Psycho-social Contributions to Higher Type 2 Diabetes Mellitus Prevalence among South Asian Immigrants Living in Canada

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Abstract

This thesis studies psycho-social aspects of the experiences of South Asian immigrants (SAI) in Canada and how these may be related to the elevated presence of type 2 diabetes mellitus (T2DM) in this group. It does so by examining the way in which variables such as education and income levels, the gap between education and income levels, and psycho-social variables related to stress, predict the presence of T2DM in this group as compared to two other social groups: Chinese Immigrants (CI) and Canadian born whites (CBW). The results of this research support the hypotheses laid out for this dissertation that exposure to education/income gap increases risk for T2DM, and that SAI have higher risk for T2DM compared to CI and CBW.

Acknowledgements

This dissertation is dedicated to my dear late father Dr. Syed Mohammed Anwarul Kabir (MRCP, UK), my mother Raushan Kabir, my husband Saiful Hasan and my three children - Sareen Syeda Hasan, Rayyan Hasan and Aayan Hasan. While my mother's dream motivated this effort to pursue a doctoral degree, my husband supported my mother's dream. Needless to say that my children as well as my husband made the greatest sacrifices during the prolong period of pursuing master's degrees in Economics and in Health Policy and finally pursuing a doctoral degree in Health Policy and Equity.

During my doctoral journey, I received tremendous support from my friends and family to continue pursuing my doctoral degree and to not give up even during the hardest and most challenging times. Personally, I did not give up on pursuing the doctoral degree, because it was a dream held by my mother and my husband, as much as by me. At the same time, as an immigrant, I felt that I had the responsibility to successfully complete this degree, to set a good example to encourage future doctoral opportunities for immigrant women of colour at York University.

Last but not the least, my supervisor Dr. Dennis Raphael personally guided me to shift from being an economist to a policy researcher. He shared books with me and encouraged me to use quantitative research skills I learned from my economics background, in answering complex research questions in health policy. In this regard, I am also most grateful to Dr. Joel Lexchin, Dr. Marcia Rioux and Dr. Farah Ahmad who coached me through my doctoral education in countless ways - starting from thinking with a unique lens to writing without fear in presenting on sensitive and complex social issues.

During my doctoral tenure I taught classes at York University. While teaching students from a diverse background, I saw hope in the eyes of immigrants, specially coloured men and women, both single and married. I saw in their eyes hope that one day they could also be where I am today! These students came to see me with a big smile in their faces during my office hours and wanted to know how I got to where I am today. They asked about my pathway to success in Canada.

Having said the above, I want to continue to inspire vulnerable populations in Canada, teaching them and guiding them to achieve what is deemed impossible by many. I want to thereby truly practice the motto of York University "Tentanda via" or "The way must be tried". I want others to try this path of knowledge in Canada, irrespective of their socio-economic and cultural background. I also want to continue my research on vulnerable populations in Canada to better understand what unique experience or conditions impact health of minority populations living in Canada. This effort will help in addressing the existing knowledge gap and policy gap in reducing health inequities observed in Canada.

At the very end, I want to thank Allah for this gift of experiencing such holistic and tremendous support from my faculty members, family and friends in completing this dissertation which is just the beginning of my journey in academia.

Sincerely,

Syeda Kabir

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SAI: South Asian Immigrant

CI: Chinese Immigrant

CBW: Canadian-born White

T2DM: Type 2 Diabetes Mellitus

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Chapter 1: Overview and Purpose

Diabetes Mellitus

Diabetes mellitus (DM) is the seventh leading cause of death in Canada and affects over two million Canadians (Public Health Agency of Canada, 2008). DM is a complex metabolic disorder which is characterized by abnormalities related to carbohydrate, lipid, and protein metabolism that impacts insulin production and/or insulin absorption in the body (McKinlay & Marceau, 2000).

There are three forms of DM, type 1 (T1DM), type 2 (T2DM), and gestational. Among those having DM, 5-10% of individuals have T1DM (PHAC, 2009) and around 4% of all pregnant women develop gestational diabetes (PHAC, 2011), which is linked to a higher T2DM incidence risk in the future for the mother and child (PHAC, 2011). However, in Canada, of the three types of DM, type 2 diabetes (T2DM) affects approximately 90% of Canadians diagnosed with diabetes (Canadian Diabetes Association, 2017) and is the primary focus of this thesis.

High blood glucose is a distinctive feature to all categories of DM. Patients with DM are at risk to develop "eye disease (retinopathy); kidney disease (nephropathy); nervous-system damage (neuropathy); heart disease; hypertension; pregnancy complications; infection; periodontal disease; and many others" (McKinlay & Marceau, 2000, p. 757).

T1DM occurs when the immune system destroys the beta cells of the pancreas which leads to an inadequate supply of insulin to meet the need of the body (PHAC, 2009). T1DM usually develops in childhood or adolescence (PHAC, 2009). Insulin is always used in treatment for T1DM (Canadian Diabetes Association, 2017).

T2DM develops when the body makes inadequate amounts of insulin and/or does not respond well to the insulin the body makes (PHAC, 2012). T2DM usually occurs after the age of

40, although it is now being seen in children and adolescents (PHAC, 2012). Treatment of T2DM depends on severity and can be managed through change in lifestyle (such as exercise and eating habits) with or without a combination of medications to control blood sugar more effectively (Canadian Diabetes Association, 2016).

Gestational diabetes occurs during pregnancy and usually disappears after delivery (PHAC, 2011). Gestational diabetes increases "risk of developing diabetes for both mother and child" (Canadian Diabetes Association, 2016).

T2DM prevalence is increasing in Canada. According to the Public Health Agency of Canada (2011), the prevalence of diagnosed diabetes increased by 70% among Canadians from 1998/99 to 2008/09. Also, there were more than 200,000 Canadians with newly diagnosed diabetes (6.3 cases per 1,000 individuals) in 2008/09 compared to 1998/99. Estimates suggest that if T2DM incidence increases at the rate observed between 1998/99 and 2008/09, then approximately 3.7 million Canadians will have T2DM by 2018/19 (PHAC, 2011). Research has not found a way to prevent T1DM (Expert Panel Report, PHAC, 2009), but T2DM is seen as being preventable (PHAC, 2012). Since 90-95% of individuals with DM have T2DM in Canada and it is seen as being preventable, it is important to consider its causes and means of preventing it. There are various ways of conceptualizing the aetiology of T2DM with each having implications for both prevention and treatment. These different approaches are considered below in brief and discussed in detail in the next chapter.

Explaining T2DM with Health Inequality Models

A variety of models have been proposed to explain how conditions such as T2DM are more common in some groups than others. Commonly known as models of health inequalities, a

number of these -- genetic, cultural-behavioral, materialist, life course and psycho-social -- have all been applied towards issues such as greater incidence of chronic disease – including T2DM -- in some groups than others. A brief description of these models follows. They are presented in more detail later.

The genetic model of health inequalities argues that genetics are the basis for health inequalities in relation to T2DM. The cultural-behavioral model of health inequalities explains health inequalities as resulting from individual personal preferences towards eating habits and exercise routines which may result from the influence of community beliefs or "shared ideas, values and norms" (Bartley, 2004, p. 71). These two models are popular in explaining differences in T2DM prevalence among people of various social groups.

The materialist model argues that material advantage and disadvantage cause health inequality by exposing individuals to differential positive and negative experiences related to the material or the physical world (Lynch, Davey Smith, Kaplan & House, 2000). The life course model applies a multidisciplinary approach to comprehend the significance of time and timing to link lived experience and its effects at the individual and the population levels. The life course model analyses health inequalities such as differences in T2DM risks in terms of various advantages and disadvantages of an individual's entire life -- starting from childhood or even before birth (Bartley, 2004). Finally, the psycho-social model takes account of both stresses associated with adverse life experiences and cultural approaches towards problem solving. As such, the psycho-social model argues that stress can result from adverse living and working conditions, thereby contributing to adverse health outcomes (such as risk for T2DM) among certain groups (Bartley, 2004). In this thesis, the psycho-social model is seen as contributing to the differences in T2DM prevalence among people of various social groups.

While the mainstream medical literature at times acknowledges that T2DM is associated with multiple factors, a substantial portion of the literature attributes the prevalence of T2DM to culture, behaviour, and genetics. These are primarily individualistic discourses with recommendations for reducing its prevalence focusing on responding to groups' cultures and changing their behavior to enable "healthy" eating habits and taking up physical activity.

However, there is an increasing literature that highlights the importance of the social determinants of health – i.e. living and working conditions -- in the prevalence of T2DM (Raphael, Anstice, & Raine, 2003; Pilkington, Daiski, Bryant, Dinca- Panaitescu, Dinca-Panaitescu, & Raphael, 2010). These approaches call for changing the socio-economic circumstances that may both directly lead to this affliction as well as the disease-causing behaviours that is currently the focus of so much thinking about T2DM. Increasingly, this focus has been on how T2DM differences among various social groups -- including racial and ethnic groups -- arise from these living and working conditions.

Race and Ethnicity as Social Constructs

The concept of race arises in the discussion of inter-racial health inequalities and usually revolves around having a common hereditary trait that set a group of people apart from other groups. While race is sometimes explained in terms of biological traits such as a person's physical characteristics (bone structure and skin, hair, or eye colour), ethnicity commonly refers to having a common cultural heritage (nationality, regional culture, ancestry, and language). The primary researcher views race as a socially constructed concept and not a simple hereditary trait. For example, not all Africans or Europeans can be differentiated with a single or even more complex set of genetic difference. Therefore, the concept of race has a social meaning that

moves well beyond the biological concept of human genetic diversity. Such sociological understanding of the concept of race is important in this dissertation since it directs attention to issues of racism, discrimination and structural inequities along with resultant health inequalities amongst groups (Krieger et al., 1993; Muntaner et al., 1996).

Ethnicity usually refers to a set of common traditions, beliefs or behaviours. Sometimes, academics have also used the terms "race" and "ethnicity" interchangeably in the literature to represent the concept of differences across social groups (Witzig, 1996; Smale, 1997; Smedly et al., 2005). In this dissertation, race and ethnicity are seen as complex concepts that are primarily socially constructed but also represent a shared reality for many. South Asian immigrants to Canada, for example show specific characteristics such as income, education, employment, and language skills related to their social origins and experiences in Canada. This dissertation therefore sees the defining label of South Asian Immigrants – as well as comparison groups of Chinese immigrants and Canadian-born whites - as providing a heuristic for identifying and explaining their and others' experiences in Canada and how these may be contributing to their risk of T2DM.

The focus of this study is on South Asian immigrants and it is necessary that such a focus does not get bogged down in conceptual debates of the meaning of race and ethnicity. SAI share some common characteristics related to their nation of origin and their experiences in Canada that are related to skin colour and other characteristics ("race") and their shared languages and cultural beliefs ("ethnicity"). These aspects are clearly related to differing social and health outcomes that are a function of societal public policies (e.g., accepting educational credentials) and societal attitudes (e.g., discrimination in employment and educational opportunities). Therefore, in this dissertation, instead of using the terms "race" and "ethnicity", I use the term

"social group" to represent the essence of these concepts (i.e. structural/social forces). Therefore, for this dissertation whenever the term social group is observed, it represents aspects of both race and ethnicity with an assumption that these are socially constructed such that their association with T2DM outcomes is also a social event related to structures and processes of Canadian society.

To place the South Asian immigrants' T2DM situation in comparative perspective, in this dissertation I investigated three social groups living in Canada: South Asian immigrants (SAI), Chinese immigrants (CI) and Canadian Born whites (CBW).

Health Inequity and Health Inequality

This dissertation discusses inequity/inequality in the prevalence of T2DM. Scholars have proposed various terms to refer to health differences over time. Some of the most relevant terms, health equity, health inequity, and health inequality have been defined in various ways. Braveman (1998) provides an operational definition of health equity as reducing preventable and unfair disparities in health and the determinants of health. Braveman (1998) also explains that health inequity entails health differences due to social disadvantages.

In a paper titled "The Concepts and Principles of Equity and Health", Whitehead (1985) explains the difference between health inequity and health inequality. She explains that health inequities are health differences which are "avoidable, unfair, and unjust" (p. 5) with particular reference to "disadvantaged groups" (p. 3) in a society. She also asserts that those who face injustice and unfairness in a society have poorer health than those who do not, and that these health differences are avoidable.

Whitehead (1985) asserts that it requires fairness and social justice in a society to ensure equal opportunity to access, to utilization and to quality of health care for equal needs, to achieve health equity. She also argues that variations in health outcomes can occur across social groups living in the same country. Whitehead (1985) explains that all health differences, variations or disparities are not health inequities. While all health inequities are health inequalities, all health inequalities are not health inequities. For example, incidence of gynaecological illnesses are observed in women, but not in men. While this gender difference in the incidence of gynaecological illnesses is an example of health inequality, it is not an example of health inequity. This is so because of a gender difference in gynaecological illnesses among men and women that is rooted in their biological differences and not rooted in social difference/s.

After Whitehead's definitions of health equity and health inequality were proposed, other scholars proposed various definitions to explain these concepts, with little consensus on any single definition (Braveman, 2006; Braveman & Gruskin, 2003; Braveman, Kreiger, & Lynch, 2000; Braveman, Starfield, & Geiger, 2001; Mooney, 1983; Mooney, 1987; Murray, Gakidou, & Frenk, 1999). Definitions are used to formulate measurement methods. Therefore, a lack of precise definition impacts measurement of health differences and may have considerable policy implications with practical consequences on what issues are addressed or obscured in relation to reducing health differences.

In this dissertation I use the term health inequity to refer to preventable and unfair disparities in health and the determinants of health as I believe that the differences in T2DM prevalence across various social groups in Canada are avoidable, unfair, and unjust – particularly for disadvantaged immigrant groups such as SAI in Canada. My view is in support of

Whitehead's (1985) assertion that social groups facing injustice and unfairness in a society have poorer health than those who do not, and that these health differences are avoidable.

T2DM Prevalence in South Asians Living in Canada

Research findings show differences in the incidence and prevalence of T2DM across various social groups living in Canada. More specifically, South Asians living in Canada as well as in other Western high income countries such as the United Kingdom (UK) and the United States of America (USA) have a higher risk of developing T2DM than others (ICES, 2017; Sohal, 2006; Davachi, Flynn, & Edwards, 2005; Chowdhury, 2003; Egede & Dagogo-Jack, 2005; Misra & Vikram, 2004; Bajaj & Banerji, 2004). There are numerous definitions of "South Asians" in Canada that are variously based on language, religion, ancestral origins, culture, and geo-political boundaries. According to Statistics Canada's Canadian Community Health Survey (CCHS), South Asians are those who self-identify as having ancestors who are "South Asian (e.g. East Indian, Pakistani, Sri Lankan)" (Statistics Canada: Canadian Community Health Survey (CCHS) – Annual Component).

However, the census gives a broader definition for South Asians and defines "South Asian" as those who self-identify as having "ancestry that originates in South Asia, including those reporting their origin as at least one of Bangladeshi, Bengali, East Indian, Goan, Gujarati, Kashmiri, Pakistani, Punjabi, Nepali, Sinhalese, Sri Lankan, Tamil, or South Asian" (Statistics Canada, 2007). According to the 2006 Census (Statistics Canada, 2006), there are over 1.26 million South Asians in Canada (4.0% of the total population of Canada), and this group is the largest visible minority group in Canada (Statistics Canada, 2006). According to Statistics Canada (2017), "visible minority" is defined in terms of the Employment Equity Act as those

who are not Aboriginal peoples, non-Caucasian in race or are not white in colour. The primary visible minority groups are: South Asian, Chinese, black, Filipino, Latin American, Arab, Southeast Asian, West Asian, Korean and Japanese (Statistics Canada, 2017).

There is a rather high prevalence of T2DM among South Asian immigrants residing in countries such as USA, UK, and Canada (Chui et al. 2011; Anand et al., 2000; Bajaj & Banerji, 2004). Research findings show that while T2DM prevalence is 3-5% among those of European white descent, it is 12-15% among South Asians living in US, UK and Canada (Chowdhury, 2003; Egede & Dagogo-Jack, 2005; Misra & Vikram, 2004; Bajaj & Banerji, 2004; Chui et al., 2011).

Chui et al. (2010) and Chui et al. (2011) reported that South Asians in Canada have higher T2DM than those of white and Chinese people living in Ontario, Canada (populations as defined and identified by Statistics Canada's population health surveys). Chui et al. (2011) and Chui et al. (2010) studies also show that in Canada, even though South Asians are more educated than white people, they earn much less average income than those who are white. Both South Asians and Chinese people in Canada were observed to have higher education level than whites, but less annual average income, with South Asians earning the lowest annual average income among these three groups. White people earn $13,000 to $16,000 more than Chinese and South Asians respectively, while prevalence of higher education is more common in South Asian and Chinese people compared to whites in Canada.

Anand et al. (2000) analyzed data on South Asian, European, and Chinese people living in Hamilton, Toronto, and Edmonton, and found South Asians to have the greatest glucose abnormalities even though they were not the heaviest (Anand et al., 2000). Compared to whites, South Asians were more prone to elevated levels of glucose at any given level of Body Mass

Index (BMI). BMI is an indicator of body mass and a BMI cut-off point indicates the maximum point of weight and height ratio beyond which risk for incidence of illnesses such as T2DM may increase. Literature also suggests that South Asians develop T2DM at an earlier age than people of some other social groups (Chui et al, 2011; Chowdhury, 2003; Mukhopadhyay, Forouhi, Fisher et al., 2006). Details of these research studies are discussed in the later chapters.

South Asians also have a higher prevalence of pre-diabetes as compared to European white, black and Chinese people in US, UK and Canada (ICES, 2017; Sohal, 2006; Davachi, Flynn & Edwards, 2005; Chowdhury, 2003; Egede & Dagogo-Jack, 2005; Misra & Vikram, 2004; Bajaj & Banerji, 2004; Gupta & Brister, 2006; Gupta & Singh, & Verma, 2006). Pre-diabetes, also known as impaired glucose tolerance or impaired fasting glucose, refers to having higher blood glucose levels than normal, but lower than the established T2DM level (PHAC, 2008). It is believed that by managing pre-diabetes blood glucose levels, it may be possible to delay or prevent T2DM incidence (PHAC, 2008). Therefore, based on research findings it appears that South Asians have a higher risk of developing T2DM than other groups. It has been suggested – and this is one of the assumptions of this dissertation -- that it is the lived experiences of South Asians that contributes to their greater risk for T2DM (Raphael, 2012; Creatore et al., 2010; Riste et al., 2001; Raine, 2002). The next section considers this hypothesis.

