses, the following bivariate exploratory analyses between smoking and sociodemographic variables were conducted. Results showed that not smoking is significantly associated with holding a post-bachelor degree (OR 0.37 [95% CI: 0.14, 0.81]), and being married (OR 0.37 [95% CI: 0.16, 0.85]).

Multivariable logistic regression was fitted, and the adjusted odds are reported in Table 7. The results did not show any association between smoking and acculturation.
3.1.3. The association between current drinking and acculturation

Acculturation and current drinking 75% (n= 154) of participants reported drinking alcohol during the past year.

The bivariate analyses showed the associations between drinking and acculturation was statistically significant (OR: 1.31, 95% CI: [1.17, 1.48]).

In addition to analyzing the data regarding the thesis hypotheses, the following bivariate exploratory analyses between drinking and sociodemographic variables were conducted. Results showed there were significant associations between drinking and not holding a post-bachelor degree (OR: 0.45, 95% CI: [0.22, 0.91]), and being a Canadian citizen (OR: 3.33, 95% CI: [1.39, 8.07]).

A multivariable logistic model was fitted, and adjusted odds are reported in Table 7. Drinking was significantly associated with acculturation. For every one unit increase in acculturation score, the odds of drinking were 1.30 times higher, adjusting for other variables (AOR 1.30 [95% CI: 1.14, 1.50]).

3.1.4. The association between acculturation and binge drinking

32% of participants who reported drinking during the past 12 months reported drinking at least 5 shots of alcohol on at least one occasion during the month before the survey. These participants were categorized as binge drinkers.

The bivariate analyses results did not show a significant association between binge drinking and acculturation (p-value = 0.20).

In addition to analyzing the data regarding the thesis hypotheses, the following bivariate exploratory analyses between binge drinking and sociodemographic variables were conducted.
The association between binge drinking and gender was significant. The odds of binge drinking among male participants were 2.57 times the odds of binge drinking among female participants (OR: 2.57, 95% CI: [1.21, 5.40]).

A multivariable logistic model was fitted, and adjusted odds are reported in Table 7. There was also no significant association between acculturation and binge drinking.

3.1.5. The association between acculturation and current physical activity level

Participants were asked to describe their physical activity. 34% reported low physical activity, 54% reported moderate activity level, and 12% reported vigorous physical activity.

The bivariate analyses did not show a significant association between the level of physical activity and acculturation (p-value = 0.25).

In addition to analyzing the data regarding the thesis hypotheses, the following bivariate exploratory analyses between physical activity level and sociodemographic variables were conducted. Results showed the association between being vigorously active with age at the time of arrival in Canada was significant ((OR: 0.95, 95% CI: [0.91, 0.99])).

A multivariable logistic model was fitted, and adjusted odds are reported in Table 7. There was no significant association between acculturation and self-described physical activity level.
3.1.6. The association between acculturation and fruit and vegetable intake

3.1.6.1. Acculturation and fruit intake
Participants were categorized into four groups based on their fruit intake. 30% of participants reported intake of 1 unit or less of fruit daily, 29% reported around 1.5 servings, 22% reported 2-3 servings, 17% reported more than 3.5 servings.

The bivariate analyses did not show a significant association between the daily fruit intake and acculturation (p-value = 0.23).

In addition to analyzing the data regarding the thesis hypotheses, the following bivariate exploratory analyses between the daily fruit intake with sociodemographic variables, and awareness of cancer risk factors were conducted. Results showed the odds of consuming 3.5 servings or more of fruit daily versus consuming less than one serving of fruit daily was directly associated with higher awareness (OR: 1.15, 95% CI: [1.06, 1.25]).

A multivariable logistic model was fitted, and adjusted odds are reported in Table 7. There was no significant association between acculturation and daily intake of fruit.

3.1.6.2. Acculturation and vegetable intake
Participants were categorized into four groups based on their vegetable intake. 31% of participants reported an intake of 1 serving or less of vegetables daily, 26% reported intake of 1.5 servings, 24% reported 2-3 servings, 19% reported more than 3.5 servings.

The bivariate analyses did not show a significant association between daily fruit intake and acculturation (p-value = 0.55).

In addition to analyzing the data regarding the thesis hypotheses, the following bivariate exploratory analyses between daily vegetable and fruit intake with sociodemographic variables and awareness were conducted. Results showed the odds of consuming 3.5 servings or more of
vegetables daily versus consuming less than one serving of vegetable daily was directly associated with higher awareness (OR: 1.16, 95% CI: [1.07, 1.26]).

A multivariable logistic model was fitted, and adjusted odds are reported in Table 7. The results showed there was no significant association between acculturation and daily intake of vegetables.

### 3.1.7. The association between acculturation and red meat and processed meat intake

Participants were asked to report their weekly frequency of red and processed meat intake. Participants were categorized into four groups. 7% of participants in this study reported that they consume red and/or processed meat daily. 17% reported that they ate red and/or processed meat 4 to 6 times in the last week, 61% had red and/or processed meat three times or less per last week, and 15% did not have any red and/or processed meat during the last week.

The bivariate analyses did not show a significant association between daily red and processed meat intake and acculturation (p-value = 0.52).

In addition to analyzing the data regarding the thesis hypotheses, the following bivariate exploratory analyses between the frequency of red/processed meat intake per week and sociodemographic variables were conducted, and the bivariate analyses did not show a significant association.

A multivariable logistic model was fitted, and adjusted odds are reported in Table 7. There was no significant association between acculturation and daily intake of red and processed meat.
Table 3.7: the association between the likelihood of behaviours and acculturation (95% Confidence Intervals)

