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ACCULTURATION AND POST-IMMIGRATION CHANGES IN OBESITY, PHYSICAL ACTIVITY, AND NUTRITION: COMPARING HISPANICS AND ASIANS IN THE WATERLOO REGION, ONTARIO, CANADA.

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ACCULTURATION AND POST-IMMIGRATION CHANGES IN OBESITY, PHYSICAL ACTIVITY, AND NUTRITION: COMPARING HISPANICS AND ASIANS IN THE WATERLOO REGION, ONTARIO, CANADA

Ву

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DISSERTATION

Submitted to the Department of Geography and Environmental Studies, Faculty of Arts in partial fulfillment of the requirements for Doctorate of Philosophy in Geography Wilfrid Laurier University

Michele Vitale 2016

Author's Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

Preface Statement

The manuscripts presented in this dissertation are the result of a collaborative effort.

Michele Vitale, as the first author, developed the methodology, collected the primary data, and statistically analyzed the results; Dr. Sean Doherty, as the second author, supervised the whole process, suggested the implementation of specific methods, and edited all manuscript versions.

Signatures:

First Author (Michele Vitale)

Second Author (Dr. Sean Doherty)

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Dedication

A mia mamma, Immacolata, mio papa, Sossio, e mio fratello, Luigi.

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1. Introduction

The purpose of this doctoral dissertation is to build the theoretical and empirical foundations for undertaking a deeper analysis of the propensity of immigrants to become overweight and obese since time of immigration.

The 'Background' chapter of the document underlines the most relevant uncertainties that still characterize the current knowledge of obesity, and emphasizes how complex and difficult it is to deal effectively with this phenomenon. The causal pathways that lead to obesity and link adiposity to health status are not clear yet, while the relative contributions of genetic factors, physical activity and dietary intake remain in dispute.

The overall level of complexity and uncertainty becomes even higher when considering minority groups and acculturation. Ethnic differences in body conformation question the validity of body mass index (BMI) as a universal measurement of obesity; the consistency of findings in studies that investigate ethnic differences in physical activity and nutrition varies; and the uniformity and magnitude of the (assumed) acculturation effect (weight gain) across immigrant groups and gender remain unclear. Overall, the lack of sufficient data on behavioral and metabolic factors does not allow researchers to explain the higher prevalence of obesity among minorities, and the reasons behind individual changes in diet and physical activity since time of immigration are still unanswered questions.

Finally, this section describes the main four specific objectives of this dissertation. Overall, these objectives are logically linked to the current research gaps in the literature, and attempt to provide a concrete contribution to: 1) the assessment of the acculturation hypothesis across different immigrant groups, 2) the evaluation of the role played by acculturation processes and psychological stress in terms of post-settlement obesity trends, 3) the identification of possible motivations responsible for individual changes in lifestyle behaviours and differences in obesity prevalence between ethnic groups, and 4) the examination of the existence of a threshold effect (timing of weight gains).

The third chapter briefly describes the data collection process and both the quantitative and qualitative methodologies implemented. More precise details on research setting, recruitment of participants, measures, and statistical techniques are provided in the three manuscripts, which are presented in chapters 4, 5, and 6. Each manuscript addresses a specific research objective, as follows: Fist Manuscript (Objective 1), Second Manuscript (Objective 2), and Third Manuscript (Objectives 3 and 4).

Finally, the last chapter summarizes the main results, and highlights the most important implications for both future research and preventive efforts, while the Appendix section presents the English version of the questionnaire utilized to collect the data, the script used to interview local health professionals, and the informed consent statement signed by study participants.