Lived Experience of South Asian Immigrants in Canada

Human Resources and Skills Development Canada (2011) states in their report "A Profile of South Asians in Canada" that South Asians in Canada on average earned 10% less than the non-visible minority population in 2000. As a result, as compared to European immigrants, South Asians have a higher risk for poverty (Colour of Justice Network, 2007). According to

Statistics Canada (2007), while the Canadian unemployment rate was 7.4% in 2001, the rate among South Asians was 9.5%. This is despite Statistics Canada (2007) data showing that 25% of the South Asian Canadian populations had at least a University degree compared to 15% of the total population in Canada in 2001. In addition, nine percent of South Asians had a post-graduate degree compared to just 5% of the total population in Canada. Also 93% of South Asians were able to have a conversation in either French or English, the two official languages in Canada.

Despite higher comparative academic credentials than the general Canadian population, South Asians earned on average $4,000 less income a year than the national average. Average incomes for South Asians were $26,000 compared to $30,000 for all Canadians in 2001 (Statistics Canada, 2007). In addition, a higher proportion of South Asians reported income (23%) below low-income cut-offs (LICO) compared to the total Canadian population (16%) (Statistics Canada, 2007). Hence, South Asians living in Canada, despite having comparable and even better academic credentials than other Canadians living in Canada, faced higher unemployment and lower average income as well as a higher percentage of people with low income in Canada.

In addition to these realities, about 35% of South Asians reported that they experienced unfair treatment based on language, accent, social group, ethnicity or religion after arriving in Canada, particularly in matters related to employment (Statistics Canada, 2007). Among them, a majority of those (about 74%) who experienced discrimination said that they felt it was based on their race or skin colour, while 59% said that the discrimination took place at work or when applying for a job or promotion. (Statistics Canada, 2007).

Further, immigrants of colour – including South Asians -- report being healthier than their European peers when they first come to Canada, but recent immigrants from non-European nations are twice as likely to experience deterioration in health after arrival to Canada (Colour of Justice Network, 2007). The racialization of poverty in Canada, as evidenced "through a double digit racialized income gap, higher than average unemployment, differential labour market participation, deepening and disproportionate exposure to low income" (Galabuzi, 2005, p.38), create adverse living and working conditions that may contribute to the higher prevalence of T2DM among South Asians living in Canada.

Ontario's Institute for Clinical Evaluative Sciences (ICES) and St. Michael's Hospital conducted a three-year comprehensive study of 140 Toronto neighbourhoods and found that immigration and poverty are two key factors in developing T2DM. The researchers investigated factors related to prevention and control of T2DM in Toronto such as immigration, socioeconomic status, and ethnic composition and its relationship to T2DM (ICES, 2007). They concluded that:

- Visible minorities, including people of South and East Asian descents have a greater disposition to diabetes than persons of European descent.
- Diabetes rates are highest in areas that have lower income levels, higher unemployment rates, higher proportion of visible minorities and higher immigration rates.
- Wealthy areas in Toronto have low diabetes rates, regardless of the level of access to healthy resources or neighbourhood that were friendly for physical activity.

Therefore, factors such as higher levels of poverty and unemployment, immigrant status, visible minority status are all more common among SAI as compared to other Canadians. These factors may very well be contributing to the higher prevalence of T2DM among SAI.

History and Statistics of SAI to Canada

In 2011 over 250,000 people immigrated to Canada as permanent residents (Citizenship and Immigration Canada, 2011). About 15% of these emigrated from South Asia: 24,965 from India (10%), 6,073 from Pakistan (2%), 3,104 from Sri Lanka (1%), 2,449 from Bangladesh (1%), and 1,249 from Nepal (0.5%) (Citizenship and Immigration Canada, 2011). Statistics Canada (2016) reports, "South Asians—the largest visible minority group — could represent 28% of the visible minority population by 2031, up from 25% in 2006" (Statistics Canada, 2016). As noted, South Asians appear to be especially likely to report having T2DM, directing attention to this issue.

According to a Statistics Canada (2007) report "The South Asian Community in Canada", a majority of the Canadian population with South Asian origins living in Canada were born outside the country. This report also states that, 68% of Canadians reporting a South Asian origin were born outside of Canada, compared to 18% of the overall population, and most South Asian immigrants are also recent immigrants (Statistics Canada, 2007). Among these SAIs, "In 2001, 53% of immigrants of South Asian origin had arrived in the previous decade, while another 22% came to Canada between 1981 and 1990. In contrast, only 5% had arrived in the 1960s, while less than 1% had come to Canada before 1961" (Statistics Canada, 2007).

Tran et al. (2005) shows that during the early 20th Century, the South Asian community in Canada was "relatively small and homogenous" (Tran el al., 2005, p. 21) due to restrictive immigration laws prohibiting Asian and Indian immigration to Canada. By the 1960s criteria to select immigrants changed from social group or country of origin to "employment skills, education and language ability" (Tran el al., 2005, p. 21). This change brought about a tripling of number of SAI to Canada from 223,000 in 1981 to 917,000 in 2001 (Tran et al., 2005, p. 21).

Further, at the time of the 2001 Census, 29% of South Asians living in Canada had been born here, 69% were immigrants and 2% were nonpermanent residents (Tran et al., 2005, p. 21).

Buchignani (2015) states that, due to the coming independence of India, immigration regulation and quota for SAI to Canada was changed from very low figures. Indeed, in 1951 only 150 individuals were allowed from India, 100 from Pakistan, and 50 from Ceylon (Buchignani, 2015). There were only 2,148 South Asians in Canada in 1951 and with a moderate expansion of immigration, the number of SAIs to Canada increased to 6,774 by 1961, and 67,925 by 1971. By 2011 the number of South Asian population in Canada was 1,567,400 (Buchignani, 2015).

Statistics Canada (2008) reports that since 2006, South Asians are the largest visible minority population in Canada and have surpassed the Chinese population. According to Census statistics, the number of people who identified as South Asians was an estimated 1,262,900 individuals with a growth rate of 37.7% from 917,100 individuals in 2001. South Asians represent about one quarter (24.9%) of all visible minorities, which is about four percent of the total Canadian population.

Hence a majority of current South Asian population in Canada are recent immigrants. South Asians are also a young population compared to the overall Canadian population (Statistics Canada, 2007). In 2001, while in the overall Canadian population the percentage of children under the age of 15 was 19%, it was 25% among South Asians. In the age group 15 to 24 of South Asians, the figure was 15%, while for the overall population it was 13%. In contrast, there were only 6% South Asians in the seniors group aged 65 and over, while for the total Canadian population it was double at 12%. Similarly, 20% of South Asians were in the 45 to 64 age group versus 24% of the overall population (Statistics Canada, 2007). Therefore, most South

Asians in Canada are a recently arrived and younger population as compared to the overall population in Canada.

Research Aim

T2DM is more common in South Asian populations as compared to people of other social groups in Canada. The existing literature on T2DM inclines towards genetic and cultural-behavioral models in explaining higher T2DM among South Asians. However, there is increasing recognition of the role material and social deprivation may play in explaining the South Asian scenario. For example, some studies suggest that South Asians have a higher incidence of T2DM due to their experience of poverty (Gupta & Brister, 2006; Lin et al., 2010; Ramachandran et al., 2008; Creatore et al., 2010). Therefore, part of having higher prevalence of T2DM among South Asians may be due to T2DM disproportionately afflicting socially and materially disadvantaged adults of which many South Asians belong. Since research studies suggest that there is increasing income inequality among Canadians and continuing high rates of poverty during the past few decades, special attention to potential effects of low income upon the health and wellbeing of these individuals is required. This is especially the case in relation to the etiology of T2DM among South Asians living in Canada.

Furthermore, some studies show that South Asian Canadian populations of low income have higher T2DM prevalence than people of other social groups at the same income levels (Creatore et al., 2010; Raine, 2002). Therefore, mechanisms linking the prevalence of T2DM with low income may not be the same across people of various social groups. This leads to the need for further investigation beyond materialist factors to explain differences in T2DM prevalence among South Asian people and those of other social groups. Along these lines,

McKinlay and Marceau (2000), argue that factors responsible for T2DM incidence may encompass psycho-social factors. Such psycho-social factors have not had as much attention paid in investigations of the causes of T2DM in South Asians in Canada.

From the perspective of lived experience, immigrants of certain social groups such as South Asians face unique challenges upon immigration to Canada. Evidence suggests that many highly educated South Asians are working in low income manual jobs (Galarneau & Morissette, 2008). When highly skilled people of colour such as educated South Asians fail to get acknowledgement of their credentials upon which they were selected to immigrate to Canada, this can lead to especially adverse experiences of living in low income dwellings, eating foods that are unhealthy, social exclusion, and long hours of manual labour and stress which may lead to anxiety and mood disorders. These represent adverse psycho-social outcomes that are increasingly being associated with T2DM (McKinlay & Marceau, 2000; Bartley, 2004; Kelly & Ismail, 2015). All of this bears investigation as potential contributors to prevalence of T2DM in this vulnerable group.

The purpose of this study is to go beyond traditional genetic, cultural-behavioral, and materialist approaches to investigate particular psycho-social factors that may be behind the higher prevalence of T2DM among South Asians as compared to other populations living in Canada. This research investigates the association between potential higher prevalence of a gap between education and income levels and T2DM to explain the higher prevalence of T2DM among SAI living in Canada compared to other ethnicities such as Chinese immigrants (CI) and Canadian-born whites (CBW). More specifically, SAI group may be more likely to experience discrepancy between levels of education and earned income, thereby creating higher level of

psycho-social stress generated by adverse life experiences (i.e. low social status, poor living conditions, and poor work conditions), contributing to the onset of T2DM.

This thesis therefore extends previous work by considering how psycho-social factors related to immigration and settlement in Canada may contribute to the incidence of T2DM among SAI. It applies a model of socio-biological translation developed by Tarlov (1996) to understand the influence of psycho-social factors and mental health outcomes upon higher T2DM prevalence among SAI as compared to other groups in Canada.

Tarlov (1996) speculates that varying socio-biological translations of experiences causes differential vulnerability to chronic disease across groups – a factor that has not been investigated yet in a Canadian context across populations. Tarlov (1996) explains socio-biological translation as follows:

> Sociobiological translation is proposed as a mechanism by which human beings receive messages about the social environment and convert the messages to biological signals that trigger the processes of disease development. (p. 85)

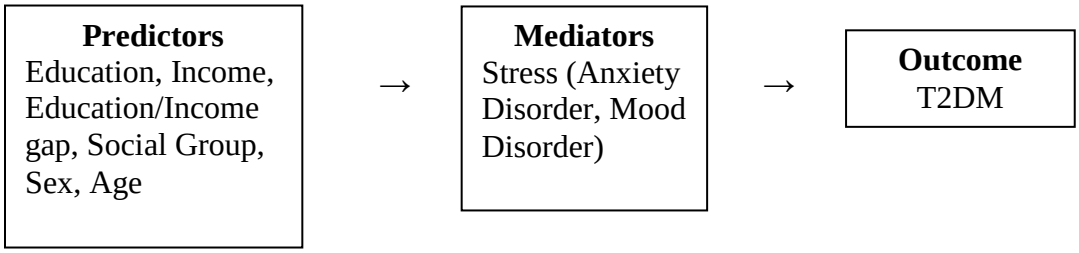
Tarlov (1996) explains that variations in chronic disease incidence across populations are due to "variations in the strength of the dissonance that results from the identity-expectations-reality interplay" (p. 86), and hence, when there is a clash between expectations and reality, "the chronic, persistent, inescapable dissonance between what a person would like to do, or become and what seems accomplishable triggers biological signals that are antecedent of chronic disease development" (Tarlov, 1996, p. 85-86). Tarlov's identity-expectations-reality interplay model may be useful to investigate the association between experience of SAI upon immigration to

Canada and their higher T2DM prevalence as compared to other populations. This model is discussed more fully in following sections.

This thesis therefore examines the relationship between having a gap between educational experience and income and being afflicted with T2DM. Drawing upon data from the Canadian Community Health Survey, a large Canadian data set, it examines potential differences between immigrant and non-immigrant populations, in particular, SAI and CI living in Canada with CBW in education, income, the gap between the education and income, and the likelihood of reporting having T2DM. This data set also allows analysis segregated by men and women and by social groups. In this dissertation, the predictor variables are education/income gap, social group, sex, and age; the mediator variable is stress (Anxiety Disorder, Mood Disorder), and the outcome variable is T2DM. These variables are explained in detail in the methodology chapter.

Figure 1

Outcome, Mediator, and Predictor Variables in this Study



The aim of this research is to answer the following research question:

I. Are variations in socio-biological translation related to contrasts in identity-expectation versus reality experience (such as a gap in education and income) across SAI, CI and CBW associated with variations in the prevalence of T2DM in these populations living in Canada?

In this dissertation I apply critical social and feminist political economy theory to analyze how T2DM prevalence among SAI may come to be higher than people in other social groups such as CI and CBW. I present the findings of this investigation to inform evidence-based policy making in order to reduce T2DM prevalence among SAI living in Canada. In the following chapter I present how the existing literature conceptualizes differences in T2DM incidence and relate these to the models of health inequalities briefly presented in this chapter.

Chapter 2: Models of Health Inequality

Scholars approach the presence of health inequalities from various perspectives. While some scholars explain health inequalities as a consequence of genes, individual behavioral choices attributable to factors such as cultural influence and education, others argue that social structures and processes particular to societies shape the health of individuals (Townsend, Davidson, & Whitehead, 1986). In other words, scholars argue that health inequalities can be either attributed to individual choices or broader societal influences.

Research findings suggest that South Asians in Western developed countries have a higher incidence of T2DM. These outcomes can be interpreted through the health inequality models briefly presented in the earlier chapter: genetic, cultural-behavioral, materialist, life course, and psycho-social. These health inequality models suggest alternative explanations for these observed differences in health outcomes within and across populations. In this chapter I discuss these various models of health inequalities in relation to T2DM to identify an existing gap in literature in explaining the higher prevalence of T2DM among SAI living in Canada. These five models of health inequality are provided in Table 1.

Table 1

Models of Health Inequality

Genetic Model	The genetic model argues that genetic differences are the basis for health inequalities.
Cultural-Behavioral Model	The cultural-behavioral model explains health inequalities as resulting from individual's personal behavioural preferences, i.e., diet, physical activity and tobacco and alcohol use, and how these may result from the influence of community beliefs or "shared ideas, values and norms" (Bartley, 2004, p. 71).
Materialist Model	The materialist model explains health inequalities in terms of material advantage and deprivation that expose individuals to differential positive and negative experiences (Lynch, Davey Smith, Kaplan & House, 2000).
Life-Course model	The life course model applies a multidisciplinary approach to comprehend the significance of time and timing, to link lived experience and disease outcomes at the individual and the population levels (Lynch & Smith, 2005).
Psycho-social Model	According to the psycho-social model, health inequality results from stresses associated with adverse life experiences. As such, the psycho-social model argues that the stresses of low social status, poor living conditions, and poor work conditions contribute to health inequalities (Bartley, 2004).

Genetic Model

The genetic model argues that the presence of genetic differences is the basis for health inequalities. The genetic model argues that genes carried over from one generation to subsequent generations lead to good or poor health. In more sophisticated models, (Bartley, 2004), the intersection of genes with environmental characteristics is explored as a basis for resultant health inequalities.

The genetic model of health inequalities at times is strongly represented in T2DM discourse, particularly in relation to South Asians. Below I discuss findings of some research studies that draw upon the genetic model to explain the higher T2DM incidence among South Asians. A body of research on T2DM incidence among South Asians highlight genetic

predisposition as a dominant risk factor. Researchers argue that South Asians living in developed/high income Western countries adopt a high calorie diet which with inadequate physical activity intersects with genetic dispositions to create insulin resistance that leads to T2DM (Gupta & Brister, 2006; Gupta, Singh, & Verma, 2006; Anand, Yusuf, Vuksan, et al., 2000; Razak, Anand, Vuksan et al; 2005; Hales & Barker, 1992).

Kajantie, Osmond, Barker et al. (2005) argue South Asian babies have higher levels of cord leptin and insulin, suggesting an intrauterine origin for adiposity and hyperinsulinemia. Kajantie et.al., and Bajaj and Banerji (2004) argue South Asian babies more commonly have the thin-fat phenotype (muscle thin, body fat), which outs them at a higher risk of developing DM. Future investigations may reveal whether the thin-fat phenotype in South Asian babies is of genetic origin or can be attributed to other factors.

The International Diabetes Federation (2008) considers central obesity as a significant contributor to developing metabolic syndrome. Some researchers argue that South Asians tend to have more visceral fat at any BMI such that even non-obese South Asians would tend towards higher levels of insulin resistance (Egede & Dagogo-Jack, 2005; Misra & Vikram, 2004; Bajaj & Banerji 2004; Gupta & Brister, 2006; Gupta, Singh, & Verma, 2006) as visceral fat is related to levels of insulin resistance. Since research studies suggest that South Asians show metabolic abnormalities at a much lower waist circumference (Gupta & Brister, 2006; Gupta, Singh, & Verma, 2006; Cheng & Leiter, 2006; International Diabetes Federation, 2008), the International Diabetes Federation (2008) proposes a lower waist circumference cut-off point for South Asians as compared to Europeans.