<table>
<thead>
<tr>
<th>Category</th>
<th>Adjusted Odds Ratio</th>
<th>CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overweight: BMI: 25.0-29.9&lt;sup&gt;1&lt;/sup&gt;</td>
<td>0.93</td>
<td>(0.83 1.03)</td>
</tr>
<tr>
<td>Obese: BMI ≥ 30&lt;sup&gt;1&lt;/sup&gt;</td>
<td>1.05</td>
<td>(0.91 1.21)</td>
</tr>
<tr>
<td>Currently Smoker: Daily/Occasionally&lt;sup&gt;2&lt;/sup&gt;</td>
<td>0.88</td>
<td>(0.75 1.01)</td>
</tr>
<tr>
<td>Currently Drinking: Yes&lt;sup&gt;3&lt;/sup&gt;</td>
<td>1.30 *</td>
<td>(1.14 1.50)</td>
</tr>
<tr>
<td>Binge drinking: Yes&lt;sup&gt;4&lt;/sup&gt;</td>
<td>1.03</td>
<td>(0.98 1.27)</td>
</tr>
<tr>
<td>Physical Activity Level: Moderate activity&lt;sup&gt;5&lt;/sup&gt;</td>
<td>0.99</td>
<td>(0.89 1.11)</td>
</tr>
<tr>
<td>Physical Activity Level: Vigorous activity&lt;sup&gt;5&lt;/sup&gt;</td>
<td>1.04</td>
<td>(0.89 1.23)</td>
</tr>
<tr>
<td>Daily Fruit Intake: 1.5 servings&lt;sup&gt;6&lt;/sup&gt;</td>
<td>0.94</td>
<td>(0.83 1.06)</td>
</tr>
<tr>
<td>Daily Fruit Intake: 2-3 servings&lt;sup&gt;6&lt;/sup&gt;</td>
<td>1.06</td>
<td>(0.92 1.21)</td>
</tr>
<tr>
<td>Daily Fruit Intake: 3.5 or more servings&lt;sup&gt;6&lt;/sup&gt;</td>
<td>1.05</td>
<td>(0.91 1.21)</td>
</tr>
<tr>
<td>Daily Vegetable Intake: 1.5 servings&lt;sup&gt;7&lt;/sup&gt;</td>
<td>0.98</td>
<td>(0.87 1.12)</td>
</tr>
<tr>
<td>Daily Vegetable Intake: 2-3 servings&lt;sup&gt;7&lt;/sup&gt;</td>
<td>1.03</td>
<td>(0.91 1.18)</td>
</tr>
<tr>
<td>Daily Vegetable Intake: 3.5 or more servings&lt;sup&gt;7&lt;/sup&gt;</td>
<td>1.09</td>
<td>(0.89 1.18)</td>
</tr>
<tr>
<td>Weekly Red/Processed Meat Intake: None&lt;sup&gt;8&lt;/sup&gt;</td>
<td>1.22</td>
<td>(0.98 1.52)</td>
</tr>
<tr>
<td>Weekly Red/Processed Meat Intake: 3 times or less&lt;sup&gt;8&lt;/sup&gt;</td>
<td>1.09</td>
<td>(0.90 1.32)</td>
</tr>
<tr>
<td>Weekly Red/Processed Meat Intake: 4-6 times&lt;sup&gt;8&lt;/sup&gt;</td>
<td>1.04</td>
<td>(0.84 1.29)</td>
</tr>
</tbody>
</table>

CI = Confidence Interval

* p ≤ 0.05

Reference categories:

<sup>1</sup>BMI ≤ 24.9, <sup>2</sup>Non-smokers, <sup>3</sup>Non-drinkers, <sup>4</sup>Non-binge drinkers, <sup>5</sup>Low physically active, <sup>6</sup>Consuming 1 serving or less of fruit, <sup>7</sup>Consuming 1 serving or less of vegetables, <sup>8</sup>Daily intake of red/processed meat
Test of Mediation

3.1.8. Test of the effect of awareness on the association between acculturation and current BMI

In the first step, the association between acculturation (IV) and BMI (DV) was examined and results established BMI was not significantly associated with acculturation (p-value = 0.07). The mediation effect was not supported.

3.1.9. Test of the effect of awareness on the association between acculturation and smoking

In the first step, the association between acculturation (IV) and current smoking habit (DV) was examined and results established that smoking was not significantly associated with acculturation (p-value = 0.42). The mediation effect was not supported.

3.1.10. Test of the effect of awareness on the association between acculturation and drinking

In the first step, the association between acculturation (IV) and drinking (DV) was examined and results established that drinking was significantly associated with acculturation (OR: 1.31, 95% CI: [1.17, 1.48]). In the second step, the association between acculturation (IV) and awareness of cancer risk factors (mediator) was assessed, and results showed that awareness was significantly associated with acculturation (OR: 1.14, 95% CI: [1.01, 1.29]). In the third step, the association between acculturation (IV) and drinking (DV) was examined in the presence of cancer awareness (mediator) via a multiple regression model. The third step showed that awareness of cancer risk factors was not a mediator for the association between drinking and acculturation (AOR: 1.32, 95% CI: [1.18, 1.50]).
3.1.11. Test of the effect of awareness on the association between acculturation and physical activity level

In the first step, the association between acculturation (IV) and physical activity level (DV) was examined and results established that physical activity level was not significantly associated with acculturation (p-value = 0.25). The mediation effect was not supported.

3.1.12. Test of the effect of awareness on the association between acculturation and daily fruit intake

In the first step, the association between acculturation (IV) and daily fruit intake (DV) was examined and results established that daily fruit intake was not significantly associated with acculturation (p-value = 0.232). The mediation effect was not supported.

3.1.13. Test of the effect of awareness on the association between acculturation and daily vegetable intake

In the first step, the association between acculturation (IV) and daily vegetable intake (DV) was examined and results established that daily vegetable intake was not significantly associated with acculturation (p-value = 0.559). The mediation effect was not supported

3.1.14. Test of the effect of awareness on the association between acculturation and weekly red/processed meat intake

In the first step, the association between acculturation (IV) and weekly red/processed meat intake (DV) was examined and results established that weekly red/processed meat intake was not significantly associated with acculturation (p-value = 0.52). The mediation effect was not supported.
4. Chapter 4: Discussion

4.1. Summary of thesis findings

28% of participants had low awareness, 50% were moderately aware, and 22% were highly aware of cancer risk factors. Participants in this study were highly aware of smoking as a cancer risk factor. Awareness that the risk of cancer increased with age was low. The majority of participants in this study were not aware that eating less than five servings of fruits and vegetables a day, eating red or processed meat once a day or more, getting sunburnt more than once as a child, and infection with HPV increase the chance of getting cancer. The findings demonstrated significant associations between acculturation and awareness of cancer risk factors.

43% of participants were overweight or obese, 13% were daily or occasional smokers, 75% reported drinking during the past 12 months, 32% of participants who reported drinking during the past 12 months reported binge drinking, 34% reported low physical activity, 59% of participants had less than two servings of fruit, 57% of participants had less than two servings of vegetable per day, and 7% of participants reported that they consume red or processed meat daily. Acculturation was not related to most of these health behaviours except drinking. The findings indicated a significant association between acculturation and drinking.

For the first time, the mediation effects of awareness of cancer risk factors on the associations between acculturation and health behaviours were assessed among Iranian immigrants. The results of mediation analyses in this study did not indicate that awareness of cancer risk factors was a mediator for the associations between acculturation and health behaviours.

Acculturation is a complex psychosocial process, and health behaviours could be affected by different social, personal, and environmental variables. Differences in metrics and measurements, differences in socioeconomic status among immigrants, and differences in social norms and
behaviours in the home and the host countries could lead to different results (Satia-Aboua et al., 2002; Hendershot et al., 2008; Tserendejid et al., 2013). Also, due to the non-probability sampling method participants in this study did not have an equal chance of being selected, which could lead to the self-selection bias. 73% of participants were women, and 96% had a university degree, and 81% of the participants in this study were currently employed. This high socioeconomic profile likely affected participants’ responses. The skewed nature of this sample and the high socio-demographic level could mask the true associations between acculturation and health behaviours and the mediation effects of awareness of cancer risk factors on this relationship. Also, due to the lack of variability in participants, hypotheses on the mediation effects of cancer awareness on the association between acculturation and health behaviours were not able to be tested.

The results for each research objective are discussed below. This is followed by a review of study strengths and limitations, a discussion of the directions for future research, and finally policy implications and concluding remarks.