2. Background

2.1 Obesity as a Complex Condition

Data indicates that obesity has increased considerably since the 1980s in many countries and regions, including developing nations. For instance, in the United States, in the period 1980-2004, the prevalence of obesity increased from 15% to 33% among adults (Ogden et al., 2007). Similarly to many other industrialized nations, in recent decades, an increasing proportion of Canadians are also considered as obese and overweight, and results from the 2004 Canadian Community Health Survey-Nutrition indicate that 23.1% of adults were obese. This was up from 13.8% in 1979 (Luo et al., 2007; Tjepkema, 2006). The 2004 CCHS indicated that the prevalence of obesity in Canada increased for all age groups and for both women and men. It was also estimated that over 8,000 deaths were attributable to obesity in 2004. The social and economic costs associated with obesity are also estimated high. In Canada, the total direct health care cost of obesity in 2001 was estimated to be over \$1.6 billion, which represented 2.2% of the total health care expenditures for all diseases (Luo et al., 2007).

Obesity has also been associated with an increased incidence of a number of conditions, with an increased risk of disability, and with a moderately increased risk of all-cause mortality (Ogden et al., 2007). In particular, obesity and overweight have been linked to hypertension, type II diabetes, coronary heart disease and stroke, osteoarthritis, endometrial cancer, breast cancer, and colon cancer (Luo et al., 2007). However, higher body weight has also been associated with some positive outcomes, such as an increased bone density and lower

prevalence of both osteoporosis and hip fracture, which seems to suggest that, in older age groups, the negative effects of obesity may be at least partially counterbalanced by some positive aspects (Ogden et al., 2007).

Overall, obesity is a very complex condition, and numerous uncertainties still characterize its current epidemiological and biomedical knowledge (Evans, 2006; Gard and Wright, 2005), and these uncertainties have even led some researchers to question the claim that almost all countries are experiencing an obesity epidemic, maintaining that "the vast majority of people in the overweight and obese categories are now at weight levels that are only slightly higher than those they or their predecessors were maintaining a generation ago" (Campos et al., 2006).

Obesity is defined as excess body fat; but, the definition of excess is ambiguous, and it is difficult to quantify body fat directly. Thus, obesity is habitually described as excess body weight rather than excess fat, and most epidemiological studies classify weight and evaluate associated health risks through a Body Mass Index-BMI (Table 1), which is a value derived from the weight and height of an individual (Ogden et al., 2007). In particular, BMI is computed by dividing weight (in kilograms) by the square of height in meters, and is universally expressed in units of kg/m² (Starky, 2005).

Yet, BMI may not be an accurate predictor of health risk since it does not consider body composition or fat distribution on the body, and these limitations are particularly important for specific subgroups, such as adolescents who have not reached their full height, adults who are naturally very lean or muscular (like athletes), pregnant women, the elderly, and certain ethnic groups (Starky, 2005; Tjepkema, 2006). Partially because of lower bone mass and muscle, women tend to be characterized by a higher proportion of body fat than men at the same MBI; similarly, changes in body composition with age are responsible for a higher percentage of body fat in older persons. Therefore, the interpretation of BMI varies by several factors and a given numerical value of BMI may represent different proportion of body fatness and degree of risk (Ogden et al., 2007).

BMI Range	Classification	Risk of Developing Health Problems
< 15	Very Severely Underweight	Very High Risk
15.0 - 16.0	Severely Underweight	High risk
16.0 - 18.5	Underweight	Increased Risk
18.5 - 25	Normal (Healthy Weight)	Least Risk
25 - 30	Overweight	Increased Risk
30 - 35	Obese Class I	High Risk
35 - 40	Obese Class II	Very High Risk
> 40	Obese Class III	Extremely High Risk

Table 1 Body Weight Classifications for Adults

(Source: Starky, 2005).

Moreover, prevalence estimates are usually derived from surveys based on self-reported height and weight, which may result in inaccurate estimates, and research shows that overestimation of height augments with age, and is more likely among men than women, while underestimation of weight is greater among women (Ogden et al., 2007). Besides, "the net effect of overweight and obesity on morbidity and mortality is difficult to quantify" (Ogden et al., 2007) and not enough evidence has been provided concerning the issue of exactly how adiposity is supposed to cause disease. Thus, the "causal links between body fat and disease remain hypothetical" (Campos et al., 2006), and it is even possible that a higher than average adiposity may be an expression of underlying metabolic processes, which themselves may be the root causes of the pathologies in question (Campos et al., 2006). In other words, there is the "possibility that obesity may be a symptom rather than a cause of these diseases" (Evans, 2006).