In Ontario, Canada, Chiu, Austin, Manuel, Shah, and Tu (2011) compared T2DM incidence among various social groups. In this study 59,824 non-diabetic subjects of white,

South Asian, Chinese, and black races (race as defined and identified by Statistics Canada's population health surveys, Chui et al.) who were non-diabetic adults aged 30 years and above were followed for up to 12.8 years for T2DM. They found 4,076 subjects developed T2DM during the research study period and that as compared to white subjects, South Asian subjects had 3.40 times and Chinese subjects 1.87 times greater risk of developing T2DM. On average, South Asians had their T2DM occurring nine years earlier and Chinese subjects had T2DM occurring 3 years earlier than white subjects in this study. For South Asian subjects the average age at diagnosis was 49 years, for Chinese subjects it was 55 years, and for white subjects, 58 years. A major finding of this study is identifying ethnic-specific BMI cutoff points to assess risk for T2DM. In this study the authors reported that South Asian and Chinese subjects developed T2DM diabetes at a higher rate, at an earlier age, and at lower ranges of BMI than their white counterparts. This study also reported that in Canada, T2DM was more common among males than females in South Asian, Chinese and white populations.

In another Canadian study, Chiu, Austin, Manuel and Tu (2010) examined 154,653 whites, 3,364 South Asians, and 3,038 Chinese people between 1996 and 2007. This study found group variations in T2DM and various T2DM risk factors. Prevalence of obesity was highest among White people at 14.8% followed by South Asians at 8.1% and Chinese at 2.5%. Among these three groups, T2DM was the highest at 8.1% among South Asians, followed by 4.3% in Chinese and 4.2% in white people. T2DM prevalence is almost the same among whites and Chinese, but double in case of South Asians. Like other studies, while males had a higher prevalence of T2DM than females in the white and South Asian groups; among Chinese females had a greater prevalence of T2DM than their male counterparts. The authors suggest that there are striking differences in health risk profiles across ethnic groups, and it is important to raise

awareness of these differences to help identify priorities for development of appropriate disease prevention programs for specific ethnic groups.

Another group of researchers collected and analyzed data on 985 South Asian, European, and Chinese people living in Hamilton, Toronto, and Edmonton. Anand et al. (2000) found South Asians to have the greatest glucose abnormalities even though they were not the heaviest among subjects from the three groups. Compared to whites, South Asians were more prone to elevated levels of glucose and to lipid-related factors at any given level of BMI. The authors argue that the BMI cut-off point for South Asians was only 21.0 kg/m^2, compared to 30.0 kg/m^2 for white subjects, implying that at a given BMI, South Asian subjects have a greater level of abdominal adiposity compared to white subjects. BMI is an indicator of body fatness, and a BMI cut-off point indicates the maximum point of weight and height ratio beyond which risk for incidence of illnesses such as T2DM may increase.

A group of UK researchers carried out a genome-wide association study (GWAS) of T2DM and argue that there are common genetic variants at six loci that are recently linked with T2DM (Kooner, Saleheen, Sim et al., 2011). These researchers state that among various genetic variants, one gene is linked to insulin sensitivity, while another two are linked with pancreatic beta-cell function. Kooner et al. (2011) study found, “no evidence for heterogeneity of effect between South Asians and Europeans at the six new loci discovered, including those carried forward for further testing based on GWAS results from South Asians only” (p. 986). This finding implies that the researchers found no difference in genetic variants between the two social groups. Therefore, Kooner et al. study does not imply difference in risk for T2DM in South Asians and Europeans, as presence of certain genes were common in both South Asians and Europeans. Kooner et al. (2011) study does not report whether people of South Asians group

are at a similar, higher or lower risk for T2DM than other populations due to presence of certain genes. It rather implies that genetic variants identified in Konner et al. study are more related to risk for T2DM, rather than people of South Asian social group having higher risk for T2DM compared to Europeans.

With regards to genes, Brunner and Marmot (1999) also argue that genetic susceptibility need not be a cause for irreversible destiny, as claimed in some traditional research findings. For example, if behavioral attributes are responsible for incidence of illnesses, it is possible to address behavioral attributes by changing the environment in which people live, instead of blaming individuals for illnesses due to their behavioral attributes (Brunner & Marmot, 1999). In support of this, some scholars argue that causes for diseases are often inappropriately attributed to genes when a familial tendency is observed which may be due to environmental exposures common to families (Barker, 1992; McDermott, 1998).

McDermott (1998) states that "[t]he genetic paradigm seeks to emphasize the 'independence' of the disorder and of the group, making it a 'special problem' with no immediate ramifications for the rest of the society or for specific interventions to improve the situation." (McDermott, 1998, p. 1192). McDermott (1998) states that risk factor epidemiology is a narrow (reductionist) approach which blames individuals of certain racial groups for having genes that cause increased risk for certain disease incidence such as T2DM. Therefore, this narrow approach limits policy interventions to prevent T2DM among populations with higher T2DM than others such as Aboriginals in Australia, labeling it as an irreversible genetic trait (McDermott, 1998). In addition, McDermott (1998) states that a three decades search to make a connection between genes, and non-insulin dependent diabetes mellitus (NIDDM), has not been found. The practice of blaming T2DM as a genetic condition denies the right of agency of

individuals and communities to prevent risk for T2DM through policy interventions as it completely ignores “the need to attend to environmental factors, including socio-economic environment and prevention” (McDermott, 1998, p.1190).

To this end, Cruickshank et al. (2001) state that intergenerational socioeconomic influences and energy imbalance are more influential factors to T2DM incidence than variations in ethnic/genetic predispositions, and that a novel technique of ‘proteomics’ may potentially discover triggers in the environment that impact gene product. They affirm that genetic screening in isolation to other risk factors to T2DM incidence may lead to inaccurate and ineffective conclusions. Cruickshank et al. (2001) also mention that the emergence of T2DM and hypertension in less wealthy populations challenges the genetic hypothesis. They mention that genes do not change in two generations. Therefore, the authors wonder, “do all such populations carry ‘thrifty genes rendered detrimental by progress’ (Dowse and Zimmer, 1993) or do the few with lower prevalence (e.g. Europeans) carry ‘mutant’ genes allowing some escape (Sharma, 1998)? Are gene defects relevant at all?” (p.112). According to these researchers, as of now there has been a “weak and imprecise” (p.115) association between candidate genes and chronic disease phenotype when they occur, and they mention that even “twin studies offer little support to genetic hypothesis” (Cruickshank et al., 2001, p. 111). They state that “[t]his is despite many millions of dollars spent in research funding and years of searching, which might also suggest publication bias” (Cruickshank et al., 2001, p. 115).

In support of the above, Chaufan (2008) states that there are conceptual problems in the genes–lifestyle framework which caused confusion in “potential contribution of genetics to human health” (p. 269). She states that "[t]he familial aggregation of diabetes is hailed in and of itself, time and again, as providing "evidence" that the disease is "genetic" (p. 278), and explains

that a trait may run in families, i.e., may be "familial", yet have nothing to do with genes. She adds that familial and genetic have different meanings - whereby familiarity is an observation that may or may not be explained by the action of genes, as many traits run in families for purely social or cultural reasons, for example, language, religion, and social status. Chaufan (2008) states that, experts continue to describe diabetes in terms of "biology and behavior - "genes-as-destiny" and "lifestyles-as-choice" – said to have spared no social group" (p. 269). She also mentions that there is a disproportionate distribution of diabetes among the poor and minority racial and ethnic groups. Therefore, the author argues that disparities related to T2DM "are not mere differences but differences that are avoidable, unnecessary, and unjust" (p. 269). The author recommends political rather than medical solution to address root causes of diabetes, as they "lie in inequities in social power" (p. 269). She concludes that, "insofar as dominant accounts of the diabetes epidemic ignore or downplay these roots, they will legitimize research and policies that reproduce or even increase diabetes disparities" (p. 269).

Hence, genetic predispositions may not be a vital risk factor to developing T2DM. Nevertheless, the underlying principle that genetic predisposition dominantly influences T2DM incidence among high risk populations such as South Asians dictate the T2DM incidence discourses in Canada. The other dominant model addressing the aetiology of T2DM incidence among South Asians is the cultural-behavioral model.

Cultural-Behavioral Model

The cultural-behavioral model explains inequalities as resulting from individual's personal preferences towards risk behaviours including eating habits, exercise routines and tobacco and alcohol use. These preferences may be influenced by community beliefs or "shared ideas, values

and norms" (Bartley, 2004, p. 71). The cultural-behavioral model argues that low income groups, for example, have a 'culture' of making unhealthy lifestyle choices, while high income groups are perceived to have a 'culture' of making healthy lifestyle choices (Bartley, 2004). Sarah Nettleton discusses the holy trinity of risk – diet, activity, and tobacco use whereby individuals' risk of developing an illness is dependent on behavioral and lifestyle factors (Nettleton, 2006).

The cultural-behavioral model of health inequality in addressing T2DM is clearly endorsed by many health organizations in Canada. For example, the South Asian Diabetes Prevention Program (SADPP) in Canada highlights in addition to genetic predisposition a diet rich in refined carbohydrates, sugar and fats, and sedentary lifestyle (SADPP, 2012). Various policies and programs have been designed based on the cultural-behavioral model to reduce T2DM incidence in Canada.

Many research studies are based on the cultural-behavioral model of health inequality. These focus on physical exercise, eating habits, and a culture of unhealthy lifestyle as the leading risk factors for higher T2DM incidence among South Asians living in developed Western countries. Liu, So, Mohan, Khan, King, and Quan (2010) used data from 2000, 2003, and 2005 iterations of the Canadian Community Health Survey (CCHS) to study T2DM incidence among various social groups. CCHS is a national cross-sectional survey data of persons aged 12 years and older, residing in 10 provinces, and 3 territories in Canada. Liu et al. (2010) assert that among 371,154 subjects of various social groups in Canada, Aboriginals (10.9%) had the highest proportion of age-adjusted T2DM, followed by South Asians (9.9%). However, age adjusted prevalence of obesity (with BMI greater than or equal to 30) was less among South Asians (14.6%) than whites (8.9%) in this study. They suggest that with increased duration of stay in Western developed countries, immigrants increase their risks of obesity as a result of their

adapting a sedentary lifestyle and engaging in high calorie diets. The authors also state that most visible minorities/ethnic groups are physically less active compared to the white respondents. They found that Chinese and South Asian people are the least active groups. However, their T2DM prevalence are not the same. Prevalence of T2DM is less than half in the Chinese group (2.5%) compared to the South Asian group (5.6%), even though both groups are reported to be physically least active. While 61.3% Chinese people were physically inactive, similar percentage of people in the South Asian group (62.8) were physically inactive. This challenges the link between physical activity and T2DM prevalence by social groups. The study results also show that males have a higher prevalence of T2DM than females in Canada.

Several other studies on T2DM incidence conclude that South Asians have a higher T2DM incidence than individuals of other social groups living in Western developed countries due to lifestyle changes upon migration to Western developed countries (Ramachandran, Mary, Yamuna et al., 2008; Bhopal, 2002; Mukhopadhyay, Sattar, & Fisher, 2005; Anand, Yusuf, Vuksan et al., 2000; Kuppuswamy & Gupta, 2005).

Finally, a British study by Owen, Nightingale, Rudnicka, Cook, Ekelund, and Whincup (2009) affirm that objectively measured physical activity levels among South Asian children are lower than white Europeans and black African–Caribbeans. The authors investigate ethnic differences in mean daily activity (counts, counts per minute of registered time or CPM and steps) adjusted for age, gender, day of week and month. As compared with white Europeans, South Asians recorded 18,789 fewer counts [95% confidence interval (CI) 6390-31187], 41 fewer CPM (95% CI 26-57) and 905 fewer steps (95% CI 624-1187). Black African-Caribbeans recorded 25,359 more counts (95% CI 14 273-36 445), and similar CPM, but fewer steps than white Europeans. The authors assert a lack of physical activity as influential factors

for further investigation for reversing higher T2DM incidence among South Asians. The authors mention that lower physical activity levels among South Asians and lesser time spent on various physical activities may make a significant impact to metabolic differences across social groups. However, the authors also recognize that emerging evidence suggest that insulin resistance and hyperglycaemia are important contributors in certain high risk groups such as black African–Caribbeans when compared with white Europeans. Hence, they mention that differences in physical activity are not likely to be a major contributing T2DM risk factor. This finding supports the hypothesis of this research to investigate other potential T2DM risk factors such as psychosocial stress.

The cultural-behavioral model focuses primarily on individual attributes and focuses on behavioral attributes and the culture of social groups. However, many scholars argue that blaming individuals for illnesses such as T2DM is problematic and unduly reductionist (Pearce, 1996) ignoring broader determinants of illnesses. For example, if behavioral attributes are responsible for incidence of illnesses, these result from the environment in which people live (Brunner & Marmot, 1999). McKinlay and Marceau (2000) highlights factors such as "social determinants, geographical and environmental variations, health-care access and utilization, behaviour and lifestyles of individuals, the influence of bio-physiology, fetal experiences, and family history" (McKinlay & Marceau, 2000, p. 758). Further, Raphael et al. (2011) also finds that income swamps the effects of body weight and physical exercise in predicting T2DM among Canadians. Hence, in investigating the aetiology of higher T2DM incidence among South Asians in Canada, it may be useful to consider alternative models of health inequality such as the materialist, the psycho-social, and the life course models.

Materialist Model

The materialist model explains health inequality in terms of material advantage and disadvantage associated with exposures to differential positive and negative experiences (Lynch, Davey Smith, Kaplan & House, 2000). These material advantage and disadvantage may be related to unequal distribution of social and economic resources within a society such as income, education, housing, and so on (Grabb, 2007). Individuals living under low socioeconomic conditions are also more prone to adopt risky health related behaviours (Anstice, 2002; Travers, 1996) such as high calorie diet, lack of exercise, sedentary lifestyle and so on.

Several studies have shown that there is increased risk for T2DM morbidity and mortality in individuals with lower socioeconomic positions (Wamala et al., 1999). In the USA and other developed countries, minorities and those who are poor bear greater burden of T2DM (Diabetes Research Working Group, 1999, p. 76).

Wright (2003) found T2DM increasing at a disturbing speed among poor Appalachians, both white as well as ethnic minorities. Morikawa et al. (1977) found T2DM to be eight times more likely among low-income as compared to high income individuals.

While, most research focuses on males, Wamala et al. (1999) investigated the association between the metabolic syndrome and socioeconomic position (as indicated by education) among healthy women in Sweden aged 30-65 years. These women were representative of the general population in a metropolitan area. Wamala et al. (1999) found women of lower socio-economic strata had an increased risk for T2DM. The authors found that after adjusting for "age, menopausal status, family history of diabetes, cigarette smoking, lack of physical exercise, and alcohol consumption" (p. 2001), women with less than 9 years of education had 2 to 3 times higher risk of having T2DM compared to those with college/university education. In this study, behavioral attributes (physical exercise, smoking, and alcohol consumption) had association with

low education and the metabolic syndrome. However, these behavioral attributes were not able to identify the bulk of the higher risk for T2DM in women with low socio-economic status or SES (low education). Therefore, Wamala et al. study shows the significant effects of low socioeconomic status (by levels of education) in increasing risk for T2DM in women.

Chaufan and Weitz (2009) acknowledge that the incidence of T2DM is rooted in biology and develops when "a malfunctioning pancreas, the producer of insulin, is faced with insulin resistant tissues and so no longer can maintain an individual's blood glucose levels within a healthy range" (p. 77). However, the authors focus on the root causes of having insulin resistance in the first place. For example, the authors explain that a fetus is deprived of adequate nourishment when a pregnant woman is malnourished. As a result, the development of fetal pancreas is affected leading to "largely irreversible glucose intolerance, i.e., an in-born (but not genetic) biological predisposition to diabetes" (p. 79).

Malnourished young children going through the development of pancreatic functions, are also at a risk of becoming insulin resistant (Chaufan and Weitz, 2009). Therefore, if an insulin resistant baby or young child becomes pregnant later in life, the resulting fetus is exposed to its mother's insulin-resistant state, which can impair the pancreatic development in the fetus, leading to T2DM later on in life (Silverman et al., 1995).

Many research studies suggest that this can be a continuous cycle over generations whereby biological predisposition to T2DM is reproduced "that can be triggered or compounded by multiple pregnancies, high calorie diets and low levels of physical activity" (Chaufan and Weitz, 2009, p. 79). They further mention that these factors may explain the high rates of T2DM among Southwestern Native Americans as well as the explosion of T2DM in India and China. There is currently a substantial body of medical research explaining the direct impact of poverty

in causing insulin-resistant states, pre-diabetes, and, eventually, T2DM (Silverman et al., 1995; Benyshek et al., 2001; Ben-Shlomo and Kuh, 2002; Branca and Ferrari, 2002; Barker, 2003).

Marmot and Brunner (2001) see deprivation over the life course as influencing sugar uptake by impeding the effects of insulin. This happens through behavioural coping mechanisms and central physiological mechanisms (Marmot and Brunner, 2001). In Canada also, T2DM incidence is more prevalent among those who are poor and insecure than those who belong to high-income groups (Raphael, Anstice, & Raine, 2003; Pilkington, Daiski, Bryant, Dinca-Panaitescu, Dinca-Panaitescu, & Raphael, 2010; James, Young, Mustard, & Blanchard, 1997).

In a Canadian study, Creatore and colleagues (2010) conducted data analysis of a population-based sample from Ontario to examine T2DM risk distribution among immigrants aged 20 years or older. They compared T2DM incidence rates of 1,122,771 immigrants to Ontario by country and region of birth against rates of 7,503,085 long term residents of Ontario. The authors examined the distribution of risk for T2DM across ethnicities adjusting for sex, age, country of birth, time since arrival and socio-economic characteristics. South Asians had increased risk for developing T2DM compared to long-term Ontarians and compared to immigrants from Europe, North America, and Central Asia. The authors support that higher prevalence of T2DM is attributable to a complex interplay of genetic and environmental factors (i.e. including acculturation, stress, social isolation, and employment and economic challenges). The authors conclude that ethnic differences in T2DM existed after controlling for age, immigration category, level of education, level of income and time since arrival. However, low socio-economic status was also associated with increased risk for T2DM. They state that, when compared to long-term residents, Canadian recent immigrants predominantly from East-Asia (27.5%), South Asia (19.4%), and Latin America and the Caribbean (15.8%) were more likely to

live in lower-income neighbourhoods. The authors found that for immigrant women, low SES as measured by low education (i.e., less than a high school diploma) was a significant independent risk factor for T2DM. The authors found that rates of T2DM was significantly higher in South Asian men (OR 4.01, 95% CI 3.82– 4.21) and women (OR 3.22, 95% CI 3.07–3.37) compared with immigrants from Western Europe and North America, with men from all regions together having higher risk for T2DM than women. Based on this study, the authors recommend further exploration of lifestyle-related interventions to reduce T2DM risk among recent immigrants such as South Asians.