### 4.1.1. The association between awareness and acculturation

In this study, it was hypothesized that acculturation is associated with cancer risk factor awareness after immigration among Iranians who are living in the Greater Vancouver area. The results provide direct support for this hypothesis.

Overall, 28% of participants had low awareness, 50% were moderately aware, and 22% were highly aware of cancer risk factors. In a similar study conducted in Tehran, Feizi et al.’s found that public awareness of cancer risk factors was low. They reported that 31% of their sample had low awareness, 57% were moderately aware, and 12% were highly aware of cancer risk factors (Feizi et al., 2010). In comparison to Feizi et al.’s results, this study found a higher percentage of participants with a high level of awareness of cancer risk factors. Higher awareness of cancer risk factors relative to Feizi et al.’s study could be explained by differences in sampling methods and metrics. In this study, non-probability sampling (the snowball and voluntary sampling) methods were used to reach Iranian immigrants in the Greater Vancouver area. In comparison, Feizi et al.
used probability sampling. In non-probability sampling method, participants do not have an equal chance for being selected, which can lead to selection bias (Sweetland, 1972; Nilsen et al., 2009; Szklo and Nieto, 2014). Self-selection bias is one type of selection bias regarding voluntary sampling method (Nilsen et al., 2009). 73% of participants were women, and 96% had a university degree, and 81% of the participants in this study were currently employed which could be the biggest source of bias.

To the best of our knowledge, there has been a limited number of studies on cancer awareness among the Canadian population. Research in Canada has been focused heavily on secondary cancer prevention awareness including awareness about cancer screening and early cancer signs, or other chronic disease prevention. As a result, it was not possible to compare the prevalence of cancer risk factor awareness among Iranian immigrants in Canada with the prevalence of awareness among Canadian adults.

The odds of being highly aware of cancer risk factors versus having low awareness was directly associated with acculturation (AOR: 1.28, 95% CI: [1.09, 1.50]). This finding is consistent with the available literature. More acculturated Chinese immigrants in the US were more likely to be aware of the association between diet and cancer (Jessie Satia-Abouta et al., 2002). Immigrants with a higher level of acculturation were more aware of cancer preventive genetic testing (Vadaparampil et al., 2006). Chinese immigrants who had higher ability to speak English in Canada had a higher level of awareness about cardiovascular disease (Chow et al., 2008). The awareness of Arab immigrants in Toronto about the importance of having a healthy dietary choices increased after immigration (Abou, Hassan, and Hekmat, 2012).

This result might be related to more language proficiency among more acculturated participants. Acculturation scales have mostly used language proficiency as an indicator (Koca and Lapa, 2014) and language barriers and poor communication are also cited as potential causes of lower cancer awareness among immigrants (Dunn et al., 2017). Also, higher English proficiency among more acculturated participants in this study could lead to higher access to the healthcare system and health-related materials on Canadian media which can explain the higher level of awareness of cancer risk factors among this population. Chow et al. reported that the media is a common source
of health information among immigrants (Chow et al., 2008). Immigrants with higher language proficiency have better access to the healthcare system and media in the country of destination (Vadaparampil et al., 2006; Chow et al., 2008).

4.1.2. The association between obesity and acculturation

4.1.2.1. The association between health behaviours and acculturation

In this study, it was hypothesized that acculturation is associated with the higher likelihood of obesity among Iranians who are living in the Greater Vancouver area. The results have not found direct support for this hypothesis.

Overall, in this study 4% of participants were underweight, 53% were normal, 30% were overweight, and 13% were obese. The prevalence of obesity and overweight among participants is consistent with the prevalence of obesity and overweight detailed in a recent systematic review on residents of Iran (Jafari-Adli et al.). The review reported that the prevalence of overweight in Iran was between 27 and 38.5% and obesity was between 12.6 and 25.9% (Jafari-Adli et al., 2014). According to Canadian statistics, 36% are overweight, and 26.9% of Canadian adults are obese (STATCAN, 2017). The findings of this study show that 43% of Iranian immigrants in the Greater Vancouver area are obese or overweight. The difference between our results and CCHS results, could be explained due to differences in population characteristics and sampling methods. The prevalence of obesity could be affected by sociodemographic variables and ethnicity (Arroyo-Johnson and Mincey, 2016). Participants in this study had a high sociodemographic status. 73% were women, 96% had a university degree, and 81% were currently employed. The sociodemographic status in this sample would not be comparable to the sociodemographic of the general population in Canada. Self-selection bias regarding voluntary sampling method might cause more non-obese individuals to participate in this study (Szklo and Nieto, 2014).

The findings of this study did not show a significant association between acculturation and being overweight or obese. In contrast, this study’s results are different from those reported by Wu et
al.’s study of Chinese students living in the US (Wu and Smith, 2016), Afable et al.’s study on Chinese immigrants in the US (Afable et al., 2016), Guo et al.’s study on Asian immigrants in Australia (Guo et al., 2015). Ro et al.’s study on Asian immigrant women in the US (Ro and Bostean, 2015), Shah et al.’s study on male Asian immigrant workers in the UAE (Shah et al., 2015). As discussed in previous studies, immigration is a unique experience and immigrants may have different health results based on acceptance by the country of destination, naturalization rates, integration policies, and access to the healthcare system for immigrants (Berry, 1997; Malmusi, 2015). Also, differences can be explained due to metrics, sample characteristics, sampling methods, and behavioural norms in the different home countries (Guo et al., 2015; Ro and Bostean, 2015; Shah et al., 2015; Afable et al., 2016; Wu and Smith, 2016). Non-probability sampling method led to the skewed nature of this sample and higher sociodemographic profile. The high sociodemographic status in this sample would not be comparable to Chinese students or Asian workers. Using different scales for acculturation can affect the results (Wang et al., 2011). A self-report method was used for weight and height and the changes in weight, which increases the chance of recall and response biases. Previous studies reported that self-report is related to overestimation for height and underestimation for weight (Wang et al., 2011). Acculturation is a complicated process, and in most of the acculturation scales, language proficiency and length of stay in the new country after immigration is the leading indicators (Isasi et al., 2015). Most of the acculturation scales such as the one which was used in the current study, cannot capture biculturalism (Isasi et al., 2015). Also, previous studies reported that these indicators could not reflect immigrants’ adherence to their sociocultural norms of their home country (Koca and Lapa, 2014). In this study, a non-probability sampling method was used to reach Iranian immigrants, which can cause self-selection bias (Nilsen et al., 2009). According to the self-selection bias, the decision of Iranian immigrants to participate in this study may reflect their characteristics.

4.1.2.2. The relationship between smoking and acculturation among Iranian immigrants who live in Greater Vancouver

It was hypothesized that acculturation is associated with a higher likelihood of smoking. The results have not found direct support for this hypothesis.
3% of Iranians who participated in this study were daily smokers, and 10% were occasional smokers. In comparison with smoking prevalence among Iranians who are living in Iran, Iranian immigrants in the Greater Vancouver area had a lower prevalence of smoking (Moosazadeh et al., 2013; STATCAN, 2017). In Iran, the prevalence of smoking among men has been reported as between 12.3% and 38.5%, and in women as between 0.6% and 9.8%, and in Canada in 2017, the overall smoking prevalence was 16.2% (Moosazadeh et al., 2013; STATCAN, 2017). The prevalence of daily and occasionally smoking among participants in this study was lower than with the prevalence of smoking in Canada (STATCAN, 2017).