2.2 Determinants of Obesity

The root causes of obesity are also unclear. A common hypothesis is that the exposure to present day obesogenic environments has caused genetically predisposed individuals to become extremely obese, and "these individuals may possess the 'thrifty genes' (obesity genes), which would otherwise be protective against starvation" (Lee, 2009). The thrifty genes hypothesis assumes that over the centuries the human body has been enriched with genes to improve its overall ability to conserve energy (in the form of adipose tissue), diminish energy expenditure, and eventually acquire a significant survival advantage in prolonged periods of starvation and hardship. Over time, the human body became very efficient in preventing weight

loss, but somehow ineffective in avoiding weight gain. Eventually, the modern obesogenic environments of the industrialized nations created a "biology-environment mismatch, as the human weight regulation is unable to evolve fast enough to keep pace with environmental change" (Lee, 2009).

Available data supports the hypothesis that genes play a significant role in the pathogenesis of human obesity, and several studies in twins and families have tried to measure the genetic contribution to variability in body fatness (Lee, 2009). Indeed, the different relative contributions of environmental and genetic factors may be the cause of the obesity's large phenotypic variability. There does exist a large spectrum of obesity levels (from mildly overweight to morbidly obese), and individuals can become obese either in childhood or in adulthood. For instance, researchers hypothesize that the environment may be the dominant contributing factor in the development of late onset obesity in an adult, while genetic factors may play a more significant role in the development of child obesity (Lee, 2009).

Although scholars seem to agree that genes do play a role in the variation in body fatness, there is no consensus on the exact genetic contribution. Estimates usually range between 25 and 70% and "environmental factors may be overwhelming our genetic defenses against obesity" (Hill and Melanson, 1999). Even if identified, a genetic predisposition would be considered as an essential but not sufficient condition for the development of obesity, and it would still be necessary to explain which environmental and social factors are ultimately responsible for the expression of obesity (Kumanyika, 1994). In reality, environmental, social, and genetic factors

operate in a complex combination, such as that: "the genetic background loads the gun, but the environment pulls the trigger" (Candib, 2007).

Hence, most scholars agree that obesity is the result of an increasing energy imbalance (too much energy consumed for the amount of energy expended), and that (since the human genotype has not significantly changed over the past three decades) the most likely explanation for the relatively recent surge in obesity levels is an obesogenic environment that constantly promotes energy intake and discourages physical activity (Hill and Melanson, 1999).

If genetic and biological factors alone cannot explain the rapid rise in obesity levels, it becomes important to consider a whole range of environmental factors, as suggested by ecological models, which take account of multiple levels of influence on behaviors, including individual (psychological, biological), social and cultural, organizational, community, and policy levels (Sallis and Glanz, 2009). Obesity determinants can be grouped into three inter-related strata (the macro-level, the meso-level, and the individual-level), and each of these three levels can both directly and indirectly influence physical activity and dietary behaviors, and eventually affect weight status (Black and Macinko, 2008).

The macro-level consists of all those historical, social and political factors that shape neighborhoods` quality of living conditions and availability of amenities, such as public policies, economic resources, and legislations (Black and Macinko, 2008). The meso-level refers to the neighborhood contextual features that have a direct or indirect impact on weight-related behaviors. Research suggests that some urban neighborhoods may be more obesogenic than others, and that residing in an economically deprived neighborhood may increase the likelihood of being obese and overweight (Black and Macinko, 2008).

Numerous studies have examined the association between overweight and obesity and neighborhood characteristics. Environmental determinants normally associated with physical activity are: density, land use diversity, parks and green spaces, the aesthetic quality of the streets, houses, and buildings, the size and orientation of parking lots, availability and quality of sidewalks, street lighting, vegetation cover, bike routes, paths, slopes, features that provide shelter from the elements, and crime rates (Boarnet, 2005). On the other hand, the influence of the built environment on nutrition is often analyzed by the use of the term 'food environment', which refers to the spatial distribution of (un)-healthy food choices within defined areas, such as fast food restaurants and grocery stores (Saarloos and Timmermans, 2009).