A British study by Riste, Khan, and Cruickshank (2001) investigated T2DM prevalence of 1,318 subjects from white European, African Caribbean, and South Asian (Pakistani) origins residing in Britain's third most impoverished areas. Above 60% of these subjects reported household annual income <£10,000 ($15,000) per year. They investigated the contribution of deprivation, measured by reported income in an area with poor socioeconomic indexes, education level, physical activity, and obesity. All groups had high prevalence of T2DM. Newly detected T2DM was 20% in Europeans, 22% in African Caribbean, and 33% in Pakistani descents. Their findings show that factors such as lower height, older age and waist girth as well as physical activity levels were independently related to plasma glucose levels. However, they mention that it is unclear whether increasing rates of T2DM in certain populations such as South Asians are due to genetic or environmental factors. They add that while arguments in favour of genetic contribution has been made elsewhere, the link between poverty and T2DM prevalence has been under-recognized. The authors also mention that individuals exposed to more deprivation have higher T2DM prevalence individually and by areas.

Raphael (2010) asserts that even though “traditional explanations focus on genetic and lifestyle causes [with regards to T2DM], increasing evidence is coming to support the view that [T]2DM is primarily a disease of material and social deprivation associated with poverty and marginalization” (p.1). It is therefore likely that besides cultural-behavioral and genetic factors, differences in levels of income and material deprivation in Canada may be responsible for higher T2DM prevalence in South Asian populations.

Life-Course Model

The life course model applies a multidisciplinary approach to comprehend the significance of time and timing to disease outcomes (Lynch & Smith, 2005). These multiple influences depend on "the position of individuals and families in social and economic structures and hierarchies of status" (p. 115) in terms of various advantages and disadvantages of an individual's entire life events - starting from childhood or even before birth (Bartley, 2004). In terms of chronic illnesses such as T2DM, a life course approach examines how temporal processes are interconnected and influence the development of chronic illnesses (Lynch & Smith, 2005). A life-course perspective on chronic disease epidemiology sees "early and later life biological, behavioral, social, and psychological" factors (Lynch & Smith, 2005, p. 2) as impacting adult health.

There are primarily two models applied in approaching life course studies: the critical period model and the accumulation of risk model. The critical period model gives emphasis to experience at a definite phase in the life course that has long-term consequences on the bodies function, ultimately increasing risk to illnesses. The phrase “critical period” is generally reserved for experiences taking place through identified periods of irreversible biological growth.

However, there may also be sensitive phases where the outcome of a specific experience is multiplied, meaning that the outcome of the same experience in a different phase is much less damaging to our health (Kuh, Ben-Shlomo, Lynch, Hallqvist, & Power, 2003). For example, experience of insufficient income over important childhood events such as entry to school (Duncan, Yeung, Brooks-Gunn, & Smith, 1998). The other model, namely, the accumulation of risk model focuses on the total amount and/or series of experience over a lifetime (Lynch & Smith, 2005). These models propose that consequences may build up over the life-course (Ben-Shlomo & Kuh, 2002). Damage to health amplifies with the period and/or quantity of harmful experiences (Lynch and Smith, 2005).

In this context, the authors assert that chronic illnesses accrue due to the multifaceted interaction of critical and sensitive phases, and pathway and growth processes which increase risk for developing T2DM. The life course approach is useful for integrating findings from various individual level studies. These findings may explain T2DM trends at the population level (Leon, 2001; Kuh, Power, & Rodgers, 1991; Smith, 1997; Smith & Lynch, 2005). Findings from studies may involve investigating impacts of birth weight, height, diet, behaviours and other potential life course risk factors on consecutive birth cohorts, alongside their trends over a long term, as well as ways these trends overtime map onto development of various diseases (Lynch & Smith, 2005) such as T2DM.

Despite robust evidence in support of the life course model in relation to T2DM, it has not been applied to investigate differences in T2DM prevalence among people of various social groups such as South Asian, Chinese and European social groups. This is primarily because such longitudinal studies are costly and inclusion of various social groups may also pose recruitment challenges. Next, I discuss the psycho-social model.

Psycho-Social Model

According to the psycho-social model, health inequality results from stresses associated with adverse life experiences such as poor living and working conditions (Bartley, 2004). Kelly and Ismail (2015), suggest that the risk for T2DM increases when the physiologic stress response (PSR) is activated "from chronic exposure to stressors, low socioeconomic status (SES), severe mental health problems, or aggressive behavior" (Kelly and Ismail, 2015, p. 441). The authors suggest that "T2D[M] prevention research would be more effective if (*a*) the PSR [p]hysiologic stress response to psycho-social factors (especially social disparities) was recognized and (*b*) intervention programs evaluated reduction in social disparities as part of a comprehensive approach" (p. 441).

There is a well-established evidence base to support the link between stress and T2DM. While Lloyd, Smith and Weinger (2005) argue that stressful experiences are linked to T2DM, Novak et al.'s (2012) study of 899 men with T2DM, over a 35-year period also found excess risk of T2DM when stress was present. It is not only stress but a combination of factors which lead to T2DM such as "chronic anxiety, low self-esteem, social isolation, and lack of control over work appear to undermine mental and physical health" (Brunner & Marmot, 1999, p. 41). The authors mention that stress activates stress hormones in humans which raise heart rates, divert blood to muscles and lead to increasing insulin-resistance. Long term exposure to psycho-social circumstances also increases risks of developing metabolic syndrome: "FFA [f]ree fatty acids, cortisol, and testosterone have powerful combined effects, resulting in insulin resistance and increased hepatic gluconeogenesis" (Bjorntorp, 1991, p. 1132).

Further, endocrine aberrations provide accumulation of visceral fat due to regional differences of the density of steroid hormone receptor suggesting higher prevalence of psycho-

social stress factors and visceral distribution of body fat are linked (Bjorntorp, 1991). Also, environmental stressors influence the development of abdominal obesity and metabolic abnormalities (Tull and Chambers, 2001). Those prone to defeat-oriented responses from stressors in the environment show “a dysfunctional response of the hypothalamic-pituitary-adrenal (HPA) axis to stress” (p. 1498) leading to obesity in the abdomen, glucose intolerance and other metabolic abnormalities (Tull and Chambers, 2001). The authors assert that stress and its connection to T2DM may indicate the significant impact “of a psycho-social stress mediated pathway" (p. 1498) in causing T2DM.

The Canadian study by Chiu et al. (2011) compared T2DM incidence among various social groups as discussed earlier. In this study as compared to white subjects, South Asian subjects had 3.40 times and Chinese subjects 1.87 times greater risk of developing T2DM. South Asians were also observed to have an education-income gap in Canada. While South Asians had similar or higher level of education compared to white and Chinese subjects, South Asians in Canada had double the percentage of people in the lowest income category compared to the Chinese and white subjects which had similar representation in the lowest income group. Also, while psycho-social stress was highest among whites (26%), it was higher in South Asians (23%) as compared to Chinese (19%) people. Psycho-social stress was measured by the individual’s self-assessment of stress on most days: “extremely” or “quite a bit” v. “not at all,” “not very” or “a bit.” Hypertension was also highest in whites (20.4%), followed by South Asians (17.1%) and Chinese (15.2%). According to this study South Asians develop T2DM at a higher rate and at an earlier age than Chinese and the white populations in Canada; South Asians are exposed to a greater education-income gap than whites and Chinese people, and have comparatively higher

prevalence of psycho-social stress and hypertension – usually seen as a stress-related affliction -- compared to Chinese people in Canada.

Another Canadian study Chiu, Austin, Manuel and Tu (2010), also discussed earlier in this chapter, examined whites, South Asians, and Chinese people between 1996 and 2007. This study found group variations in T2DM and various T2DM risk factors. They reported T2DM prevalence was highest among South Asians at 8.1%, followed by Chinese at 4.3% and whites at 4.2%. Small differences in hypertension was seen, with South Asians at 17.0%, Chinese people at 15% and whites at 14%. Similarly, prevalence of psycho-social stress was more uniform in the three groups with whites at 24%, South Asians at 22% and Chinese people at 19%. Psychosocial stress was defined as the individual's self-assessment of stress on most days: "extremely" or "quite a bit" v. "not at all," "not very" or "a bit." Importantly, white people earned $13,000 and $16,000 more than Chinese and South Asians respectively, while South Asian and Chinese groups have greater percentage of people with a higher level of education. This suggests an education/income gap among social groups and this is especially the case for the South Asian group. Overall, according to this study, South Asians showed a higher prevalence of T2DM, a higher education/income gap and evidence of greater stress.

Even though there is substantial research evidence in support of the impact of psycho-social conditions in causing T2DM incidence, like the life-course model there is a lack of application of the psycho-social model in investigating the aetiology of difference in inter population T2DM prevalence. It seems that since South Asians experiencing low income have higher prevalence of T2DM than low income populations of other social groups, it suggests a need to apply a psycho-social lens to understanding higher T2DM prevalence among SAI in Canada.

Summary

In this chapter I discussed research studies that draw upon various health inequality models to explain the causes of having T2DM in general as well as studies which aimed to explain the reason behind higher T2DM rates among South Asians living in Western developed countries. The existing literature concerned with explaining these findings is dominated by the traditional genetic and cultural-behavioral models. However, some studies have explored the association of material advantage and disadvantage to T2DM incidence.

The dominant genetic and cultural-behavioral models of health inequalities say little about the consequences of exposures and effects of factors such as migration, precarious employment, poor housing, racism, and so on. Materialist models identify the adverse living and working conditions experienced. In addition, the psycho-social model of health inequality may be especially relevant in relations to these issues of immigration, precarious employment, poor housing, and racism. Since the research literature clearly demonstrates the connection between psycho-social factors and T2DM, the psycho-social model may be useful in explicating reasons why the migration experience in Canada comes to be associated with higher T2DM among SAI to Canada than other immigrant groups. In the next chapter I discuss the methodology for this dissertation.

Chapter 3: Methodology

Theoretical Understandings

The theoretical perspective of this dissertation is related to feminist political economy, critical social theory and the psycho-social model of health inequality.

Feminist political economy. A political economy lens studies society and its effects upon health as an integrated system. Politics and economics shape the living and working circumstances that come to shape health. A feminist political economy (FPE) lens focuses on these issues using gender as a defining category. Even though the FPE lens highlights a focus on experience of women, it also includes investigations of the society as a whole or the environment we live in.

Critical social theory. Critical social theory (CST) investigates unjust sociopolitical conditions and their health effects. A critical social theory focuses on the connection between people and their social systems, how they construct each other, and finally ways the critical social theory can contribute to the liberation of both.

This dissertation applies a critical social theory lens to consider the higher prevalence of T2DM among South Asians living in Canada compared to other immigrant groups as well as Canadian born white people. I critically analyze various models of health inequality and how they explain the prevalence of T2DM and identify gaps in literature in relation to addressing higher T2DM among SAIs to Canada.

This dissertation aims to provide evidence to make necessary policy changes/additions in addressing policy gaps that currently affect lives of millions of immigrants in Canada, particularly South Asians in Canada. Currently policy and programs to reduce T2DM prevalence are limited to cultural-behavioral factors with focus on changing dietary habits and encouraging

physical exercise. As explained in the previous chapter, psycho-social factors may contribute to health inequalities in T2DM, and Tarlov's model may help to explore these factors.

Tarlov's Model

Tarlov (1996) explains socio-biological translation as a mechanism of receiving messages from the social environment and translating these messages to biological signals, which initiate progression to chronic disease development. Variations in chronic disease incidence across populations are due to differences in the "strength of the dissonance that results from the identity-expectations-reality interplay" (p. 86). When there is a clash between expectations and reality, "the chronic, persistent, inescapable dissonance" (Tarlov, 1996, p. 86) triggers biological signals which are precursors to having chronic diseases (Tarlov, 1996, p. 85-86).

For Tarlov, identity begins to take shape at the age 2 or 3 such that by the age of 18, identity is completely formed. Identity is informed by early life experiences whereby experience and observations related to factors such as type of job, social inclusion, inequality in housing, education level and income influence the process of identity development (Tarlov, 1996). A key component of Tarlov's model is that education and income are related to identity, expectation and reality. In Canada 25% of the South Asian Canadian populations have at least a university degree compared to 15% of the total populations in Canada (Statistics Canada, 2007). Therefore, South Asians who immigrated to Canada have comparatively strong social backgrounds in that they were able to afford the education necessary for a university degree, an aspect of positive identity development developed in their home countries. For Tarlov (1996), later life experiences and observations related to type and stability of job, inequity, social exclusion, inequality in housing, education level and income intersect with the expectations held, thereby influencing

chronic disease incidence. This is where the stress of immigration can come into play. From material presented above, the experiences in Canada of SAI have been problematic for many. Many SAIs may face a clear contrast between career and social inclusion expectations held prior to immigration and those experienced upon arrival to Canada. Back home, they were brought up in an environment which allowed completion of higher education and afforded the economic resources that allowed emigration to Canada. These background experiences may have created expectations of success in Canada.

However, the reality of emigration to Canada for South Asians is one of limited success in the labour market and the experience of discrimination and exclusion as documented in Human Resources and Skills Development Canada (2011), Colour of Justice Network (2007) and Statistics Canada (2007) explained earlier in this dissertation. The potential clash between personal identity and expectations with reality would be consistent with the processes associated with chronic disease development as suggested by Tarlov. This process may contribute to SAI coming to experience higher T2DM rates in Canada as compared to other social groups living in Canada such as CI and CBW.

Therefore, from the perspective of Tarlov's identity-expectations-reality interplay lens, we may hypothesize the influence of experiences through which the socio-biological translation comes to create the differential vulnerability to T2DM shown by SAI group. Based on these assumptions, we might expect to see a greater gap between education and income and related stress levels amongst SAIs and other immigrants and Canadian-born whites that would contribute to differences in T2DM prevalence among these groups living in Canada.

As discussed in the previous chapter, low income SAI in Canada have a higher risk of T2DM compared to low income CI and CBW. Tarlov's identity-expectation-reality model serve

as a heuristic for exploring the higher T2DM incidence among SAI in Canada from a psycho-social perspective. This would be done by investigating the gap between education (serving as a proxy for expectations) and income (serving as a proxy for reality). The presence of stress disorders (mood disorder, anxiety disorder) in people of various social groups would be expected to be associated with these gaps as well as with the presence of T2DM. This would allow for investigating how dissonance between the identity-expectations-reality interplay may cause differential vulnerability to T2DM incidence by triggering biological signals such as mood disorders and anxiety disorders, which are precursors to T2DM incidence.

In summary, Tarlov's identity-expectations-reality interplay model can be applied to investigate a potential relationship between aspects of the immigration experience such as the presence of a gap between income and education and higher T2DM prevalence observed in SAI compared to CI and CBW.

Stress

Stress may be defined differently by concept and measurement. Below is a table with various definitions of stress commonly used in stress related literature.

Figure 2.

Definitions of Stress

Source	Definition
Tarlov (1996).	Biological signals triggered by "the chronic, persistent, inescapable dissonance between what a person would like to do, or become and what seems accomplishable" (Tarlov, 1996, p. 85-86)
CAMH (2018). (https://www.camh.ca/en/health-info/mental-illness-and-addiction-index/stress).	"Stress is a normal response to situational pressures or demands, especially if they are perceived as threatening or dangerous. A certain amount of stress is a normal part of daily life. However, long-term stress

	can become harmful. Long-term stress increases the risk of mental health problems such as anxiety and depression, substance use problems, sleep problems, pain and bodily complaints such as muscle tension."
Statistics Canada (CCHS Questionnaire, 2014).	Perceived life stress/self-perceived work stress - Self-reported amount of stress in one's life/work life.
Chui et al (2010).	Psychosocial stress was defined as the individual's self-assessment of stress on most days: "extremely" or "quite a bit" v. "not at all," "not very" or "a bit."

The following section introduces the hypotheses for this dissertation.

Research Hypotheses

As discussed in the previous chapter of this dissertation, studies generally found that men had a higher prevalence of T2DM than women in most social groups. Also, individuals with low income, low SES, and/or low education have a higher prevalence of T2DM than those of higher SES. Canadian studies found that South Asians living in Canada have a higher prevalence of T2DM than Chinese and white people in Canada. These studies also found that South Asians and Chinese groups in Canada are exposed to an education-income gap, with South Asians having similar or higher education levels than Chinese and white subjects, but white people having much higher average annual income compared to the other two groups. South Asians were observed to have the highest education-income gap among these three groups. There is also evidence that South Asians in Canada have greater prevalence of hypertension compared to Chinese and white people in Canada. Studies also show that South Asians in Canada have a prevalence of psycho-social stress similar to white people, but Chinese people have lesser psycho-social stress compared to white people in Canada.

Based on these findings from the literature review, below I present the research hypotheses for this dissertation where I focus on three social groups: SAI, CI and CBW. As the second largest immigrant group in Canada, Chinese subjects are often included in Canadian

studies as a representation of immigrant community in Canada for T2DM and other illnesses. Also, since comparing visible minorities with dominant white groups is a norm in inter-group comparative studies in all western societies, CBW are included in this study.

In this dissertation, SAI is the primary group of interest, while CI and CBW are comparison groups. This dissertation compared non-immigrant CBW with SAI and CI to highlight aspects of the immigration experience and how they be precursors to T2DM, with a particular focus on prevalence of T2DM among SAI in Canada. The dissertation undertook analysis of the Canadian Community Health Survey, 2013-2014 (details described next). As the main outcome was binary (presence or absence of T2DM), logistic regression analyses were planned (Tabachnick & Fidell, 2013). Following univariate and multivariate hypotheses were examined along with expected group differences:

Descriptive group differences.