Canadian tobacco control policies could explain the lower smoking prevalence among Iranian immigrants in comparison with the residents of Iran (the population in the home country). In Iran, as well as other developing countries, the tobacco control policies are developing slowly, and people have more access to tobacco products in comparison with developed countries (Bosdriesz et al., 2013). Higher cigarette prices, more taxes, and banning smoking in public areas and residences were associated with quitting or reduction in smoking among immigrants in previous studies (Bosdriesz et al., 2013).

The healthy immigrant effect theory could explain the lower smoking prevalence among Iranian immigrants in comparison with Canadian adults. This theory suggests healthier behaviours and higher socioeconomic status increase the chance of immigration (Bosdriesz et al., 2013). According to this theory, Iranians who were healthier had a better socioeconomic status, and were less apt to smoke may have been more likely to immigrate to Canada.

Consistent with the results of the present study, Myers et al. and Bosdriesz et al. did not find a significant association between smoking and acculturation among immigrants in the US (Myers et al., 2009; Bosdriesz et al., 2013). However, in contrast to the findings reported here, several other studies showed a significant direct association between acculturation and smoking (Chiu et al., 2012; Gorman, Lariscy and Kaushik, 2014; Gotay et al., 2015; Guo et al., 2015). Sample characteristics could be one explanation for these discrepant findings (Hendershot et al., 2008). In this study, findings indicated that not smoking among Iranian immigrants was significantly associated with holding a postgraduate degree and being married. This finding may stem from the
sociodemographic characteristics of study participants compared to the general BC population in BC. In BC, only 29.9% of residents have a university certificate, diploma or degree at bachelor level or above, and 41% are married (STATCAN, 2016b). High rates in the sample for holding a university degree and being married could have led to lower variability in outcomes, which may mask true associations between smoking and acculturation (Hendershot et al., 2008).

4.1.2.3. The association between drinking and acculturation

In this study, it was hypothesized that acculturation is associated with more likelihood of drinking. The results provide support for this hypothesis.

Because alcohol consumption has been illegal in Iran since the Islamic revolution, there is no official data on alcohol consumption prevalence among Iranians. It is estimated that the prevalence of drinking in Iran is 10% (Lankarani and Afshari, 2014). In this study, 75% of participants drank alcohol during the past year.

Acculturation is one explanation for the shift in drinking among Iranians after immigration. The results of this study indicate a significant association between acculturation and drinking (AOR 1.30 [95% CI: 1.14, 1.50]).

Consistent with the findings in this study, previous studies showed an association between acculturation and drinking. Talegawkar et al.’s study on South Asian immigrants in the US (Talegawkar et al., 2016), Arfken et al.’s study on Arab immigrants in the US (Arfken et al., 2014), Park et al.’s research on Asian immigrants in the US (Park et al., 2014), Pedersen et al.’s study on Asian college students in the US (Pedersen et al., 2013), Amundsen et al.’s study on Iranian immigrants in Norway (Amundsen, 2012), and Parikh et al.’s study on older Chinese women who were living in the US (Myers et al., 2009) are in agreement with the results of this study. However, Kane et al.’s study in 2016 on Vietnamese and Cambodian immigrant women in the US (Kane et al., 2016), and Hendershot et al.’s study of Chinese and Korean immigrants in the US (Hendershot et al., 2008) are inconsistent with the results presented here. Differences in time of immigration, social norms regarding alcohol consumption in the home country, and acceptance in the host
country, which affects the acculturation process among immigrants, could explain these discrepant results (Parikh et al., 2009; Amundsen, 2012).

In this study, holding a postgraduate degree showed a significant inverse association with drinking (AOR 0.44 [95% CI: 0.20, 0.93]). As mentioned before, most participants in this study held a postgraduate degree and possibly this masked other effects.

4.1.2.4. The association between binge drinking and acculturation

In this study, it was hypothesized that acculturation is associated with more likelihood of binge drinking. The results provide support for this hypothesis. The results have not found direct support for this hypothesis.

32% of participants who reported drinking during the past 12 months reported drinking at least 5 shots of alcohol on at least one occasion during the month before the survey. There are no data on the prevalence of binge drinking in Iran, which makes it impossible to compare binge drinking among Iranian immigrants and Iran’s residents. 2017 CCHS data reported that 19.5% of all Canadians reported binge drinking (STATCAN, 2017). As such, the prevalence of binge drinking in this study is consistent with the prevalence in Canada and BC.

Acculturation does not account for the binge drinking in this sample (AOR 1.15 [95% CI: 0.98, 1.27]). The results reported here agree with those of Ayers et al.’s study on Korean female immigrants in the US (Ayers et al., 2011). However, differing findings have been reported elsewhere: by Kane et al.’s study on Vietnamese and Cambodian immigrant women in the US (Kane et al., 2016), Bryant et al.’s work on Asian immigrants in the US (Pedersen et al., 2013), Hahm et al.’s study on Asian immigrants in the US (Hahm, Lahiff and Guterman, 2003). All of these studies reported a significant association between acculturation and binge drinking and drinking in general. Different metrics, different sampling characteristics, and background norms could explain differences in the results. Also, self-report measurement methods for smoking, such as used in this study, can result in underestimation of smoking by participants, which can bias the results (Bosdriesz et al., 2013).
4.1.2.5. The association between acculturation and physical activity

It was hypothesized that acculturation is associated with a higher level of physical activity. The results did not find direct support for this hypothesis.

Results indicated that 34% of participants have a sedentary lifestyle, 54% are moderately active, and 12% are vigorously active. Other studies show that the prevalence of inactivity among Iranians in Iran is significantly higher than among Iranian immigrants in Canada (Fakhrzadeh et al., 2016). However, the prevalence of moderate and vigorous physical activity among Iranian immigrants in the Greater Vancouver area was close to that of Canadians and British Columbians. Statistics in Canada showed that 58.5% of Canadian adults engaged in 150 minutes of moderate to vigorous physical activity per week (STATCAN, 2017).

Acculturation was not significantly associated with the level of physical activity in this study, consistent with other research: Delavari et al. found no significant association between acculturation and the physical activity level among Iranian immigrants in Australia (Delavari et al., 2015). However, other research has found the opposite, such as Kahan et al.’s study on Middle Eastern college students in the US (Kahan, 2009), Li et al.’s work on immigrants in the US (Li and Wen, 2013), Nelson-Peterman et al.’s study of female Cambodian refugees and immigrants in the US (Nelson-Peterman et al., 2015), Walker et al.’s results on South Asians living in Calgary, Canada (Walker et al., 2015), Guo et al.’s results on immigrants in Australia (Guo et al., 2015), Yi et al.’s results among Chinese immigrants in the US (Yi et al., 2016), Brown et al.’s results among women immigrants in the US (Brown et al., 2016), and Afable et al.’s results on Chinese immigrants in the US (Afable et al., 2016).