However, even though several studies have found statistical associations between neighborhood characteristics and weight-related behaviors, researchers have not found empirical evidence for causal links (Boarnet, 2005; Hanson, 2006), and "most studies suffer from the epidemiologic 'black box' problem: they do not identify the actual features of the environment that account for the relationship between the environment and health behaviors or obesity" (Taylor et al., 2006). Thus, it is not clear yet which neighborhood factors are the most agreeable to change or which ones should be the target of policy interventions (Black and Macinko, 2008). At the individual level, (besides genetic predisposition), determinants of obesity comprise age, gender, education, ethnicity, cultural traditions, and income. Behavioral intentions also play an important role, as a combination of personal attitudes, social norms, and perceived control over the desired behavior. Eventually, individual attributes mediate contextual factors, and shape weigh-related behaviors (Black and Macinko, 2008).

Yet, the patterns and the underlying reasons of all these associations are not clear, and require further investigation. Data suggests that the prevalence of overweight generally increases with age. For instance, in the USA, between 1999 and 2004, among adults 20-39 years of age, 26.8% were obese. Among 40- to 59-year-old adults 34.8% were obese, and among 60- to 79-year-old adults 35.2% were obese (Ogden et al., 2007). Gender-wise, data from the Canadian Community Health Survey indicate that in 2004 men and women were similarly likely to be obese (BMI≥30): 22.9% and 23.2%, respectively. However, women were more likely than men to be classified as severe obese: class II and III of obesity (Tjepkema, 2006). Finally, research conducted in different settings (UK, United States, and Canada) indicates that the relationship between economic deprivation and obesity prevalence is particularly strong among women. Poor women with a low education level are more likely to be obese, but this pattern is less clear for men (Gatineau and Mathrani, 2011; Kumanyika, 1994; Tjepkema, 2006), and research suggests that the association between income level and obesity is not straightforward. For instance, data from both the 2004 and 2005 Canadian Community Health Surveys indicate that household income is a good predictor of overweight and obesity for women (lowest rates of obesity among women in the highest income households), but not for men. Low income for

men appeared to be protective and was not associated with high rates of obesity and overweight (Slater et al., 2009a; Tjepkema, 2006).

2.3 Relative Contributions of Physical Activity vs. Diet to Obesity

Although there seems to be a consensus that obesity and overweight are the results of an increasing energy imbalance, the relative contributions of physical activity and dietary intake remain in dispute (Slater et al., 2009b). Energy expenditure includes three elements: resting metabolic rate (RMR), the thermic effect of food (TEF), and the energy expended in physical activity (EEA). Resting metabolic rate is the amount of energy per minute the body uses to maintain the essential body functions that support life, such as breathing, heart function, nervous system activity, and maintenance of body temperature. Thermic effect food is the energy required to digest, metabolize, and store the food we eat. Energy expenditure of activity is the amount of energy needed to fuel body movement as it occurs in activities of daily living, including exercise.

Data suggests that neither RMR nor TEF play a significant role in the etiology of obesity, and there is no indication that they have declined over the past few decades. On the contrary, the available data suggests that physical activity plays a major role in the development of obesity. For instance, in Canada, the 2004 CCHS indicated that people with sedentary lifestyle, during their leisure time, were more likely to be obese than those who were physically active. In particular, 27.0% of sedentary men were obese, compared with 19.6% of active men. Among women, obesity levels were high for both those who were sedentary and those who were moderately active (Tjepkema, 2006). Scholars agree that genetic factors may influence physical activity, but less than on the other two components. Therefore, it becomes important to consider how environmental changes over the past few decades may have affected daily physical activity levels (Hill and Melanson, 1999).