1. SAI are more educated than CI and CBW.
2. SAI earn lower income than CI and CBW.
3. A larger percentage of SAI experience a gap between education and income than CI and CBW.
4. SAI have a higher prevalence of T2DM than CI and CBW.

Univariate binary logistic regression. Following are the hypotheses for the univariate regression models:

1. Higher odds of T2DM in
    a. people with an **education/income gap** than those with no gap across social groups
    b. people with **stress-related afflictions** such as mood disorder or anxiety disorder across social groups

c. **SAI** as compared to CI and CBW.

d. **males** than in females across social groups

e. people with **low income**

f. people with **low education**

Multivariate logistic regression.

1. Having an education/income gap increases the odds of having T2DM.
2. SAI have higher odds of having T2DM than CI and CBW.

Data Source: Canadian Community Health Survey

In this research I analyzed data from the Canadian Community Health Survey (CCHS) 2013-2014 (24 month combined file). This is a cross-sectional survey conducted by Statistics Canada that collects information related to health status, health care utilization and health determinants for the Canadian population aged 12 and over living in privately occupied dwellings in 110 health regions covering all provinces and territories. The CCHS covers approximately 98% of the Canadian population aged 12 and over. Excluded from the CCHS survey are those living on Indian Reserves and on Crown Lands, institutional residents, full-time members of the Canadian Forces, and residents of certain remote regions.

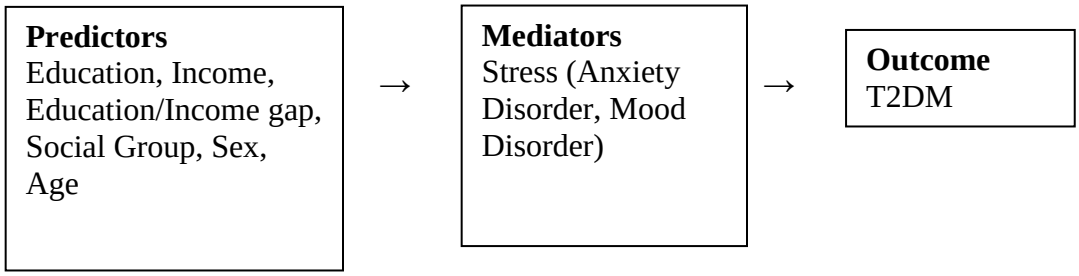
In total, 193,813 of the households selected for survey in the CCHS 2013-2014 were initially selected for CCHS. Out of these, 147,009 households accepted to participate in the survey resulting in an overall household level response rate of 75.9%. One individual was selected from each of these 147,009 responding households, out of which a response was obtained for 128,310 individuals, resulting in an overall person-level response rate of 87.3%. At the Canada level, this yields a combined response rate of 66.2% for the CCHS 2013-2014. A common data collection method was used in 2013 and 2014 (CCHS 2014 and 2013-2014

User Guide, Statistics Canada, 2015).

According to Statistics Canada (2014, 2015) during the first 3 months between January and December of 2013 and 2014, over 60,000 interviews took place in person and using computer devices.[i]

I performed analysis on 96,800 of the 128,310 cases (75%) of two years of data. Among them there were 93,665 CBW, 1575 SAI, and 1560 CI. This sample focused on ages 20 and over to conduct investigation on adult onset diabetes or T2DM. I evaluated the quality of data by percentage of missing responses, which was low.

Measurement of Outcome, Mediator, and Predictor variables



In this research, the associations between predictors, mediators and the outcome variable were investigated through correlation and regression analyses.

I chose variables of interest relevant to my research from the CCHS questionnaire for binary logistic regression analyses. Variables were entered in a step by step approach of binary logistic regression analysis. The order of variable entry was determined based on the hypotheses to be tested. The first hypothesis was to test association between T2DM and gap, where stress is a mediator. Hence gap was the first variable and stress (anxiety disorder, mood disorder) was the second variable entered to the model. The third variable was social group, as the second hypothesis is to test that SAI has a higher risk for T2DM than CI and CBW. Socio-

demographic variables sex and age were entered at the last steps.

I assessed the association of T2DM presence (outcome variable) and the education/income gap between education and income levels, considering a range of contributing variables such as mood disorder, anxiety disorder, social group, age and sex. The variables are discussed below. Details on these variables are based on CCHS definitions and explanations. Methods used to recode and create dummy variables are also provided.

The outcome variable for this dissertation is T2DM while the predictor variables are education/income gap, social group, sex and age. The mediator variables are stress measured by anxiety disorder and mood disorder.

Outcome variable.

***T2DM*.** In the CCHS questionnaire respondents were asked if they have diabetes diagnosed by a health professional that is expected to last or have already lasted 6 months or more. They were also asked about their diabetes type. A dichotomous dummy variable (T2DM Yes, T2DM No) was created from the responses.

Predictor variables.

***Social group*.** In the CCHS questionnaire, respondents were asked about their cultural/racial backgrounds. The question asked is "You may belong to one or more racial or cultural groups on the following list. Are you?" The interviewer read categories to respondent such as white, South Asian (e.g., East Indian, Pakistani, Sri Lankan, etc.), Chinese, Black, Filipino, Latin American, Arab, Southeast Asian (e.g., Vietnamese, Cambodian, Malaysian, Laotian, etc.), West Asian (e.g., Iranian, Afghan, etc.), Korean, Japanese and Other (Specify). In this CCHS question, Aboriginal people or First Nations are not included in the list of response categories because the Employment Equity Act of 19 defines visible minorities as

"persons, other than Aboriginal persons, who are non-Caucasian in race or non-white in "colour". The CCHS guidelines state that, "Due to their status as First Nation people, Aboriginal peoples are specifically excluded from the definition". Under the Employment Equity Act, Aboriginal Peoples are considered to be a separate designated group.

As mentioned earlier, for this research people of three social groups were considered, namely SAI, CI and CBW.

Immigration status. In the case of those of South Asian and Chinese groups, only those who answered "yes" to the question "immigrant" status were considered in the analysis. In case of white people, only Canadian born white people were included. Therefore, measures of social group and immigration status are a composite measure of the following categories: CBW, SAI and CI.

Income. For income I used the variable that includes personal income from all sources (e.g. wages and salaries, income from self-employment, dividends and interest (e.g., on bonds, savings), employment insurance, worker's compensation, benefits from Canada or Quebec Pension Plan, job related retirement pensions, superannuation and annuities, RRSP/RRIF (Registered Retirement Savings Plan/Registered Retirement Income Fund), old Age Security and guaranteed Income Supplement, provincial or municipal social assistance or welfare, child tax benefit, child support, alimony and other (e.g., rental income, scholarships), and none).

To get an estimate of personal income from some or all the above sources, interviewees were asked, "Can you estimate in which of the following groups your personal income falls? Was your total personal income in the past 12 months?" Various options were provided to choose from starting from less than $5000 to $100,000 and over (i.e. less than $5,000; $5,000 to less than $10,000; $10,000 to less than $15,000; $15,000 to less than $20,000; $20,000 to less

than $25,000; $25,000 to less than $30,000; $30,000 to less than $40,000; $40,000 to less than $50,000; $50,000 to less than $60,000; $60,000 to less than $70,000; $70,000 to less than $80,000; $80,000 to less than $90,000; $90,000 to less than $100,000 and $100,000 and over)

The options were recoded to 2 categories: “Low Income Yes” and “Low Income No”. “Low Income Yes” category included those with less than $20,000 and the “Low Income No” category included those above $20,000 total personal income from all sources. This also helped to derive a categorical variable called the “Education/Income Gap”.

Education. In the CCHS “Educational Attainment” category, interviewees were asked to respond to the following question, “What is the highest certificate, diploma or degree that [respondent name] has completed?” There were various options to choose from (e.g. less than high school diploma or its equivalent; high school diploma or a high school equivalency certificate; trade certificate or diploma, college, CEGEP or other non-university certificate or diploma (other than trades certificates or diplomas); university certificate or diploma below the bachelor's level; bachelor's degree (e.g. B.A., B.Sc., LL.B.); and University certificate, diploma, degree above the bachelor's level). These categories were recoded into 4 categories where education was based on the highest level of education successfully completed. Four categories of education were considered: less than secondary school; secondary school; some post-secondary, and post-secondary graduation with the last category as reference. To create the “Education/Income Gap” variable, the first 2 categories were re-coded together as “Low Education Yes” and last 2 categories recoded as “Low Education No” category.

Education/income gap. A dichotomous dummy variable called “education/income gap” was created using the re-coded education and income variables. Education/income gap is not simply an aggregation of education and income but a qualitatively different variable that is

not simply a combination of each of these variables. The sociobiological translation due to the experience of this education/income gap manifested through anxiety and mood disorder is what is intended in this dissertation to establish the connection between predictor, mediators and outcome variables, and connects this dissertation with Tarlov's model. Therefore, variables education and income were not added to the multivariate regression models, instead the education/income gap variable created from using the education and income variables was used.

Dichotomous dummy education variable was created by reclassification of education categories into low and high education. Four categories of education were considered: less than secondary school; secondary school; some post-secondary, and post-secondary graduation with the last category as reference. These categories were further recoded with first 2 categories recoded together "Low Education Yes" and last 2 categories recoded as "Low Education No" category to use in creating a dummy variable called "Education/Income Gap".

The dichotomous dummy income variable was created by reclassification of income categories into low and high income. "Low Income Yes" category included those with less than $20,000 and the "Low Income No" category included those above $20,000 total personal income from all sources. The categories were as follows:

No Gap. Low Income (< 20,000) and Low Education (less than secondary school; secondary school)

No Gap. High Income (>20,000) and High Education (some post-secondary, and post-secondary graduation)

No Gap. High Income (>20,000) and Low Education (less than secondary school; secondary school):

Education/Income Gap. Low Income (< 20,000) and High Education (some post-secondary, and post-secondary graduation):

The "education/income gap" category includes those with a high education but earning a low income. The "No Gap" category is one where income and education are either both low or both high or there is a high income with low education combination.

Mediator variable.

Stress. There were two variables related to stress in the CCHS (i.e. mood disorder and anxiety disorder) which were based on a diagnosis given by a health professional. The presence of mood disorders includes depression, bipolar disorder, mania or dysthymia; and anxiety disorders include phobia, obsessive- compulsive disorder or a panic disorder.

Mood disorder. For *mood disorder* participants were asked, "Do you have a mood disorder such as depression, bipolar disorder, mania or dysthymia?" (CCHS Questionnaire, 2014, p. 42). Interviewer was asked to also include manic depression. Options offered for answer were: Yes or No.

Anxiety disorder. For *anxiety disorder p*articipants were asked, "Do you have an anxiety disorder such as a phobia, obsessive-compulsive disorder or a panic disorder?" (CCHS Questionnaire, 2014, p. 42). Options offered for the answer were: Yes, or No.

Analytical Details

Frequency distributions provided characteristics of the three groups of interest in this dissertation in relation to variables of interest such as gap, anxiety disorder, mood disorder, education, income, sex and age. Univariate and multivariate binary logistic models were computed to identify association between T2DM and education/income gap for the three social

groups – SAI, CI and CBW. Descriptions of the models and related hypotheses are presented below.

Univariate binary logistic regression.

1. The dependent variable was T2DM, and the independent variables were education/income gap; mood disorder, anxiety disorder, social group, sex and age. Since this is a univariate regression model, only one independent variable was analyzed against the dependent variable at a time.

2. Univariate Binary Logistic Regression was also analyzed with data split by social group and by sex.

Multivariate logistic regression.

Three binary logistic regression analyses were conducted. The first model includes the whole sample without any splits, the second model has data split by sex, while the third model has data split by social groups. Hypotheses of each type of these analyses are given below with model descriptions. Specific reference groups were used in these analyses. For example, among the three social groups, CBW were the reference group. For sex, males were the reference group. Reference groups are indicated as "ref" in the tables.

Multivariate regression model 1: full sample. <u>All data taken together without segregating for social group sex, gap, education, income, mood and anxiety disorders.</u>
In this model, the dependent variable was T2DM, while the independent variables were education/income gap; mood disorder, anxiety disorder, social group, sex, and age.

Multivariate regression model 2: split by sex. In this model data was split by sex (i.e. male and female). The dependent variable was T2DM, and the independent variables were education/Income gap; mood disorder, anxiety disorder, social group and age.

Multivariate regression model 3: split by social groups. In this model data was split by social groups. The dependent variable was T2DM, and the independent variables were education/Income gap; mood disorder, anxiety disorder, sex and age.

In the next chapter, I present data and findings on prevalence of T2DM and other variables segregated by social groups. I also present results of univariate and multivariate binary regression models. Results for the models are presented in terms of odds ratios (ORs) together with 95% confidence intervals (CIs). Differences were considered statistically significant at $p < 0.05$. Analyses were conducted separately for the above three models. Rescaled population weights were used to account for multistage stratified design. The results of the analyses were weighted to produce estimates representative of the Canadian population. All analyses were conducted using SPSS Version 24.

Chapter 4: Results

In this chapter I present the findings of my research. I first present results of the estimated prevalence showing whether they support the prevalence hypotheses. Then I present results of univariate and multivariate regression analyses.

Estimated Prevalence Statistics

Following are the hypotheses related to estimated prevalence statistics. These findings were used to inform the follow-up statistical analyses.

1. SAI are more educated than CBW and CI living in Canada.
2. SAI earn lower income than CBW and CI living in Canada.
3. A larger percentage of SAI experience gap between education and income than CBW and CI living in Canada.
4. SAI have a higher prevalence of T2DM than CBW and CI living in Canada.

Table 2: *Population Characteristics by Social Group*

Variables	CBW (%)	SAI (%)	CI (%)
Sex			
Male	50	50	46
Female	50	50	54
Age-Groups			
20-29	20	19	18
30-44	25	40	29
45-59	29	24	31
60 plus	27	17	22
Low Personal Income	37	49	49
High education level	80	86	84
Education/Income Gap	25	39	37
Mood Disorder	9	5	3
Anxiety Disorder	8	4	1
T2DM	6	10	7

Prevalence estimates show similar male –female distribution in the data. SAI have a smaller percentage of people in the 60+ group than CBW and CI, indicating that SAI are a younger population. Representation of people in the low personal income category is similar in SAI and CI, but lower in CBW. However, SAI are the more educated than both CBW and CI, which is an indication of SAI having greater exposure to gap than CBW and CI. Estimated prevalence statistics shows that percent of people with an education/income gap is much higher in SAI compared to CBW. However, the education-income gap representation is similar in both immigrant groups, and both immigrant groups are better educated than CBW. The expectation was that CI will be much less educated than SAI, and will not have education-income gap at similar percentage levels as SAI. Mood and anxiety disorders are higher in CBW, compared to the immigrant groups. However, these stress disorders are higher in SAI compared to CI. There are issues of under-reporting of mental health issues in immigrant communities. Prevalence of T2DM is much higher in SAI compared to CI and CBW.

Table 3

Distribution of T2DM by Sex and Social Group (%)

Variable	**CBW**	**SAI**	**CI**
Male	7	12	9
Female	6	9	5

The male-female prevalence estimates show that males have higher prevalence of T2DM than females in all three groups. Also, SAI males and females have higher prevalence of T2DM compared to CBW and CI.

Table 4

Results of Hypotheses for Estimated Prevalence

Hypothesis	Result
1. SAI are more educated than CBW and CI.	Result of estimated prevalence statistics supports this hypothesis. Results show that while both immigrant groups, SAI and CIs are more educated than the CBW, SAI are most educated among the three groups.
2. SAI earn lower income than CBW and CI.	Results show that both SAI and CI earn lower income compared to CBW. Both immigrant groups have similar representation in the low personal income category.
3. A larger percentage of SAI experience a gap between education and income than CBW and CI.	Results show that SAI and CI have similar prevalence of education/income gap, both higher than CBW.
4. SAI have a higher prevalence of T2DM than CBW and CI.	Result of estimated prevalence statistics supports this hypothesis.

In summary, the statistics presented above indicate that education-income gap exists in Canada, and the prevalence is not equally distributed among SAI, CI and CBW, the three social groups investigated in this dissertation. Both immigrant populations – SAI and CI, also show greater education-income gap than CBW. T2DM prevalence is also higher in immigrant groups than CBW. These findings lead to the need for investigating potential associations between education/income gap and T2DM in univariate and multivariate environments to investigate T2DM risk of these three social groups against having an education-income gap.

Further univariate and multivariate analyses with sequential adjustments of predictors and mediators will allow to investigate the hypotheses set out for this dissertation. The results will show us if there is a credible relationship between education-income gap and T2DM, and also if any certain social group such as SAI has higher risks for T2DM than CI and CBW due to an education/income gap - where stress acts as a mediator to having T2DM as a result to having an exposure to this gap.

For this purpose, I conducted univariate regression analysis and multivariate binary logistic regression analysis to investigate these associations between the outcome variable, predictor variables and mediator variables as per hypotheses laid out for this research.

Univariate Binary Logistic Regression

Following are the hypotheses which are addressed by the univariate regression analyses:

1. There are higher odds of T2DM for those with an **education/income gap** than those with no gap across social groups.
2. There are higher odds of T2DM for those with **stress-related afflictions** such as mood and anxiety disorder across social groups.
3. There are higher odds of T2DM in **SAI** as compared to CBW and CI in Canada.
4. There are higher odds of T2DM in **males** than in females across social groups.
5. There are higher odds of T2DM in people with **low income**.
6. There are higher odds of T2DM in people with **low education.**

Table 5

Univariate Regression Results Showing Strength of Association between T2DM and Mediator/Predictor Variables

Variable in the Equation	**Odds Ratio**	**95% C.I.**	
		Lower	**Upper**
T2DM and Education/Income Gap	1.16	1.16	1.17
T2DM and Mood Disorder	1.52	1.52	1.53
T2DM and Anxiety Disorder	1.04	1.03	1.05
T2DM and Social Group			
CBW (Ref)			
SAI	1.69	1.68	1.70
CI	1.03	1.02	1.03
T2DM and Sex			
Female (Ref: Male)	0.77	0.77	0.77
T2DM and Low Personal Income	1.91	1.91	1.92
T2DM and Low Education	2.12	2.11	2.13
T2DM and Age-groups			
20-29 (Ref)			
30-44	8.36	8.19	8.54
45-59	32.13	31.47	32.79
60 plus	80.61	78.98	82.27

Table 5 presents results of the univariate regression analyses of the association between T2DM and the mediator and predictor variables. The results of the univariate logistic regression analyses show that in Canada odds of having T2DM is higher for people with low income, low education, having an education/income gap, mood disorder, and being a SAI. Impact of having anxiety disorder on T2DM is marginal. Not surprisingly, older people are at a higher risk for

T2DM. Detailed results of univariate regression analysis for the full sample, as well as by social group and sex are given in the appendix.