Physical activity level could be affected by several personal and environmental factors (Seefeldt, Malina and Clark, 2002). One possible explanation for the differences in the results could be the lengthy period of time in BC among participants in this study, who had been in the province for a mean of 8.18 years. Canadian ministry of health reported that staying in BC for more than 10 years was associated with a 10% increase in the physical activity level of immigrants (Ministry of Health, 2015). During this time, the participants may have had more access to physical activity facilities.
and parks, safe neighbourhoods, less air pollution, and support for childcare than they had experienced in Iran.

Another explanation could be differences in ethnical background, and behavioural norms between Iranian immigrants in Canada come from different cities in Iran. People in different cities have unique lifestyles, socioeconomic statuses, and access to physical activity facilities (Fakhrzadeh et al., 2016). According to the city of origin, people could have different physical activity levels before immigration. In this study, participants were not asked about their city of origin and results are not adjusted for this variable which may have affected the results.

This study used a self-report single-item physical activity questionnaire to assess physical activity, and different types of physical activity were not taken into account. Various definitions of physical activity among participants in different studies could explain the results (Jepsen et al., 2004; Najafipour et al., 2016). Also, in this study, the differences between leisure-time physical activity and work-related physical activity are not distinguished, which could be another explanation for the differences in the results of this study in comparison to previous studies (Banna et al., 2012). Basing analyses of this self-reported measure may have increased the chance of overestimation, response bias, or recall bias (Li and Wen, 2013).

4.1.2.6. Association between fruit and vegetable intake and acculturation

It was hypothesized that acculturation is associated with a higher intake of fruit and vegetable. The results did not directly support this hypothesis.

Esteghamati et al. reported the prevalence of daily intake of 5 servings or more of fruit and vegetable among Iranians to be 12.5% (Esteghamati et al., 2012). In this study, the prevalence of daily intake of 5 servings or more of fruit and vegetable was between 20-34%. A comparison between the results in this study and Esteghamati et al.’s results shows the intake of fruit and vegetable among here was higher than in Iranians living in Iran. In 2017, the prevalence of daily intake of 5 servings or more of fruit and vegetable among Canadians was 28.6% (STATCAN,
The fruit and vegetable intake among Iranian immigrants in this study was closer to the fruit and vegetable intake among Canadians.

The intake of fruit and vegetable among participants in this study was not associated with acculturation, consistent with Delavari et al.’s results on Iranian immigrants in Australia. In contrast, Brown et al. found an association between higher acculturation and higher fruit and vegetable consumption among women immigrants in the US (Brown et al., 2016). Acculturation was also found to have an association with fruit and vegetable intake among South Asian immigrants in Canada (Lesser, Gasevic and Lear, 2014). More acculturated Mongolian immigrants in South Korea had higher fruit and vegetable intake (Tserendejid et al., 2013). Arab immigrants in Toronto reported healthier food choices after immigration (Hassan and Hekmat, 2012). Chinese immigrants who stayed for a long time in the US or had greater English proficiency reported higher fruit and vegetable intake (Lv and Cason, 2004).

As both dietary habits and acculturation are multidimensional and complicated, the directions of their association are not consistent across studies (SATIA-ABOUTA et al., 2002). Differences in metrics, differences in socioeconomic status among immigrants, differences in social norms and behaviours in the home and the host countries could explain these differences in results (Jessi Satia-Abouta et al., 2002; Tserendejid et al., 2013). In this study, short dietary instruments were used to assess the fruit and vegetable intake during the past week, which is useful to rank participants based on their recent consumption, but cannot capture usual fruit and vegetable intake (Yaroch et al., 2012; Tserendejid et al., 2013).

4.1.2.7. The association between acculturation and red meat intake

It was hypothesized that acculturation is associated with higher intake of red or processed meat. This hypothesis was not supported as results also did not show a significant association between acculturation with intake of red/processed meat.

Findings indicated that 7% of participants consumed red or processed meat once or twice a day in the week before they completed the survey. There are no data on the frequency of red or processed
meat intake among Canadians or Iranians, which makes a comparison between these populations impossible.

In contrast to the findings of this study, Tran et al. reported that acculturation was directly associated with higher intake of red meat among Vietnamese immigrants in Australia (Tran et al., 2015). A longer stay in Canada has also been found to be directly associated with higher red meat intake among South Asian immigrants (Lesser, Gasevic, and Lear, 2014). More acculturated Mongolian immigrants in South Korea have been found to have significantly lower red meat intake in comparison with low-acculturated immigrants (Tserendejid et al., 2013). Chinese immigrants with higher English proficiency reported higher red meat intake (Lv and Cason, 2004).

Differences in the results reported here could be explained by Iranian dietary patterns before immigration. Previous studies, which reported a significant increase in red meat intake among immigrants, suggested that higher access to red meat in western countries is a reason for changes in diet after immigration (Lv and Cason, 2004). Among Iranians, Azizi et al. reported the Iranian dietary pattern to be characterized by a high intake of red meat (Azizi et al., 2015), which could explain the non-significant changes in red meat intake after immigration found here.

4.1.3. The mediation analyses

It was hypothesized that awareness of cancer risk factors mediates the association between acculturation and cancer behavioural risk factors (including overweight, obesity, smoking, alcohol consumption, binge drinking, physical activity, and intake of fruit, vegetable, and red/processed meat). The results did not directly support this hypothesis.

One possible explanation for these results could be that the hypothesis was not right. Previous studies showed a weak correlation between being aware of cancer risk factors and preventive behaviours (Martin, 1995; Asuzu, Unegbu and Akin-odanye, 2012). A lot of people do not practice the preventive behaviour, even when they are aware of it. To change a behaviour, awareness is
necessary but not sufficient (Miles et al., 2005). Social, environmental, political, and economic factors affect behavioural changes and choices (Kelly and Barker, 2016). Martin et al. showed that the association between skin cancer preventive behaviours and awareness of skin cancer risk factors among south Australians is not significant (Martin, 1995). Hoque et al. showed that only one-third of participants in their study who had the information about cervical cancer screening methods were used it to prevent or detect cervical cancer (Hoque, 2010). Results of another study on Nigerian women showed that 76% of participants were aware of Pap smear or other screening tests for cervical cancer, but 73% of them reported that they had never undertaken these tests (Asuzu, Unegbu and Akin-odanye, 2012). Other studies, also, showed the same results on the disconnection between awareness and engagement in preventive behaviours. (Mathys et al., 2002; Miles et al., 2005).