Diet has also been associated with obesity. In Canada, the 2004 Canadian Community Health Survey showed that a healthy diet (in terms of frequent consumption of fruit and vegetables) was associated with obesity levels. For instance, men and women who ate fruit and vegetables less than three times a day were more likely to be obese than were those who consumed such foods five or more times (Tjepkema, 2006). In general, research seems to suggest an increase in total energy consumption. For instance, in Canada, data from Statistics Canada estimated that per capita energy consumption increased from 2,362 kilocalories per day in 1992 to 2,788 kilocalories per day in 2002 (Luo et al., 2007).

However, available data on energy expenditure and energy intake is problematic. Ideally, metabolic energy expenditure should be calculated directly, and examples of direct measures of energy expenditure are doubly labeled water (subjects ingest stable isotopes of water) and indirect calorimetry, which is a respiratory gas measurement (Boarnet, 2005). Still, direct measurements are expensive, time-consuming, limited by participant burden, and therefore impractical on a large scale (Maddison and Mhurchu, 2009). At the same time, although less expensive and more convenient, indirect measures (such as self-reports collected through surveys and travel diaries) tend to be unreliable, since they rely on participants` ability to recall

their own physical activity patterns, such as types, intensity, and duration (Boarnet, 2005; Doherty, 2009).

The limited data available makes it reasonable to believe that on a secular basis technological improvements have substantially reduced occupational physical activity, active travel, and household-related physical activity. On the other hand, the evidence for leisure time physical activity varies, and industrialized nations report either stable rates or increasing trends (James, 2008). For instance, in Canada, self-reported data, collected over a 20-year period (1981, 1988, 1995, 1998, 1999, and 2000) by the Canada Fitness Survey (CFS), indicates that leisure time physical activity significantly increased among men and women and for all age groups in the 1980s and 1990s (Craig et al., 2004). However, all these changes have not been documented with certainty, and there is a great need for developing new methodologies able to assess the amount of energy expenditure required for daily living (Hill and Melanson, 1999).

Similarly, energy intake data "has been obtained from self-reports, which have been shown to misrepresent the actual amount of energy consumed" (Hill and Melanson, 1999). Indeed, so far, measuring of eating behaviors has relied on paper-and-pencil surveys (Hillier, 2008), and all traditional dietary intake methods (food records, food frequency questionnaires, and 24-hour recalls) rely on information reported by the study participants themselves, which is known to be associated with low-energy reporting, recall inaccuracies, data missing, and high burden on participants (Johnson, 2002).

In brief, the lack of consensus as to whether recorded rising obesity levels are primarily the results of physical inactivity or high caloric intakes is mostly due to the methodological challenges of measuring energy expenditure and energy intake at the population level over long periods of time. As a result of the lack of accurate methods to quantify energy imbalance, there is no agreement whether health policies should focus on modifying nutrition habits or increasing physical activity levels. For instance, Slater et al. believe that the increase in Canadian obesity rates has been primarily the result of increased food consumption, and that public health programs should focus on modifying the nutritional habits of the population (Slater et al., 2009b), while Hill and Melanson argue that the most likely explanation for the high prevalence of obesity in the United States is the low levels of energy expenditure, and thus, public health efforts meant to prevent obesity should focus on increasing physical activity levels.

Similarly, very little is known about the efficacy of policies aimed at altering dietary habits and physical activity behaviors on a broad scale, and further research is clearly needed to estimate the potential impacts of proposed policies and to precisely quantify the effects of implemented policies designed to reduce obesity levels (McKinnon et al., 2009). For instance, in Canada, even though self-reported data indicates that physical activity and the proportion of 'sufficiently' physically active Canadian adults increased during the 1980s and 1990s, relatively little is known about how Canadian national policies are associated with physical activity levels and the extent to which policy recommendations are successfully promoting physical activity (Craig et al., 2004).