Table 6

Summary Results of the Univariate Regression Analysis

Hypothesis	**Result**
1a. There are higher odds of T2DM in people with an **education/income gap** than those with no gap across social groups.	1a. Regression result supports the hypothesis.
1b. There are higher odds of T2DM in people with **stress-related afflictions** such as mood disorder or anxiety disorder across social groups.	1b. Regression result supports the hypothesis.
1c. There are higher odds of T2DM in **SAI** compared to CBW and CI in Canada.	1c. Regression result supports the hypothesis.
1d. There are higher odds of T2DM in males than in females across social groups.	1d. Regression result supports the hypothesis.
1e. There are higher odds of T2DM in people with **low income.**	1e. Regression result supports the hypothesis.
1f. There are higher odds of T2DM in people with **low education**.	1f. Regression result supports the hypothesis.

However, it is important to investigate the association between having T2DM and having an education/income gap introducing mediators/predictors using the multivariate regression analysis to analyze if the association remains strong. In the analysis below the dependent variable is T2DM and the independent variables are education/income gap; mood disorder, anxiety disorder, social groups, sex and age. These independent variables are included step by step which generate various models for this study that show the additional variation predicted at

each step. Mood disorder and anxiety disorder are added in a single step, to analyze their joint impact as stress variables (mood and anxiety disorder), on the association of T2DM and education/income gap, as well as to investigate if stress variables act as mediators to T2DM. All other independent variables are added one by one in the order given above. Below are results of these multivariate binary logistic regression models for T2DM and associated risk factors.

Multivariate Binary Logistic Regression Analysis

The multivariate binary logistic regression models are different from the univariate regression analysis. The univariate regression analysis shows the association between the dependent and each single independent variable while the multivariate regression model examines the association between T2DM and multiple independent variables generating different models of association. Upon inclusion of independent variables to the models, the new multivariate results show whether the original hypothesis holds true or not by maintaining association between the variables of interest, in this case T2DM and education/income gap. Also, since the stress variable is a mediator in this analysis, it is expected that, inclusion of anxiety and mood disorders will weaken the link between T2DM and education/income gap. Univariate regression analysis cannot examine these interrelationships among these predictor variables.

Full sample analysis. Following are the hypotheses for the multivariate binary logistic regression with the full sample.

1. Having an education/income gap contributes unique variation to the odds of having T2DM
2. Being a SAI contributes unique variation to the odds of having T2DM.

Table 7

Full Sample Multivariate Binary Regression Model

Variables	Model 1 95% C.I.	Model 2 95% C.I.	Model 3 95% C.I.	Model 4 95% C.I.	Model 5 95% C.I.
Education/Income gap	1.15 (1.15 - 1.16)	1.13 (1.13 - 1.14)	1.11 (1.10- 1.11)	1.17 (1.16 - 1.17)	1.30 (1.29 - 1.30)
Mood Disorder		1.71 (1.70 - 1.72)	1.74 (1.73 - 1.75)	1.78 (1.77 - 1.79)	1.94 (1.92 - 1.95)
Anxiety Disorder		0.80 (0.79 - 0.80)	0.81 (0.80 - 0.81)	0.82 (0.82 - 0.83)	1.04 (1.04 - 1.05)
Groups					
CBW (Ref)					
SAI			1.70 (1.69 - 1.71)	1.69 (1.67 - 1.70)	2.38 (2.36 - 2.40)
CI			1.12(1.11 - 1.13)	1.13 (1.12 - 1.14)	1.26 (1.25 - 1.27)
Sex Female (Ref: Male)				0.76 (0.75 - 0.76)	0.65 (0.65 - 0.65)
Age					1.06 (1.06 - 1.06)

Table 7 provides five multivariate binary logistic regression models generated in these analyses. In Model 1 the association is shown between T2DM and Education/income Gap. In Model 2, Mood Disorder and Anxiety Disorder are added. Model 3 adds Social Group. Model 4 adds Sex. Finally, Model 5 adds Age. With inclusion of each of these variables, the association between T2DM and Education/Income gap changes.

This research identified an association between having an education/income gap and reporting T2DM as hypothesized in this dissertation. Risk for T2DM increases by 15% with an income-education gap as shown in Model 1. The association of an education/income gap and T2DM prevalence remains generally unchanged with sequential adjustments of anxiety disorder and mood disorder in Model 2, and social group (groups) in Model 3. The association actually increases when adjustment is made for sex in Model 4 and a much stronger association between T2DM and gap is observed when age is included in Model 5 demonstrating the robustness of the association between T2DM and gap.

The finding that SAI are at increased odds of having T2DM even after adjustment for age and gender was also expected. Also, both groups of immigrants are at increased odds of having T2DM compared to CBW.

Table 8

Summary Results of the Multivariate Binary Logistic Regression Analysis

Hypothesis	Result
1. Having an education/income gap increases the odds of having T2DM.	Regression result supports this hypothesis. This association persists with the inclusion of the mediator and predictor variables. The extent of the association alters with inclusion of variables at each step. Upon inclusion of mood and anxiety disorder and social group the association decreases showing these variables contribute to T2DM.
2. SAI have higher odds of having T2DM than CBW and CI in Canada.	Regression result supports this hypothesis.

Table 8 provides a summary of findings in relation to the original study hypotheses. Results of the multivariate binary logistic regression analysis supports the hypothesis that having an education/income gap increases the odds of having T2DM. The results also support that SAI have higher odds of having T2DM than CBW and CI in Canada.

Analyses by sex. Four multivariate regression models were generated for each sex. In Model 1 the association is shown between T2DM and Education/income Gap. In Model 2, Mood Disorder and Anxiety Disorder were added to the model. In Model 3, Social Group was added and in Model 4, Age was added to the model. With inclusion of each of these variables, the regression values between T2DM and Education/Income gap changes. Below are results by sex.

Table 9

Multivariate Binary Logistic Regression Model (Male)

Variables	**Model 1 95% CI**	**Model 2 95% CI**	**Model 3 95% CI**	**Model 4 95% CI**
Education/Income Gap	1.20 (1.19 - 1.20)	1.18 (1.17 - 1.18)	1.15 (1.15 - 1.16)	1.31 (1.30 - 1.32)
Mood Disorder		1.70 (1.68 - 1.71)	1.74 (1.72 - 1.76)	1.68 (1.66 - 1.69)
Anxiety Disorder		0.66 (0.65 - 0.66)	0.67 (0.66 - 0.67)	0.81 (0.80 - 0.82)
Groups				
CBW (ref)				
SAI			1.87 (1.85 - 1.89)	2.46 (2.43 - 2.48)
CI			1.23 (1.21 - 1.24)	1.32 (1.30 - 1.34)
Age				
Age: 20-29 (ref)				
Age: 30-44				15.38 (14.76 - 16.02)
Age: 45-59				66.45 (63.82 - 69.19)
Age: 60 plus				177.80 (170.79 - 185.10)

I identified a graded association between having an education/income gap and T2DM in males and females in Model 1.

The unadjusted odds ratio for education/income gap for males increases risk for T2DM by 20% in Model 1. The association was slightly reduced with sequential adjustments of anxiety disorder and mood disorder in Model 2 and social group in Model 3 but increased with sequential adjustment with age in Model 4.

Table 10

Multivariate Binary Logistic Regression Model (Female)

Variables	Model 1 95% CI	Model 2 95% CI	Model 3 95% CI	Model 4 95% CI
Education/Income Gap	1.24 (1.23 - 1.25)	1.22 (1.21 - 1.22)	1.19 (1.19 - 1.20)	1.34 (1.33 - 1.34)
Mood Disorder		1.80 (1.78 - 1.81)	1.82 (1.80 - 1.83)	1.92 (1.90 - 1.93)
Anxiety Disorder		0.93 (0.92 - 0.94)	0.94 (0.93 - 0.95)	1.19 (1.18 - 1.20)
Groups				
CBW (ref)				
SAI			1.46 (1.44 - 1.48)	2.20 (2.18 - 2.23)
CI			1.01 (1.00 - 1.03)	1.14 (1.12 - 1.15)
Age				
Age: 20-29 (ref)				
Age: 30-44				4.70 (4.58 - 4.83)
Age: 45-59				18.54 (18.06 - 19.02)
Age: 60 plus				49.54 (48.29 - 50.83)

For females, the unadjusted odds ratio for education/income gap increases risk for T2DM by 24% in Model 1. The additional models produced the same adjustment as was the case for men.

Between males and females, the latter group are at a 4% greater risk of T2DM than males, from having an education/income gap and increased risk is also seen upon sequential adjustments for the other variables.

In short, the multivariate logistic regression analysis by sex show that those with an education/income gap males and females both have higher odds of having T2DM than those with no gap even after sequential adjustments with stress mediators and social groups and age. Females with an education/income gap are at a higher risk than males with a similar gap.

Analyses by each social group. Multivariate analyses by social groups were generated each having four multivariate regression models generated for each social group. In Model 1 the association is shown between T2DM and Education/income Gap. In Model 2, Mood Disorder and Anxiety Disorder were added to the model. In Model 3, Sex was added and in Model 4, Age was added to the model. With inclusion of each of these variables, the regression values between T2DM and Education/Income gap changes. Below are results by group. The results did not reveal any significant conclusive findings to compare SAI with CI and CBW.

Table 11

Multivariate Binary Logistic Regression Model by Social Groups (CBW)

Canadian Born White				
Variables	**Model 1**	**Model 2**	**Model 3**	**Model 4**
Education/Income Gap (Ref: No gap)	1.175	1.145	1.200	1.353
Mood Disorder (Ref: No)		1.769	1.806	2.007
Anxiety Disorder (Ref: No)		0.821	0.837	1.082
Sex: Female (Ref: Male)			0.771	0.653
Age				1.064

Within CBW, risk for T2DM increases by 17% with an income-education gap as shown in Model 1. The association of an education/income gap and T2DM prevalence reduced marginally with sequential adjustments of anxiety disorder and mood disorder in Model 2 to 14%. However, adjusting for sex and age in Model 3 and Model 4 strengthened the association between education-income gap and T2DM to 20% and 35%, attenuating the direct impact of these variables on the association between education-income gap and T2DM.

For CBW, the association between mood disorder and T2DM is strong. In Model 2, risk for T2DM increases by 76% for those with a mood disorder.

Table 12

Multivariate Binary Logistic Regression Model by Social Groups (SAI)

South Asian Immigrant				
Variables	**Model 1**	**Model 2**	**Model 3**	**Model 4**
Education/Income Gap (Ref: No Gap)	0.764	0.778	0.899	0.897
Mood Disorder (Ref: No)		1.163	1.159	0.708
Anxiety Disorder (Ref: No)		0.390	0.381	0.236
Sex: Female (Ref: Male)			0.649	0.738
Age				1.075

Within SAI, there is no conclusive association between having an education/income gap and reporting T2DM in Model 1. Adjusting for mood and anxiety disorder in Model 2, sex in Model 3, and Age in Model 4 does not alter the state of association between having an education-income gap and having T2DM.

However, risk for T2DM increases by 16% for those with a mood disorder as shown in Model 2. There is no reportable impact of anxiety disorder in Model 2 and sex in Model 3, in terms of risks for having T2DM.

Table 13

Multivariate Binary Logistic Regression Model by Social Groups (CI)

Chinese Immigrant				
Variables	**Model 1**	**Model 2**	**Model 3**	**Model 4**
Education/Income Gap (Ref: No gap)	1.090	1.092	1.182	1.078
Mood Disorder (Ref: No)		1.198	1.236	0.988
Anxiety Disorder (Ref: No)		0.349	0.369	0.395
Sex: Female (Ref: Male)			0.634	0.550
Age				1.070

Within CI, risk for T2DM increases marginally by 9% with an income-education gap as shown in Model 1. The association of an education/income gap and T2DM prevalence remained unchanged upon sequential adjustments of anxiety disorder and mood disorder in Model 2. However, adjusting for sex in Model 3 strengthened the association between education-income gap and T2DM to 18%, but adding age into Model 4 decreased the strength of association between T2DM and education-income gap to 7%. These results implicate that while gap has some association with T2DM for CI, age is more strongly associated with T2DM than sex for this group. For CI, the association between mood disorder and T2DM is stronger than anxiety disorder. In Model 2, risk for T2DM increases by 19% for those with a mood disorder, and for anxiety disorder the relationship is unclear.

Overall, the regression outputs calculated to understand within social group characteristics show strong variations in terms of association between T2DM and Gap. These results do not conform to findings of risk for T2DM where the sample was taken for all groups

together to understand influence of gap and T2DM. The outputs of analyses by sex also showed results which conformed to the main findings of this dissertation. Further research should be conducted by social groups to find out how samples of individual immigrant/non-immigrant social groups may vary in identifying within group influences/variances and related associations with T2DM and education-income gap, stress disorders, sex and age. Research studies have cautioned about mismatch between main findings of research studies using full sample, versus sub-group analyses. Researchers have also cautioned to not use sub-group findings to justify main hypothesis, especially in cases where main findings were not supported by results observed.

Conclusion

In summary, the main analysis using full sample support the main hypotheses that having an education/income gap increases the odds of having T2DM, and SAI have higher odds of having T2DM than CBW and CI. Further, those with stress-related afflictions such as mood disorder have increased odds of having T2DM.

Chapter 5: Discussion

T2DM prevalence is increasing in Canada and the prevalence of diagnosed diabetes increased by 70% among Canadians from 1998/99 to 2008/09 (PHAC, 2011). According to forecasts, approximately 3.7 million Canadians will have T2DM by 2018/19 (PHAC, 2011). Among various social groups, there is higher T2DM prevalence among South Asians immigrants (SAI) residing in developed countries such as USA, UK, and Canada (Chui et al., 2011; Anand et al., 2000; Bajaj & Banerji, 2004). While T2DM prevalence is 3-5% among those of European white descent, it is 12-15% among South Asians living in US, UK and Canada. However, T2DM is seen as being preventable but the challenge is in identifying the root causes of having T2DM.

Researchers have proposed various models to explain how conditions such as T2DM are more common in some groups than others. I presented genetic, cultural-behavioral, materialist, psycho-social and life-course models of health inequalities/inequities that researchers have used to explain the aetiology of T2DM and differences in T2DM prevalence across social groups. However, there is an increasing focus on the significance of living and working conditions in relation to T2DM prevalence. The psycho-social model considers stresses resulting from these adverse living and working conditions as contributing to health inequalities.

The psycho-social model of health inequality may be particularly relevant for SAI in Canada as they are exposed to discrimination and earn a lower income on average than Canadians despite their having high levels of education. The main hypothesis of this dissertation was that an education-income gap and related stress is associated with having T2DM and could explain why SAI in Canada are at a greater risk for T2DM than other groups.

Therefore, this dissertation looks at the psychosocial contributors to T2DM through the lens of Tarlov's model in order to contribute to understanding the aetiology of T2DM and the difference in T2DM prevalence across social groups in Canada. Results of statistical analyses

conducted for this dissertation were presented in the last chapter. In this chapter I discuss these results followed by implications. There were three layers of statistical analyses and hypotheses in this dissertation: prevalence statistics, univariate regression analysis, and multivariate regression analyses.

Main Findings

Estimated Prevalence. In analysing population characteristics, there was a mix of expected and unexpected results. For example, my expectation was that SAI are more educated than both CBW and CI as seen in earlier studies such as the Chiu et al. (2011) study. Results supported this hypothesis. However, it should be noted that both immigrant groups are more educated than CBW, which was not expected.

I was also expecting to observe that SAI earn a lower income than both CBW and CI. However, I observed that both immigrant groups have similar representation in the low-income category and both earn lower income than CBW.

In further investigating population characteristics, I expected that not only the SAI will have highest percentage of exposure to education/income gap, but also the difference between SAI and the other two groups will be huge. Contrary to my expectation, results showed that both immigrant groups, SAI and CI have higher prevalence of education/income gap compared to CBW. It is important to also note that effects of an education/income gap appear to manifest differently between these two groups (SAI and CI) in relation to T2DM (discussed below).

Finally, based on literature reviews my expectation was that SAI have a higher prevalence of T2DM than CBW and CI. Result of estimated prevalence statistics supported this

hypothesis. This result matches with findings of previous research studies conducted with samples from Canadian populations (presented in Chapter 1).

In the analysis by sex, SAI males were observed to have the highest percentage of people with an education/income gap, i.e., having high education but low income. T2DM prevalence was also the highest among SAI males compared to CI males and CBW males. In the case of females, SAI females were observed to have higher prevalence of an education/income gap compared to CI females and CBW females. Prevalence of T2DM is also highest among SAI females compared to the other two social groups namely CI and CBW.

In comparing males and females, in each of these three social groups, the prevalence of an education/income gap is much higher in females compared to their male counterparts. Gender wage-gap is a world-wide issue including Canada. It is widely recognized that with similar education levels, job titles and experience - females are often earning a lower income than their male counter-parts. T2DM prevalence is however, higher in males compared to females in all three social groups - SAI, CI and CBW, as observed in self-reported data. Further investigation is necessary to check whether there is under-reporting of T2DM in females or not. Research suggests that women in certain social groups such as South Asians face social challenges in communicating their health conditions, leading to under-reporting of chronic diseases and a lack in receiving care (Ahmad et al, 2005).