The mediation effects of awareness of cancer risk factors on the association between acculturation and health behaviours could be partial. According to models and theories to explain behavioural changes, there are other factors besides awareness that are likely to affect behavioural changes (Ajzen, 1991; Bandura, 2004; Gross, 2012). Providing knowledge about risk factors and benefits of healthy choices is likely to be the first step to motivate behavioural change, but the interaction between a wide range of personal, social, and environmental factors may be required for behavioural change (Bandura, 2004). Beside health knowledge, attitude, self-efficacy, outcome expectations, self-control, reinforcement, emotional coping, and observational learning could drive behavioural changes (Ajzen, 1991; Bandura, 2004; Gross, 2012). In this study other factors were not included, so these possibilities could not be explored. The skewed nature of the sample could mask the mediation effects of awareness of cancer risk factors on the associations between acculturation and health behaviours. 73% of participants were women, and 96% had a university degree, and 81% of the participants in this study were currently employed. This high socioeconomic profile likely affected participants’ responses and could mask the true associations between acculturation and health behaviours. As a result, the mediation effects of awareness of cancer risk factors on the associations between acculturation and health behaviours could be concealed.
4.2. **Strengths and Limitations**

4.2.1. **Strengths**

The results of this study provide new insights into cancer public awareness among Iranian immigrants in the Greater Vancouver area. The study has a number of strengths:

One strength is the homogeneity of the sample. Only Iranians who were born in Iran were invited to participate in this study given that lifestyle among second-generation immigrants are more similar to those in the native population. Also, this study provides detailed information on a particular socioeconomic class of Iranian immigrants in the Greater Vancouver area.

It was also ensured that language was not a barrier to participation, both English and Farsi versions of questionnaires were used for all participants, so participants had the option to choose the version that best suited them, likely increasing the participation rate.

The study used previously-validated scales for cancer awareness and acculturation, and items to assess health behaviours that have been previously used in large Canadian surveys. This allows a comparison of current results with other comparable research.

The acculturation scale which was used in this study was more comprehensive. Most of the previous studies only used the language proficiency and the length of stay in the host country as the indicators for acculturation. More questions with cultural aspects were added to the acculturation scale in this study.

One of the key strengths of this study was the speedy recruitment, which suggests that Iranian immigrants in Vancouver may be keen to participate in future research also. Data collection for this study was completed in almost one month. Iranian influencers in the Greater Vancouver area who shared the study’s information with their network and the conversational nature of these social
media had led to more engagement and participation. It is believed that Facebook and Telegram were more engaging platforms rather than emails, tweets, and other types of media. People started to tag each other under the posts, started the conversation with each other about the importance of their participation, and shared the information quickly with their network, which was one of the critical strengths of the study.

4.2.2. Limitations

This research also had a number of limitations.

1. Mode of recruitment
Voluntary sampling and snowball sampling was used in this study. These are non-randomized methods for sampling, which can increase the chance of selection bias and decrease the generalizability of the results. The sample was highly oriented to women, and highly educated Iranians. This strategy was used due to lack of access to the contact information for all of the Iranian population in Greater Vancouver.

2. Study design
Use of a cross-sectional design was another limitation of this study as causality could not be determined. It also did not allow for an exploration of changes in immigrants’ lifestyle over time, nor an assessment of the immigrants’ attitudes and behaviours prior to their coming to Canada.

3. Aspects of assessment
   a. all data were self-report which could have resulted in underestimation about weight, alcohol consumption and binge drinking, smoking, and red or processed meat intake, overestimation about fruit and vegetable intake and physical activity level, response bias, or recall bias.
b. Awareness of cancer risk factors scale evaluates the awareness of red meat and processed meat intake together, which could lead to misinterpretation for participants.

c. The low validity of the short dietary instrument and the single-item physical activity questionnaire. These questionnaires were chosen regarding reduction of respondent burden.

d. The intake of fruit and vegetables were asked separately, and there was a limitation regarding the ability to directly report the prevalence of daily intake of 5 servings or more of fruit and vegetable which is the recommendation for cancer prevention.

e. Other variables which could affect the mediation model including attitude, self-efficacy, outcome expectations, self-control, reinforcement, emotional coping, and observational learning were not assessed.

4. Lack of power

Lack of variability in the sample and low sample size in subgroups could lead to the lower power of this study

5. Generalizability

Due to the sampling method and the chance of self-selection bias, the sample might not be representative of Iranian immigrants. As a result, this study may have limited generalizability to Iranian immigrants in other countries or Canada’s provinces as it was conducted on Iranian immigrants who were living in the Greater Vancouver area (Wang et al., 2011).

**4.3. Implications and Suggestions**

Findings of this study have several implications regarding immigrant health awareness and health behaviour policy and research in Canada.
4.3.1. Implications and suggestions for practice

Understanding the level of awareness of cancer risk factors among immigrants can potentially influence primary cancer prevention policies in Canada. As mentioned, Canada is one of the most welcoming countries for immigrants around the world. The results of this study found some evidence to show that Iranian immigrants who come to Canada have a lower level of health awareness and different cultural and behavioural norms than the general Canadian population. Canadian health policymakers should consider immigrants’ sociocultural, socioeconomic, and linguistic barriers (Remennick, 2006) in the development of programs targeted to this group.

The Iranian community in North America is understudied, and immigrants’ health knowledge, health behaviours, their access and barriers to the health care system are largely unknown. To prevent misinformation, improve cancer awareness, and prevent cancer among Iranian immigrants in Canada a culturally tailored health education program is suggested.

Our results indicated that a number of areas where the Iranian immigrants needed more information, or to move toward healthier behaviours. For example, few participants were aware that cancer risk increased with age, and most didn’t know that eating less than five portions of fruit and vegetables a day, eating red or processed meat once a day or more, getting sunburnt more than once as a child, and infection with HPV all increase the chance of getting cancer. Also, the level of awareness of drinking as a cancer risk factor was quite high, but the prevalence of binge drinking was also high.

An increase in drinking could be caused by more access to alcoholic beverages in Canada or possibly traumatic stress after immigration. We suggest that offering a tailored program for newcomers that addresses risks of alcohol consumption, particularly binge drinking, and stress management could be useful for assisting new immigrants in learning healthy ways to adjust to their new environment.
Canadian health providers should consider training more acculturated immigrants as cultural mediators to share their experience in modifying Iranian food recipes by adding more fruit and vegetable to meals and snacks and using red meat alternatives to reduce red meat intake. Immigrants are experts in their own culture and food habits and could become powerful advocates for health in their community.

Local health providers and Iranians’ societies in the Greater Vancouver area should be the first place to deliver tailored health education to Iranian immigrants. Iranian family doctors as primary health providers should be contacted and asked to talk about cancer risk factors with their Iranian patients. Iranian pharmacies could be asked to put up posters on the wall or have brochures about cancer risk factors in both Farsi and English versions. Iranians’ societies should be asked to hold meetings and invite Iranian health providers like family doctors, nurses, and nutritionists to talk about cancer risk factors with their members. Larger clinics, hospitals, and other health care authorities in BC should be contacted in the second step and further actions should be planned to launch tailored health education programs for Iranians.

4.3.2. Suggestions for further research

Evaluating the level of awareness of cancer risk factors among the Canadian population is a vital step to understand potential areas and subgroups where awareness may need to be raised. Further research should address the limitations to this study. Further research is needed with larger and more representative samples. Studies using probability sampling would be optimal. It is suggested to collect additional data to assess the level of awareness of cancer risk factors among the Canadian population as part of the Canadian administrative data system.