2.4 Prevalence of Obesity and Related Conditions in Minorities

Research shows that the prevalence of overweight and obesity varies by ethnic group, and obesity in ethnic minorities normally exceeds that observed in white populations, with the largest disparities observed especially among adult women (Kumanyika, 1994; Ogden et al., 2007). For instance, data suggests that in the United States the higher prevalence of female over male obesity is particularly prominent in specific populations, such as African-Americans, Mexicans, Puerto Ricans, and Western Samoans (Kumanyika, 1994). In particular, in 1999-2004, about 53% of non-Hispanic black women 40-59 years of age were obese compared with 48% of Mexican American women and about 36% of non-Hispanic white women of the same age (Ogden et al., 2007). As well in Canada, obesity prevalence varies by population subgroups, and the vulnerable situation of aboriginal populations and communities is especially worrying (Belanger-Ducharme and Tremblay, 2005). In fact, combined data from the 2000/01 and 2003 Canadian Community Health Surveys indicate that off-reserve Aboriginal people had the highest self-reported prevalence of obesity (28%), compared with 17% of Whites (Tremblay et al., 2005).

There are also ethnic differences in the prevalence of health complications associated with obesity. For example, in the United States, obesity-associated diseases are found at higher rates within minority groups compared with the rest of the population. In particular, the estimated prevalence of insulin resistant syndrome (a condition that is a precursor to type 2 diabetes) tends to be greater in Mexican-Americans and African-Americans than in Caucasians, while the prevalence of obesity-related hypertension occurs at higher rates among African-Americans (Cossrow and Falkner, 2004). Scholars concur that ethnic differences in obesity-related comorbidities are linked to environmental factors, such as health-related behaviors and economic disadvantage. However, these factors do not explain all of the ethnic disparity in disease outcomes, suggesting that genetic and molecular factors may be operational as well (Cossrow and Falkner, 2004).

It is also important to note that there is ongoing debate about the applicability of obesity measures and definitions across ethnic groups. Besides body mass index, other common measures of obesity are waist circumference (WC), the accumulation of body fat around the waist (central or abdominal adiposity), waist-height ratio (WHTR), a person's waist circumference divided by a person's height, and waist-to-hip Ratio (WHR), the mean waist circumference divided by mean hip circumference. Current WC thresholds for increased risk of obesity-related health problems are 94cm or more in men, and 80cm or more in women. Current suggested WHTR boundary values to indicate different levels of risk are 0.5 and 0.6. Common WHR thresholds are 1.0 or more in men and 0.85 or more in women (Gatineau and Mathrani, 2011).

These common obesity thresholds "were originally derived primarily for white European populations", but researchers now agree that there is no optimal value that can be applied worldwide and further research is needed to identify ethnic-specific thresholds for each obesity measure. Some countries have already adopted different obesity thresholds for their own populations. For instance, in order to reflect a greater emphasis on the health risks associated

with cardiovascular diseases and diabetes, Singapore revised its BMI thresholds for public health action in 2005. In 2008, India reduced the diagnostic thresholds for BMI and standard waist circumference for both men and women (Gatineau and Mathrani, 2011). Besides, in the UK, estimates of adult obesity prevalence by ethnic group seem to differ according to the measurement used: when waist-to-hip ratio is used as a measurement, Bangladeshi women tend to have the highest obesity prevalence; whereas, when waist circumference is used, Black African women have the highest obesity levels. Regardless of the measurement used, Chinese men and women have the lowest obesity prevalence. In addition, for the same level of BMI, African ethnic groups tend to be more likely to carry less fat and people of South Asian ethnicity more fat than the general population, which may lead to an overestimation of obesity among African and an underestimation among South Asian groups (Gatineau and Mathrani, 2011).

Researchers have pointed out that the distribution of excess adipose mass may be more important than total fat in conferring metabolic and cardiovascular risk. For instance, excess fat in the upper body region, particularly abdominal or visceral adipose tissue, has been linked to greater insulin resistance; however, adverse metabolic effects conferred by abdominal adipose tissue may differ according to ethnicity (Cossrow and Falkner, 2004), and data suggests that "different ethnic groups have different physiological responses to fat storage" (Gatineau and Mathrani, 2011).