It was expected that SAI earn the lowest income having the highest education level and therefore, will have the greatest exposure to an education-income gap. However, it was observed that both immigrant groups, SAI and CI have greater representation in low income level, but higher representation in high education level compared to CBW. Also, both immigrant groups SAI and CI was observed to have much greater exposure to education/income gap than CBW.

Further, while SAI are the most educated among the three groups, low income representation is the same in SAI and CI. Therefore, SAI are exposed to more education/income gap than both CI and CBW. It was also observed that SAI have the highest prevalence of T2DM among the three social groups. However, while CI have much higher exposure to an education-income gap compared to CBW, CI were not seen to have as high a prevalence of T2DM compared to CBW. With similar extent of exposure to gap, it was expected that CI would have similar prevalence of T2DM as SAI, which is not the case. This could be due to the expectation held by SAI which is unique to the other two social groups CI and CBW.

Migrants coming from South Asia often have good command of English language because English is the second official language in countries like India and Pakistan. This is a consequence of colonization of the Indian Subcontinent by the British Empire during 1858-1947. In contrast to SAI, Chinese immigrants often learn English after arriving in Canada. Thus, it is quite possible that SAI have higher level of expectations in terms of employment and income success than Chinese immigrants. Another reason could be the strong hold of communist party in China for decades that might have curtailed people's overall expectations about achievable economic success. This could be a key reason why the impact of gap may not be similar among SAI and CI, particularly from the lens of Tarlov's expectation and reality lens, and the influence of stress in case of a gap in education and income, where there is a mismatch between expectation and reality. Therefore, ecological-level findings provide some evidence for the gap/T2DM link but only for SAI and not CI. Further, higher exposure to an education/income gap and higher prevalence of T2DM by SAI could be due to potential exposure to racism and discrimination as reported in various studies conducted on Canadian minority groups such as SAI, and related psycho-social stresses. Further, scholars have reported negative impacts of

darker skin colour on health. At the same time, Chinese people are believed to have various cultural ways to fight stress, which South Asians may not have (Kramer et al., 2002; Kolstad & Gjesvik, 2012).

In summary, focusing on the main hypothesis of this dissertation, prevalence statistics shows that as expected - SAI have the highest education level among the three groups, SAI and CI have similar representation in the low income category but CBW earn higher than both of these immigrant groups, SAI have higher exposure to education/income gap than CI and CBW, and SAI have the highest prevalence of T2DM among the three groups investigated in this dissertation. These findings justified further statistical manipulation to understand the strength of association between T2DM and other variables such as education/income gap, mood and anxiety disorders, and social groups in a univariate analysis. The results of the statistical univariate regression analyses against respective hypotheses are discussed below.

Univariate regression analyses. I explored six hypotheses to understand association between T2DM and various independent variables. The regression results supported all of these hypotheses.

The first hypothesis was that there are higher odds of having T2DM in people with an education/income gap than those with no gap across social groups. The univariate regression analysis conducted for this dissertation with T2DM as the dependent variable and education/income gap as the independent variable supported this hypothesis. No previous studies have looked at this association, therefore, this is a unique finding of this dissertation.

The second hypothesis was that there are higher odds of having T2DM in those with stress-related afflictions such as mood disorder or anxiety disorder across social groups. The univariate regression analysis showed an association between stress variables and T2DM, as

expected. However, mood disorder seemed to have stronger association with having T2DM than anxiety disorder which is relevant to this research because mood disorder is understood as experiencing feeling of sadness or hopelessness among other feelings. On the other hand, anxiety disorder can affect mood, but is not a mood disorder. Anxiety can however cause hopelessness, fear and other kind of emotions. Having a mood disorder with experience of feeling sad and hopeless seem to be better associated with negative immigration experience, especially when there is an exposure to education/income gap. Hence association between having mood disorder and T2DM as observed in this univariate regression analysis supports the main hypothesis of this dissertation. The link between stress related disorder and having T2DM as observed in this univariate regression analysis is consistent with earlier studies (Lloyd, Smith & Weinger, 2005; Novak et al., 2012; McKinlay & Marceau, 2000; Bartley, 2004; Kelly & Ismail, 2015; Tarlov, 1996).

The third hypothesis was that there are higher odds of T2DM in SAI compared to CBW and CI in Canada. As expected I found a greater association between T2DM and SAI compared to CI and CBW. This result is in line with findings of earlier studies (Creatore et al., 2010; Chui et al., 2010; Chui et al., 2011).

The fourth hypothesis was that there are higher odds of having T2DM in males than in females. I observed that females have lesser risk by 33% of having T2DM compared to males. This finding also supports previous investigations (Chui et al., 2010; Liu et al., 2010).

The fifth hypothesis was that, there are higher odds of having T2DM in people with low income. As expected, the results showed that those exposed to low income had a 91% higher risk of having T2DM than others. This supports findings from previous studies as well (Raphael et al., 2003; Pilkington et al., 2010; James et al., 1997).

Last but not the least important hypothesis was that there are higher odds of having T2DM in people with a low education level. As expected, I observed higher odds of having T2DM in people with a low education level. This finding is in line with previous studies such as Wamala et al. (1999).

In short, there are higher odds of having T2DM among those who have an education/income gap, have mood disorder or anxiety disorder, belong to the SAI group, are males, earn a low income and have low education. These univariate findings were the basis for investigating the risk for having T2DM and education/income gap in a multivariate environment where factors such as anxiety and mood disorder, social group, sex and age were included into the models step by step. T2DM was set as the dependent variable, while all others were entered step by step as independent variables, to investigate if the strength of association between T2DM and an education/income gap holds despite inclusion of mediators and predictors. The results of the multivariate regression models are discussed below.

Multivariate binary regression analyses. The primary hypotheses for this dissertation is that having an education/income gap increases the odds of having T2DM and that this could help explain why SAI have higher rates of T2DM than CBW and CI in Canada. The multivariate regression analyses results supported these hypotheses. The association between an education/income gap and T2DM persisted even after including mediators and other predictors to the models. The extent of the association between an education/income gap and T2DM altered with inclusion of predictor and mediator variables. For example, upon inclusion of mood and anxiety disorder and social groups, the strength of association decreased showing these variables contribute to T2DM, proving Tarlov's model of impact of sociobiological translation of stress to having chronic diseases such as T2DM. The multivariate binary regression models also

supported that SAI have much higher odds of having T2DM in Canada compared to CI and CBW.

The finding of the association between T2DM and an education/income gap, with stress as a mediator is a unique finding of this dissertation. Previous research studies found that SAI have higher risk for T2DM than CI and CBW; however, this research tested the risk for T2DM in the presence of an education income gap and also stress as a mediator. Therefore, as per findings of this research, Tarlov's model stays true in that stress can lead to chronic diseases through gap in identity and expectations.

Further, two other analyses were conducted to investigate relation between T2DM and gap by sex and by social groups. In the multivariate analysis by sex, risk for T2DM was higher due to exposure to an education/income gap for both sexes, with females having a slightly higher percentage of risk compared to males from gap. For both models - males and females - step by step inclusion of stress variables and social groups reduced the strength of association between T2DM and gap, indicating that stress influences risk for T2DM, as do social groups. However, including age to the model increased the strength of association between T2DM and gap instead of reducing it. This was unexpected as literature shows that age has a very strong association with T2DM. In the case of this analysis, it seemed that the generally observed influence of age on having T2DM could not weaken the strength of association between gap and T2DM. However, the results support that risk for T2DM increases with age.

In the analysis by social groups, it was observed that mood disorder increased risk for having T2DM. However, education-income gap increased risk for T2DM only for CBW, which is interesting. Since education-income gap was much higher in immigrant groups, these results were not expected. Further analysis is required to understand within-group impacts of education-

income gap on having T2DM through stress mediators. Research studies indicate that main findings of research may not match with sub group findings, as there are issues such as sample size of sub-groups. Further, there is heterogeneity within SAI and CI groups which was not possible to examine in this dissertation through CCHS survey data. The recommendation is to not highlight sub-group findings in research studies where sample size concerns exist in order to avoid potential risk for false-positive and false negative results. Sub-groups samples are often skewed, and also lack statistical strength to identify unique characteristics of sub-group populations.

In this dissertation I investigated whether variations in socio-biological translation related to contrasts in identity-expectation versus reality experience (such as a gap in education and income) is associated with variations in the prevalence of T2DM across three social groups SAI, CI and CBW. To investigate this research question I tested various hypotheses for prevalence, univariate regression and multivariate regression.

According to the findings of this dissertation, SAI in Canada have a higher proportion of people with high education levels compared to CI and CBW, however, the distribution of low income is higher in both immigrant groups than CBW. Estimates show that SAI and CI earn a lower income than CBW even though immigrants are better educated than CBW. This dissertation found that both immigrant groups, SAI and CI, have a higher percentage of education income gap in Canada than CBW, where SAI have comparatively more exposure than CI to education income gap. Among the three groups, SAI have the highest prevalence of T2DM in Canada.

The regression analyses also supported Tarlov's model that stress is a mediator to T2DM. Based on the findings of this dissertation, it can be stated that:

1. Having an education/income gap increases the odds of having T2DM.
2. SAI have higher odds of having T2DM than CBW and CI in Canada.

Therefore, this research supports the hypothesis that having an education/income gap is associated with having T2DM. Findings support that stress such as mood disorder is also associated with having T2DM. The impact of gap is unique to SAI possibly due to proficiency in English language on arrival and related expectations upon immigration, which is absent in case of CI. These findings support Tarlov's model explained in the beginning of this dissertation. In case of analysis by sex as well, this research found that education/income gap is associated with T2DM for males as well as females.

In relation to the health inequality models, findings of this dissertation strongly support the materialist approach as income/education were each related to stress and T2DM. Life-course model cannot be evaluated against the findings of this research as different timings and related experience was not investigated in this research. However, the psychosocial model is supported by the main findings of this research related to risk for T2DM and its association with education/income gap and stress factors.

While findings of this dissertation are novel to the health policy literature, it is important to discuss the implication of these findings in the context of Canadian public policy and practices.

Implications for Policy and Practice

In the world of policy and practices in Canada, there is a greater emphasis on genetic and cultural-behavioral models and a modest focus on materialist precursors to T2DM, while the contribution of psycho-social influences on T2DM are almost non-existent. Findings of this dissertation show evidence of a psycho-social connection to having T2DM, where visible

minority populations such as immigrants and particularly SAI in Canada are most vulnerable to having T2DM when compared to other social groups such as Chinese immigrants and Canadian born white social groups. Therefore, the finding of an association between higher odds of having T2DM and an education/income gap with stress as a mediator is an important finding, and a novel finding, particularly in relation to explaining higher T2DM prevalence among immigrant South Asians living in Canada compared to other social groups such as Canadian born white and Chinese social groups living in Canada.

The findings of this research shed lights on the psycho-social contributors to T2DM. These findings should be considered in policies and practices going forward in the light of feminist political economy and critical social theory perspectives. The expectation is to recognize the experience of immigrants to Canada and to recognize psycho-social factors contributing to having T2DM as a result of difficult lived experience of immigrants to Canada, and to observe changes in the policies and practices to reduce racism and discrimination leading to experiencing greater education/income gaps by certain social groups such as immigrant SAI in Canada and thus reduce health inequalities in T2DM prevalence in particular.

This dissertation is motivated by my lived experience and observation of immigrant South Asian communities struggling in Canada to avoid social exclusion and to gain acceptance in the job market matching their skills and education credentials. These immigrants had their credentials vetted by the immigration authorities, and received landing papers upon acceptance of their credentials. Nevertheless, after arriving in Canada, they find little or no acceptance of the same credentials that qualified them to enter Canada. Such rejection from the job market has shattered many, and has destroyed the career of many immigrants to Canada (Reitz, J.G., 2001a, 2001b).

SAI have also faced rejection in the dominantly white society due to the concept of mosaic, which continues to separate people by social group and inhibit inter-community interactions. The mosaic concept has translated into “not a good fit” in the labour market causing difficulty for SAI to find a place in the job market as per their credentials. While from a social perspective the mosaic culture allowed people to practice their culture and religion, in the job market, the mosaic concept did not work well, and has caused disadvantages for people who are deemed “not a good fit” among the Canadian white people.

The social and job market exclusion has forced highly skilled visible minority immigrants to accept low paid jobs, contributing to higher prevalence of T2DM due to the consequential stress from education/income gaps.

In summary, the findings of this dissertation show that there is a link between psycho-social factors and T2DM, and the expectation is to see recognition of education-income gap as a psycho-social contributor to having T2DM in Canada in addition to the cultural-behavioral factors and materialist factors to causing T2DM.

Implications for Research and Theory

The findings of this dissertation challenges the dominant use of cultural-behavioral models and genetic explanations for higher T2DM prevalence in SAI living in Canada. The findings of this dissertation offers evidence about risk for having T2DM from psycho-social contributors, as a unique lens in addition to cultural-behavioral and genetic theories.

In terms of implications to theory, it can be mentioned that, while scholars have previously associated psycho-social factors to T2DM, in this dissertation, the association of education-income gap and T2DM through mediating stress factors is unique and sheds light on

looking at psycho-social factors to T2DM in addition to commonly cited traditional factors. Also, a unique contribution of this research is looking into immigrant and non-immigrant populations to highlight potential contributions of immigrant experience by SAI in Canada. The fact that risk to T2DM is multi-factoral points to the need to identify each contributor to having T2DM. In this research I have identified the immigration experience of South Asians, and resulting stress from income-education gap as a psycho-social contributor to T2DM.

Conclusion

It is expected that future research will also use the theoretical underpinning of psycho-social contributors to investigate health inequities in relation to chronic diseases such as prevalence of T2DM in other minority high risk communities, instead of sticking only to the traditional cultural- behavioral and genetic underpinnings. Therefore, this dissertation opens up opportunities for future research in determining the role of psycho-social factors as contributors to higher prevalence of T2DM across various populations in Canada, in particular, immigrant high-risk populations. This will not only help address the much needed gaps in policy and practices but also contribute to the existing body of knowledge in understanding contributors to chronic disease prevalence. Such research efforts will also help to use Canadian tax dollars efficiently creating efficient programs and policies to address gaps such as those related to inclusion in the labour market. When we see the word diversity in workplaces, it has different meaning to different people. It will be good to see the definition of diversity in hiring to include acceptance of foreign credentials, acceptance of immigrants even without Canadian experience, and acceptance of visible minorities with accents – going forward.

Limitations

The CCHS is a questionnaire-based survey and relies on self-reported data which is subject to recall and social desirability bias. Further, according to PHAC (2011), undiagnosed diabetes was found in about 20% of all cases of diabetes in Canada in ages six and over.

There is about one undiagnosed case for each known diabetic person (Health Canada, 1999). Therefore, a potential limitation of this research is that the true prevalence of diabetes could be underestimated. Also all households do not choose to participate in the CCHS survey (78% response rate). Further, those residing on Indian Reserves, institutions in remote regions, and full-time members of the Canadian Forces were excluded from the CCHS.

Members of South Asian populations with T2DM, anxiety disorder and mood disorder analyzed in this study may have been more or less likely to choose to participate in the survey. The stigma against chronic disease and mental illness may lead to underreporting and non-disclosure of diagnoses. In addition, those living in low income situations and newcomers and immigrants to Canada also may be less likely to take part in population health surveys (Islam et.al. 2014). Studies also indicate that some immigrant populations may fail to seek help and discuss their mental health concerns as compared to Canadian born whites. This difference may exist across sex splits. For example, in Canada, research by Ahmad et al. (2005) on SAI women identified that female South Asians are less likely to seek help from mental health care providers despite access to providers of healthcare. White people use mental health services more than South Asians and Chinese people (Tiwari & Wang, 2008).

The cross-sectional design of this research also limits assumptions concerning causality regarding the association of diabetes with gap between income and education. However, the persisting effect of gap between income and education against having T2DM after adjusting for

various factors emphasizes the need for further studies considering gap among other factors to better understand T2DM disparities.

The population weights developed by Statistics Canada are unable to correct for this self-selection bias of participants. The odds ratio estimates may lead to underrepresentation of the risk of T2DM outcomes in South Asian populations because of this selection bias. This study relied upon cross-sectional survey data. Longitudinal studies that follow cohorts of immigrants and Canadian-born individuals over time may help to better illuminate the impact of migration on South Asian health in assessing association with T2DM. Moreover, as with all epidemiological surveys, the prevalence calculated are only estimates. Caution needs to be exercised in interpreting them.

As South Asian populations are a relatively new community in Canada, the sample size of South Asians was relatively low when compared with Canadian born whites, but comparable to Chinese immigrants. Further, perceived discrimination and racism are important post-migratory variables especially for racialized populations (Pumariega, A. J. et al., 2005). However, these variables were not available in the CCHS and could not be included in the models.

Strengths

The CCHS offers a nationally representative database with a large sample size, allowing modeling such as multivariate logistic regression analysis. This study used multiple measures of clinically diagnosed stress variables as mediators of having T2DM to show how migration experience can cause T2DM due to a gap between income and education upon migration to Canada.