Further studies are needed to investigate the newcomers, young immigrants, men, and diverse Iranian communities. In this study, the majority of participants had lived in Canada for almost a decade, and as such, the level of cancer awareness among new Iranian immigrants is unknown. The association between acculturation and health behaviours could be different among late arrivers.
(people who immigrated at an older age) rather than early arrivers (people who immigrated at a younger age). Younger people could be more affected by the new environment, and culture (Parikh et al., 2009). In addition, the heterogeneity of the Iranian population is essential to consider. In Iran, there are more than seven ethnic minorities including Azerbaijanis, Kurds, Lurs, Mazandaranis and Gilakis, Arabs, Balochis, and Turkmens, all of whom have different cultural norms, demographic characteristics, and behaviours.

Further research should consider mixed method approaches to provide qualitative data regarding immigrants’ motivations for lifestyle changes after immigration and barriers to cancer awareness. Also, other variables including acculturative stress and neighborhood should be assessed. Acculturative stress might be related to the health behaviour, especially drinking and heavy drinking among immigrants (Park et al., 2014). In this study acculturative stress was not examined. It is suggested that future studies assess the association between acculturative stress and drinking habits. Li et al. reported the mediation effect of acculturation and sociodemographic factors on health disparities and access to physical activity facilities after immigration among Chinese and Koreans in the US (Li and Wen, 2013). In this study, we did not examine the effects of neighbourhood access to physical activity facilities like gyms, parks, playgrounds, or open spaces, and neighbourhood safety.

Additional studies should focus on overcoming the methodological challenges faced by this study. Currently, there is no validated multidimensional tool to assess acculturation. Developing a standardized acculturation scale which is appropriate for healthcare studies should be a key focus of future research. Also, prospective studies are suggested to explore the dynamic aspects of the acculturation process, and the association between acculturation and health behaviours including direct and indirect effects of sociocultural factors on acculturation and health behaviours.
4.4. Conclusion

Awareness of cancer risk factors is the first step in the behavioural change pathway. Immigrants in Canada might have a low awareness of cancer risk factors, and further research should explore this. As highlighted in this study, the level of awareness of cancer risk factors was low among Iranian immigrants who live in the Greater Vancouver area and acculturation was directly associated with the awareness of cancer risk factors. Tailoring health-related education program for immigrants to improve their knowledge about modifiable and preventable risk is suggested. Also, the results of this study showed that acculturation is positively associated with the drinking among Iranian immigrants in the Greater Vancouver area. According to previous studies, drinking among immigrants could be related to more stress. A mental health education program is suggested for immigrants in addition to the tailored program to improve immigrants’ knowledge about cancer risk factors.

The findings of this study, the first study of its kind, have significant implications for future research and health promotion programs. This study builds on previous work suggesting the association between acculturation and awareness of cancer risk factors which could be used to improve tailored interventions. We strongly suggest continued research in this area, and its translation into cancer prevention policies for the benefit of Iranian immigrants, who are a visible minority population in Canada.
Bibliography


Research Participants Wanted!

☑ Are you 18-55 years old?
☑ Were you born in Iran?
☑ Are you living in Greater Vancouver?
☑ Have never had cancer?
☑ Not currently pregnant?

If so, you may be interested in participating in a 15 minute, one-time, confidential, online survey of cancer awareness and behaviours in Iranian immigrants in Greater Vancouver.

The researchers conducting this study are: Dr. Carolyn Gotay, Professor, UBC School of Population and Public Health; and Narsis Afghari, MSc student, UBC School of Population and Public Health.

To find out more about the study, please contact Narsis at 604-822-9191 or Iranian.health@ubc.ca

Please visit: https://ubc.ca1.qualtrics.com/jfe/form/SV_3X9xx5BB7VQwKLH
Phone scripts to contact influencers

Hello. My name is Narsis Afghari, and I am a Master’s student of Iranian descent in the School of Population and Public Health at the University of British Columbia. For my master’s thesis I am looking at the association between acculturation and awareness about cancer risk factors and health behaviours among Iranians in Greater Vancouver. To our knowledge, there is no published data on Iranian acculturation and their health behaviour and acculturation in Canada and North America.

If you are Iranian, living in Greater Vancouver, non-pregnant, not diagnosed with cancer, aged 18to55, and interested in participating in a 15-minute, one-time, confidential survey please check this link: https://ubc.ca1.qualtrics.com/jfe/form/SV_3X9xx5BB7VQwKLH

Narsis Afghari
School of Population and Public Health
Tel: 604-822-9191
Email: Iranian.health@ubc.ca
Survey url: https://ubc.ca1.qualtrics.com/jfe/form/SV_3X9xx5BB7VQwKLH
Email template to contact influencers, business owners, and admins of Facebook pages for Iranians

Hello,

My name is Narsis Afghari, a Master of Science student in the School of Population and Public Health at the University of British Columbia. I am working under the supervision of Dr. Carolyn Gotay.

We are seeking volunteers to participate in the project called “The association between acculturation and awareness about cancer risk factors among Iranian immigrants in Greater Vancouver”. The study will be conducted online, in English or Farsi, with the use of a survey that will ask participants about cultural changes that have occurred since moving to Vancouver, awareness of cancer risk factors, and their health behaviours. The results of this project will be the core component of my master’s thesis.

I am contacting you today to ask if your organization would be willing to publicize the study in a few ways:
- participation in this study by filling out the survey;
- putting up posters;
- displaying our recruitment cards for the study in your space;
- using your social media outlets to publicize the study;
- including information about the study in your next newsletter;
- sending contacts in your email list information about the study.

I have attached a copy of the poster and recruitment cards for reference.

If you would like more information about this study, please contact:
Narsis Afghari I School of Population and Public Health I 604-822-9191 I Iranian.health@ubc.ca

If you are interested in participating, please visit the URL below:
https://ubc.ca1.qualtrics.com/jfe/form/SV_3X9xx5BB7VQwKLH

Thank you very much for your consideration.

Regards,
Narsis Afghari
The message for distribution on Facebook, Instagram, email individuals, WhatsApp, and Telegram

I am Narsis Afghari, a MSc student at the University of British Columbia. For my thesis, I am looking at the association between acculturation, and the awareness of cancer risk factors and health behaviours among Iranians immigrants living in Greater Vancouver. If you are Iranian, living in Greater Vancouver, not currently pregnant, have never had cancer, are aged 18 to 55 and is interested in participating in a 15 minute, one-time, confidential survey, please check this link: https://ubc.ca1.qualtrics.com/jfe/form/SV_3X9xx5BB7VQwKLH

Phone: 604-822-9191
Email: Iranian.health@ubc.ca
Appendix B

Questionnaire in English

Personal Information:

1. Gender:
   - O Female
   - O Male ➔ Skip to question 3
   - O Third gender(other)

2. Are you pregnant?
   - O Yes
   - O No

3. Date of birth (e.g. yyyy/mm/dd):

4. Place of birth:
   - O Iran
   - O Canada
   - O Other countries rather than Iran or Canada

5. Have you ever been diagnosed with cancer?
6. Has any of your family members or close friends been diagnosed with cancer?