Thus, ethnic differences in body conformation (such as, bone density, chest width, pattern of gluteal-femoral fat) make comparisons across ethnic groups problematic, and observed

differences in prevalence and associations difficult to interpret whether real or measurementrelated (Kumanyika, 1994).

2.5 Obesity Determinants and Ethnicity

Besides genetic predispositions, evidence suggests that ethnic minorities vary on many other essential determinants of obesity, such as: exposure to environmental contexts, socio-economic status, and lifestyle behaviors (Tremblay et al., 2005).

When compared to other populations, minority groups face considerable environmental challenges to maintain a healthy weight, become physically active and acquire healthy dietary habits. Research suggests that minorities are disproportionately affected by neighborhood impacts and shows the existence of large disparities in terms of physical activity, food access and eating behaviors. Ethnic minorities tend to have less access to physical activity settings, fewer supermarkets and healthy food options (fresh fruit, produce), and are exposed to more fast-food restaurants and convenient stores (Hillier, 2008).

However, little is still known about how neighborhood effects are mediated by individual characteristics, such as ethnic background. In particular, it is not clear yet to what extent ethnic minorities are differentially responsive to obesogenic environments, and how the consistency of neighborhood factors on weight status, physical activity, and food consumption habits varies across ethnic groups (Taylor et al., 2006).

Socioeconomic variables are strongly linked to obesity prevalence, and both poverty and low educational attainment are more likely to occur among ethnic minorities than among the rest of the population (Kumanyika, 1994). Yet, the excess of poverty is not sufficient to explain the differences in obesity levels across different minorities, and "adjustment for socioeconomic status does not eliminate racial or ethnic differences", which suggests that "ethnic influences operate independently of socioeconomic status" (Kumanyika, 1994).

These other ethnic influences may include cultural values. For instance, ethnic groups might have diverse social norms defining acceptable body weight ranges, and in the USA, studies have found that African American women are more likely to accept a larger body image, and less likely to report they are trying to lose weight than non-Hispanic white and Mexican women. However, the extent to which these factors may influence weight-related behaviors is still unknown (Doyle, 2010).

Sex-specific, age-specific, sport-specific cultural norms related to physical activity and nutrition habits also exist, such as acceptable foods and quantities and dietary customs (Tremblay et al., 2005). In the Netherlands, researchers not only found that people of foreign origin travel shorter distances and more seldom than the ethnic Dutch, but also that foreigners use bicycles much less than the ethnic Dutch, and that Turkish women and second-generation Turkish immigrants use cars more frequently than any other group. Possible explanations relate to cultural factors, like the limited possibilities for Muslim women to appear in public unless accompanied by their husbands, the bad perception (risk of accidents) and low status value of the bicycle among foreigners, and the common perception (especially among secondgeneration Turkish women) of the car as a medium of emancipation and integration (Harms, 2007).

There is also evidence of the existence of significant ethnic differences in behavioral factors, and fruit and vegetable consumption, total calorie and fat intake, and physical activity levels may contribute in part to disparities recorded in obesity rates among minorities (Doyle, 2010). For instance, in the UK, South Asian populations (mostly from the Bangladeshi community) have strikingly lower levels of physical activity compared to the white population. People from Bangladeshi and Pakistani groups (especially women) were also the least likely to participate in sport and recreation activities. Among many other barriers, South Asian women reported "that negative attitudes to physical activity had been instilled by their parents who had the view that sport and femininity were incompatible". On the other hand, Black Caribbean and Black African adolescents are the most likely of all groups to engage in poor dietary practices (Gatineau and Mathrani, 2011). As well in the USA, studies indicate that ethnic minorities tend to be less likely to engage in healthy exercise and dietary behaviors than whites. Among middle-aged and older adults, African Americans and Hispanics engage in less leisure time physical activity and have a lower intake of fruits and vegetables, though, these disparities seem to diminish in late adulthood (August and Sorkin, 2011).

However, the consistency of findings in studies that investigate ethnic differences in weightrelated behaviors varies, and there is a clear need for additional research to confirm and further

clarify the patterns found. In particular, future research should include both genders, compare more than two ethnic groups, consider data on several potentially cofounding variables, and investigate a wide range of weight-related behaviors (Neumark-Sztainer et al., 2002).