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Appendix A

Table A.1

Distribution of Estimated Sample by Age and Social Group

Social Group	Sex: Male, Female	Age-groups	Percent	Cumulative Percent
CBW	**Male**	20-29	20	20
		30-44	25	45
		45-59	29	75
		60 plus	25	100
	Female	20-29	19	19
		30-44	24	43
		45-59	28	72
		60 plus	28	100
SAI	**Male**	20-29	18	18
		30-44	38	56
		45-59	26	82
		60 plus	18	100
	Female	20-29	20	20
		30-44	42	62
		45-59	22	84
		60 plus	16	100
CI	**Male**	20-29	21	21
		30-44	26	47
		45-59	30	77
		60 plus	23	100
	Female	20-29	17	17
		30-44	31	48
		45-59	32	79
		60 plus	21	100

Table A.2

Sample Characteristics by Sex and by Social Group

Social Group	Sex: Male, Female	T2DM:	%	Anxiety Disorder	%	Mood Disorder	%	No gap, Education/ Income gap	%
CBW	**Male**	**Yes T2DM**	7	**Yes**	6	**Yes**	7	**Education/ Income Gap**	18
	Female	**Yes T2DM**	6	**Yes**	10	**Yes**	11	**Education/ Income Gap**	32
SAI	**Male**	**Yes T2DM**	12	**Yes**	5	**Yes**	5	**Education/ Income Gap**	24
	Female	**Yes T2DM**	9	**Yes**	4	**Yes**	4	**Education/ Income Gap**	55
CI	**Male**	**Yes T2DM**	9	**Yes**	1	**Yes**	3	**Education/ Income Gap**	28
	Female	**Yes T2DM**	5	**Yes**	2	**Yes**	3	**Education/ Income Gap**	45

Table A.3
Characteristics of people with T2DM by Social Group

Variables		**CBW (%)**	**SAI (%)**	**CI (%)**
Low Personal Income		53	53	54
High Education Level		66	79	77
Education/income Gap		28	33	39
Mood Disorder		13	4	2
Anxiety Disorder		8	2	-
Sex	**Male**	55	58	62
	Female	45	42	38
Age Groups	**20-29**	0.6	-	-
	30-44	6.6	-	-
	45-59	29.9	-	-
	60 plus	62.9	-	-

Table A.4

Age-Distribution of the Sample

Sample Age Distribution			
Social Group	**Age-Groups**	**Estimated Frequency**	**Percent**
CBW	20-29	3707632	20
	30-44	4710951	25
	45-59	5480007	29
	60 plus	5114860	27
	Total	19013450	100
SAI	20-29	180976	19
	30-44	376667	40
	45-59	225516	24
	60 plus	159493	17
	Total	942651	100
CI	20-29	171347	18
	30-44	267076	29
	45-59	285107	31
	60 plus	203321	22
	Total	926851	100

Table A.5

Distribution of Education/Income Gap in the Sample

Education/Income Gap			
Social Group	**Education/Income Gap**	**Estimated Frequency**	**Percent**
CBW	**No Gap**	12338317	75
	Education/Income Gap	4163032	25
	Total	16501349	100
SAI	**No Gap**	499521	61
	Education/Income Gap	319060	39
	Total	818581	100
CI	**No Gap**	462191	63
	Education/Income Gap	272611	37
	Total	734802	100

Table A.6

Distribution of Mood Disorder in the Sample

Mood Disorder			
Social Group	**Mood Disorder**	**Estimated Frequency**	**Percent**
CBW	**No**	17277617	91
	Yes	1711792	9
	Total	18989409	100
SAI	**No**	898396	95
	Yes	43056	5
	Total	941452	100
CI	**No**	898348	97
	Yes	27418	3
	Total	925766	100

Table A.7

Distribution of Anxiety Disorder in the Sample

Anxiety Disorder			
Social Group	**Anxiety Disorder: Yes, No**	**Estimated Frequency**	**Percent**
CBW	**No**	17496852	92
	Yes	1484828	8
	Total	18981681	100
SAI	**No**	903741	96
	Yes	38397	4
	Total	942138	100
CI	**No**	911640	99
	Yes	12381	1
	Total	924021	100

Table A.8
Distribution of T2DM in the Sample

Diabetes Type: T2DM yes or No			
Social Group	**T2DM yes or No**	**Estimated Frequency**	**Percent**
CBW	**No T2DM**	17768366	94
	Yes T2DM	1218908	6
	Total	18987274	100
SAI	**No T2DM**	844708	90
	Yes T2DM	97943	10
	Total	942651	100
CI	**No T2DM**	864880	93
	Yes T2DM	60840	7
	Total	925719	100

Table A.9
Characteristics of Canadian Born White with T2DM

Canadian born White with T2DM		
Personal Income Low	**Estimated Frequency**	**Percent**
Low No	508542	47
Low yes	568425	53
Total	1076968	100
Education Low	**Estimated Frequency**	**Percent**
Low No	765109	66
low yes	397387	34
Total	1162496	100
Education/Income Gap	**Estimated Frequency**	**Percent**
No Gap	742292.96	72
Education/Income Gap	293635.98	28
Total	1035928.94	100
Mood Disorder	**Estimated Frequency**	**Percent**
No	1056343	87
Yes	161833	13
Total	1218177	100
Anxiety Disorder	**Estimated Frequency**	**Percent**
No	1111469	92
Yes	102619	8
Total	1214088	100
Age Groups	**Estimated Frequency**	**Percent**
20-29	7602	0.6
30-44	79997	6.6
45-59	364246	29.9
60 plus	767063	62.9
Total	1218908	100
Sex	**Estimated Frequency**	**Percent**
Male	670014.09	55
Female	548893.64	45
Total	1218907.73	100

Table A.10

Characteristics of SAI with T2DM

SAI with T2DM		
	Estimated Frequency	**Percent**
Personal Income Low		
Low No	40723	47
Low yes	45392	53
Total	86115	100
Education Low		
Low No	73818.46	79
low yes	20008.03	21
Total	93826.49	100
Education/Income Gap		
No Gap	55051.11	67
Education/Income Gap	27522.18	33
Total	82573.29	100
Mood Disorder		
No	94407	96
Yes	3536	4
Total	97943	100
Anxiety Disorder		
No	96266.07	98
Yes	1676.96	2
Total	97943.03	100
Sex		
Male	56490	58
Female	41453	42
Total	97943	100

Table A.11
Characteristics of Chinese Immigrant Populations with T2DM

Immigrant Chinese Populations with T2DM		
	Estimated Frequency	**Percent**
Personal Income Low		
Low No	25456	46
Low Yes	29425	54
Total	54881	100
Education Low		
Low No	43143	77
Low Yes	12706	23
Total	55848	100
Education/Income Gap		
No Gap	30563	61
Education/Income Gap	19596	39
Total	50158	100
Mood Disorder		
No	59540	98
Yes	1299	2
Total	60840	100
Sex		
Male	37741	62
Female	23099	38
Total	60840	100

Table A.12

Comparative Characteristics of People with T2DM in the Three Social Groups

Variables	**CBW (%)**	**SAI (%)**	**CI (%)**
Low Personal Income	53	53	54
High Education Level	66	79	77
Education/income Gap	28	33	39
Mood Disorder	13	4	2
Anxiety Disorder	8	2	-
Sex	_	Male: 58 and Female: 42	Male: 62 and Female: 38

Table A.13

Distribution of Personal income in the Three Social Groups with T2DM

CBW	**Income Personal Low: Yes, No**		
	Personal Income Low	**Estimated Frequency**	**Percent**
	Low No	508542	47
	Low yes	568425	53
	Total	1076968	100
SAI	**Income Personal Low: Yes, No**		
	Personal Income Low	**Estimated Frequency**	**Percent**
	Low No	40723	47
	Low yes	45392	53
	Total	86115	100
CI	**Personal Income Low: Yes, No**		
	Personal Income Low	**Estimated Frequency**	**Percent**
	Low No	25456	46
	Low yes	29425	54
	Total	54881	100

Table A.14

Distribution of Education in the Three Social Groups with T2DM

CBW	**Education Low Yes and No**		
	Education Low	**Estimated Frequency**	**Percent**
	Low No	765109	66
	low yes	397387	34
	Total	1162496	100
SAI	**Education Low Yes and No**		
	Education Low	**Estimated Frequency**	**Percent**
	Low No	73818.46	79
	low yes	20008.03	21
	Total	93826.49	100
CI	**Education Low Yes and No**		
	Education Low	**Estimated Frequency**	**Percent**
	Low No	43143	77
	Low yes	12706	23
	Total	55848	100

Table A.15
Distribution of Education/Income Gap in the Three Social Groups with T2DM

CBW	**No Gap, Education/Income Gap**		
	Education/Income Gap	**Estimated Frequency**	**Percent**
	No Gap	742292.96	72
	Education/Income Gap	293635.98	28
	Total	1035928.94	100
SAI	**No Gap, Education/Income Gap**		
	Education/Income Gap	**Estimated Frequency**	**Percent**
	No Gap	55051.11	67
	Education/Income Gap	27522.18	33
	Total	82573.29	100
CI	**No Gap, Education/Income Gap**		
	Education/Income Gap	**Estimated Frequency**	**Percent**
	No Gap	30563	61
	Education/Income Gap	19596	39
	Total	50158	100

Table A.16
Distribution of Mood Disorder in the three Social Groups with T2DM

CBW	**Mood Disorder: Yes, No**		
	Mood Disorder	**Estimated Frequency**	**Percent**
	No	1056343	87
	Yes	161833	13
	Total	1218177	100
SAI	**Mood Disorder: Yes, No**		
	Mood Disorder	**Estimated Frequency**	**Percent**
	No	94407	96
	Yes	3536	4
	Total	97943	100
CI	**Mood Disorder: Yes, No**		
	Mood Disorder	**Estimated Frequency**	**Percent**
	No	59540	98
	Yes	1299	2
	Total	60840	100

Table A.17

Distribution of Sample by Sex in the three Social Groups with T2DM

CBW	**Sex**		
	Sex	**Estimated Frequency**	**Percent**
	Male	670014	55
	Female	548894	45
	Total	1218908	100
SAI	**Sex**		
	Sex	**Estimated Frequency**	**Percent**
	Male	56490	58
	Female	41453	42
	Total	97943	100
CI	**Sex**		
	Sex	**Estimated Frequency**	**Percent**
	Male	37741	62
	Female	23099	38
	Total	60840	100

Table A.18

Distribution of Estimated Sample by Age and Social Group

Social Group	Sex: Male, Female	Age-groups	Estimated Frequency	Percent	Cumulative Percent
CBW	**Male**	**20-29**	1901184	20	20
		30-44	2381193	25	45
		45-59	2746025	29	75
		60 plus	2387695	25	100
		Total	9416097	100	
	Female	**20-29**	1806447	19	19
		30-44	2329758	24	43
		45-59	2733983	28	72
		60 plus	2727165	28	100
		Total	9597352	100	
SAI	**Male**	**20-29**	85959	18	18
		30-44	180058	38	56
		45-59	123905	26	82
		60 plus	85204	18	100
		Total	475127	100	
	Female	**20-29**	95017	20	20
		30-44	196609	42	62
		45-59	101610	22	84
		60 plus	74288	16	100
		Total	467524	100	
CI	**Male**	**20-29**	88340	21	21
		30-44	113246	26	47
		45-59	127951	30	77
		60 plus	99893	23	100
		Total	429430	100	
	Female	**20-29**	83007	17	17
		30-44	153830	31	48
		45-59	157156	32	79
		60 plus	103429	21	100
		Total	497422	100	

Table A.19
Distribution of Gap by Sex and Social Group

Gap between Income and Education				
Social Group	**Sex: Male, Female**	**No gap, Education/Income gap**	**Estimated Frequency**	**Percent**
CBW	**Male**	**No Gap**	6750207	82
		Education/Income Gap	1475764	18
		Total	8225971	100
	Female	**No Gap**	5588110	68
		Education/Income Gap	2687268	32
		Total	8275378	100
SAI	**Male**	**No Gap**	320000	76
		Education/Income Gap	100901	24
		Total	420901	100
	Female	**No Gap**	179521	45
		Education/Income Gap	218159	55
		Total	397679	100
CI	**Male**	**No Gap**	246501	72
		Education/Income Gap	97285	28
		Total	343786	100
	Female	**No Gap**	215689	55
		Education/Income Gap	175326	45
		Total	391016	100

Table A.20
Distribution of Mood Disorder by Sex and Social Group

Mood Disorder				
Social Group	**Sex: Male, Female**	**Mood Disorder**	**Estimated Frequency**	**Percent**
CBW	**Male**	**No**	8746283	93
		Yes	658276	7
		Total	9404559	100
	Female	**No**	8531335	89
		Yes	1053515	11
		Total	9584850	100
SAI	**Male**	**No**	451709	95
		Yes	22680	5
		Total	474389	100
	Female	**No**	446687	96
		Yes	20376	4
		Total	467063	100
CI	**Male**	**No**	417282	97
		Yes	11859	3
		Total	429141	100
	Female	**No**	481066	97
		Yes	15559	3
		Total	496625	100

Table A.21
Distribution of Anxiety Disorder by Sex and Social Group

Anxiety Disorder				
Social Group		**Anxiety Disorder**	**Estimated Frequency**	**Percent**
CBW	**Male**	**No**	8864772	94
		Yes	533353	6
		Total	9398126	100
	Female	**No**	8632080	90
		Yes	951475	10
		Total	9583555	100
SAI	**Male**	**No**	453467	95
		Yes	21608	5
		Total	475075	100
	Female	**No**	450274	96
		Yes	16789	4
		Total	467063	100
CI	**Male**	**No**	424671	99
		Yes	3906	1
		Total	428577	100
	Female	**No**	486969	98
		Yes	8475	2
		Total	495444	100

Table A.22
Distribution of T2DM by Sex and Social Group

Diabetes Type 2 Prevalence				
Social Group	**Sex: Male, Female**	**T2DM:Yes, No**	**Estimated Frequency**	**Percent**
CBW	**Male**	No T2DM	8736303	93
		Yes T2DM	670014	7
		Total	9406317	100
	Female	No T2DM	9032064	94
		Yes T2DM	548894	6
		Total	9580957	100
SAI	**Male**	No T2DM	418637	88
		Yes T2DM	56490	12
		Total	475127	100
	Female	No T2DM	426071	91
		Yes T2DM	41453	9
		Total	467524	100
CI	**Male**	No T2DM	391565	91
		Yes T2DM	37741	9
		Total	429306	100
	Female	No T2DM	473315	95
		Yes T2DM	23099	5
		Total	496414	100

Table A.23

Distribution of Estimated Sample by Age, Sex and Social Group

Social Group	Sex: Male, Female	Age-groups	Percent	Cumulative Percent
CBW	**Male**	**20-29**	20	20
		30-44	25	45
		45-59	29	75
		60 plus	25	100
		Total	100	
	Female	**20-29**	19	19
		30-44	24	43
		45-59	28	72
		60 plus	28	100
		Total	100	
SAI	**Male**	**20-29**	18	18
		30-44	38	56
		45-59	26	82
		60 plus	18	100
		Total	100	
	Female	**20-29**	20	20
		30-44	42	62
		45-59	22	84
		60 plus	16	100
		Total	100	
CI	**Male**	**20-29**	21	21
		30-44	26	47
		45-59	30	77
		60 plus	23	100
		Total	100	
	Female	**20-29**	17	17
		30-44	31	48
		45-59	32	79
		60 plus	21	100
		Total	100	

Table A.24
Distribution of Gap by Sex and Social Group

Social Group	Sex: Male, Female	No gap, Education/Income gap	Percent
CBW	**Male**	**No Gap**	82
		Education/Income Gap	18
		Total	100
	Female	**No Gap**	68
		Education/Income Gap	32
		Total	100
SAI	**Male**	**No Gap**	76
		Education/Income Gap	24
		Total	100
	Female	**No Gap**	45
		Education/Income Gap	55
		Total	100
CI	**Male**	**No Gap**	72
		Education/Income Gap	28
		Total	100
	Female	**No Gap**	55
		Education/Income Gap	45
		Total	100

Table A.25
Distribution of Mood Disorder by Sex and Social Group

Social Group	Sex: Male, Female	Mood Disorder yes, No	Percent
CBW	**Male**	**No**	93
		Yes	7
		Total	100
	Female	**No**	89
		Yes	11
		Total	100
SAI	**Male**	**No**	95
		Yes	5
		Total	100
	Female	**No**	96
		Yes	4
		Total	100
CI	**Male**	**No**	97
		Yes	3
		Total	100
	Female	**No**	97
		Yes	3
		Total	100

Table A.26
Distribution of Anxiety Disorder by Sex and Social Group

Social Group		Anxiety Disorder yes, No	Percent
CBW	**Male**	**No**	94
		Yes	6
		Total	100
	Female	**No**	90
		Yes	10
		Total	100
SAI	**Male**	**No**	95
		Yes	5
		Total	100
	Female	**No**	96
		Yes	4
		Total	100
CI	**Male**	**No**	99
		Yes	1
		Total	100
	Female	**No**	98
		Yes	2
		Total	100

Table A.27
Univariate Regression by Social Groups

Groups	Gap: Exp(B)	Edu: Exp(B)	Inc Exp(B)	Sex: Exp(B)	Age: Exp(B)
Native Born	1.19	2.19	2.00	0.79	1.06
South Asian Immigrant	0.76	1.74	1.19	0.72	1.07
Chinese Immigrant	1.09	1.64	1.21	0.51	1.07

Reference:
Dependent Variable: T2DM (Yes No)
Independent Variables:
Gap, No Gap: Gap
Education Low (Yes, No): No
Income low (Yes, No): No
Sex (Male, Female): Male
Anxiety Disorder: Results could not be reported due to Statistics Canada cell value (n<5) requirement
Mood Disorder: Results could not be reported due to Statistics Canada cell value (n<5) requirement

Table A.28
Univariate Regression by Social Groups and Sex

Variables in the Equation					
Social Groups	**Sex**	**Age: Exp(B)**	**Gap: Exp(B)**	**Education: Exp(B)**	**Income: Exp(B)**
Canadian Born White	**MALE**	1.06	1.27	1.99	1.88
	FEMALE	1.06	1.22	2.49	2.66
South Asian Immigrant	**MALE**	1.07	0.89	1.50	1.34
	FEMALE	1.07	0.86	2.12	1.67
Chinese Immigrant	**MALE**	1.07	0.72	1.74	0.98
	FEMALE	1.08	1.97	1.47	2.59

Reference:
Dependent Variable: T2DM (Yes No)
Independent Variables:
Gap, No Gap: Gap
Education Low (Yes, No): No
Income low (Yes, No): No
Anxiety Disorder: Results could not be reported due to statistics Canada Cell value requirement
Mood Disorder: Results could not be reported due to statistics Canada Cell value requirement

[i] Over 60,000 valid interviews were conducted using computer assisted interviewing (CAI). Approximately 40% of the interviews were conducted in person using computer assisted personal interviewing (CAPI) and the other 60% were conducted over the phone using computer assisted telephone interviewing (CATI)" (CCHS 2013 Microdata User Guide, pp.19, 2014; CCHS 2014 and 2013-2014 User Guide, pp.19, Statistics Canada, 2015).