O Yes

O No

7. Marital status:

O Married

O Living common law

O Divorced

O Widowed

O Single

8. Please enter your postal code:

9. The level of education

O less than college
10. Have you worked at a job or business at any time in the past 12 months?

Yes
No

11. Are you an employee or self-employed?

Employee
Self-employed
Working in a family business without pay

12. Are you working in the health field (e.g. physician, nurse, dietitian, medical assistant, home health aide, pharmacy technician, and etc.)?

Yes
No

13. In what year did you first come to Canada to live? (e.g. yyyy)

14. What was your main reason for coming to Canada?

Study
15. Please identify your immigration status in Canada:

- Citizen
- Permanent resident
- With a permit (study permit/work permit)
- Refugee

**Acculturation**

16. How many years have you spent in Canada?

- 5 years or less
- 6–15 years
- 16 or more years

17. What language do you usually speak at home?
O Farsi or other Iranian ethnicities’ languages (Azeri, Lori, Kurdish, Balochi, Gilaki, Mazandarani, and Turkmeni)
O English

18. In which language do you speak more?

O I speak only in Farsi
O I speak more in Farsi than English
O I speak in both Farsi and English equally
O I speak more in English than Farsi
O I speak only in English

19. Please rate your overall English language fluency:

O Not fluent
O Somewhat fluent
O Extremely fluent

20. How often do you read newspapers, magazines, or books in Farsi?

O Very often
O Somewhat often
O Neither often nor rarely
O Somewhat rarely
O Very rarely

21. How often do you eat Persian food?

O Very often
O Somewhat often
O Neither often nor rarely
O Somewhat rarely
O Very rarely

22. How open are you to yourself or your child marrying outside of the cultural group?

O Strongly against
O Moderately against
O Neither open or against
O Moderately open
O Very open

Awareness about cancer risk factors

23. Please list the three things that you think affect a person’s chance of developing cancer?
24. These are some of the things that can increase a person’s chance of developing cancer. How much do you agree that each of these can increase a person’s chance of developing cancer?

<table>
<thead>
<tr>
<th>Health behaviours’ assessment</th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Not sure</th>
<th>Agree</th>
<th>Strongly agree</th>
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</thead>
<tbody>
<tr>
<td>Smoking any cigarettes at all</td>
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<td>Exposure to another person’s cigarette smoke</td>
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<td>Drinking more than 1 unit of alcohol a day</td>
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<td>Eating less than 5 portions of fruit and vegetable a day</td>
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<td>Eating red or processed meat once a day or more</td>
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<td>Being overweight (BMI over 25)</td>
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<td>Getting sunburnt more than once as a child</td>
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<td>Being over 70 years old</td>
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<td>Having a close relative with cancer</td>
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<td>Infection with HPV (Human Papillomavirus)</td>
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<td>Doing less than 30 minutes of moderate physical activity 5 times a week</td>
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Health behaviours’ assessment

Anthropometrics:

25. How tall are you without shoes on (cm)?

26. How much do you weight (kg)?

27. Since coming to Canada have you gained or lost weight?
O My weight has increased since I came to Canada

O My weight has decreased since I came to Canada

O My weight hasn’t changed

Smoking:

28. At the present time, you smoke cigarettes daily, occasionally or not at all?

O Daily

O Occasionally

O Not at all

29. Since coming to Canada, is your smoking pattern changed?

O I didn’t smoke when I was in Iran and nor in Canada

O I smoked when I was in Iran and I quitted smoking since coming to Canada

O I smoked when I was in Iran, but I smoked less since coming to Canada

O I smoked when I was in Iran, and I smoked more since coming to Canada

O I didn’t smoke when I was in Iran and I started to smoke since coming to Canada

O I smoked in Iran and my smoking pattern is not changed since coming to Canada

Alcohol:

30. During the past 12 months, that is, from December 2016 to yesterday, have you had a drink of beer, wine, liquor or any other alcoholic beverage?
If yes, please answer the following questions:

30A. During the past month, how often did you drink alcoholic beverages?

- Once a week or less
- 2 to 3 times a week
- 4 to 6 times a week
- Every day

30B. How often in the past month have you had 5 or more drinks on one occasion?

- Never
- Once a week or less
- More than once a week

30C. Thinking back over the past week, did you have a drink of beer, wine, liquor or any other alcoholic beverage?

- Yes
- No

30D. Starting with yesterday, how many drinks did you have?
31. Since coming to Canada, have you changed your drinking pattern?

O I didn’t drink alcohol when I was in Iran or in Canada

O I did drink when I was in Iran and I stopped drinking since coming to Canada

O I did drink when I was in Iran, but I drank less since coming to Canada

O I did drink when I was in Iran, and I drank more since coming to Canada

O I didn’t drink when I was in Iran and I started to drink since coming to Canada

O I did drink in Iran and my drinking pattern is not changed since coming to Canada

Physical activity

32. What best describes your activity level?

O Vigorous activity (e.g., race walking, running, aerobic dancing, or any activity which makes it difficult to talk or carry on a conversation while exercising) for at least 30 minutes, 3 days or more per week

O Moderate activity (e.g., walking briskly, general gardening, ballroom dancing, or any activity where you can still talk and carry on a conversation while exercising) for at least 30 minutes, 3 days or more per week

O Seldom active, preferring sedentary activities (e.g., watching television, playing computer games or reading)

33. Compared to other people your own age, do you think you are . . .
34. Since coming to Canada, have you changed your physical activity pattern?

- Much more active
- More active
- About as active
- Less active
- Much less active

35. Think about your eating habits over the past week. “How many servings of FRUIT do you usually eat or drink each day?” Think of a serving as being about 1 medium piece, or ½ cup of fruit, or ¾ cup of fruit juice.

- 1 serving or less per day
- Around 1.5 servings per day
- 2 to 3 servings per day
- Around 3.5 servings per day
36. Think about your eating habits over the past week. "How many servings of VEGETABLE do you usually eat or drink each day?" Think of a serving as being about 1 cup of raw leafy vegetable, ½ cup of other cooked or raw vegetable, or ¾ cup of vegetable juice.

- O 4 to 5 servings per day
- O More than 5 servings per day
- O 1 serving or less per day
- O Around 1.5 servings per day
- O 2 to 3 servings per day
- O Around 3.5 servings per day
- O 4 to 5 servings per day
- O More than 5 servings per day

37. Think about your eating habits over the past week. "How often did you eat RED/PROCESSED MEAT (e.g., packaged sliced meat)?"

- O None
- O Twice a day or more
- O Once a day
38. Since coming to Canada, have you changed your fruit and vegetable intake?

- I eat more fruit and vegetable since coming to Canada in comparison to when I was in Iran
- I eat less fruit and vegetable since coming to Canada in comparison to when I was in Iran
- My fruit and vegetable intake has not been changed since coming to Canada

39. Since coming to Canada, have you changed your red/processed meat intake?

- I eat more red/processed meat since coming to Canada in comparison to when I was in Iran
- I eat less red/processed meat since coming to Canada in comparison to when I was in Iran
- My red/processed meat intake has not been changed since coming to Canada