2.6 Is There a Positive Association between Acculturation and Obesity?

Although definitions vary, acculturation has been defined as "the process by which immigrants adopt the attitudes, values, customs, beliefs, and behaviors of a new culture" (Abraído-Lanza et al., 2006; Pérez-Escamilla and Putnik, 2007), and "acculturation may play an important role whether health behaviors vary by ethnicity" (August and Sorkin, 2011).

The acculturation hypothesis speculates that as new immigrants assimilate into a new culture, they acquire dietary and lifestyle habits of the dominant group, in such as way that "the greater the degree of acculturation, the greater the risk of weight gain" (Cairney and Ostbye, 1998). Researchers believe that migration from countries of origin to industrialized and developed nations might expose immigrants to more sedentary lifestyles and energy-dense diets high in salt and fat (Molaodi et al., 2012), and evidence from various settings seems to confirm that there is a positive relationship between body weight and duration of residence (Oza-Frank and Cunningham, 2010). For instance, in Canada, data indicates that for most immigrants, "the probability of being overweight or obese is lower on arrival than for comparable native-born Canadians" (McDonald and Kennedy, 2005), but the prevalence of excess weight increases with time since immigration for both men and women (Cairney and Ostbye, 1998).

However, research also suggests that the impact of duration of residence on weight status may vary by age at arrival, sex, overall level of acculturation, ethnicity, and migration history. Research conducted in the United States indicates that younger immigrants are more likely to become obese with increased duration of residence compared to migrants who arrived at older ages. Several studies have also found that the BMI of Hispanic female immigrants tend to converge to native-born estimates faster than among male Hispanic immigrants. Finally, refugees, labor migrants and trailing families may each adjust differently to a new culture. For instance, it is likely that refugees, who have experienced extraordinary hunger and deprivation before migrating, might have different patterns of weight change from other immigrant groups (Oza-Frank and Cunningham, 2010).

In particular, the difficulty to measure energy balance at the population level makes it difficult to confirm how different population groups are adjusting to new obesogenic environments (Kumanyika, 2008). Data points out that acculturation might be linked to some positive aspects, such as an increased level of leisure physical activity. For instance, in Canada, data from the 2000/01 and 2003 cross-sectional Canadian Community Health Survey indicates the existence of a gradient in being physically active as recent immigrants (16%) were less active than immigrants (20%), who were less active than non-immigrants (24%) (Tremblay et al., 2006). Similarly, cross-sectional data indicates that immigrant women (but not men) in Sweden are more likely to engage in leisure-time physical activity as the length of the period of residency increases. Possible explanations include acculturation (immigrant women adapt to Swedish cultural norms and expectations), improved financial status (which implies access to an automobile to reach activity sites and additional financial resources to pay for activities and equipment), and increased levels of opportunities, as language skills and social networks in the new host country develop (Dawson et al., 2005).

Yet, possible increases in leisure-time physical activity appear to be either offset by decreases in utilitarian physical activity or by a disproportionate increase in caloric intake, leading to a progressive weight gain. Yet, all these trends have not been fully documented and it is not known the extent to which they vary within immigrant groups (Tremblay et al., 2006). Spatial settlement patterns can also have important implications. In the long run, as their economic status improves, immigrants slowly assimilate to automobile use and tend to relocate to higher-income neighbourhoods, perhaps in suburban areas, where minimal transit services and lower residential densities may further contribute to reduce immigrants' overall physical activity levels. However, up till now, very few studies have investigated the mobility behaviour of immigrants who moved to suburban areas, and little is known about how the spatial characteristics of immigrant neighbourhoods are correlated with travel choices (Blumenberg, 2009; Chatman and Klein, 2009; Tal and Handy, 2009).

Taken as a whole, most of the studies in the current literature that compare recent and longterm immigrants are cross-sectional, and this prevents any inference about causal relationships between duration of residence and weight status. Using cross-sectional data may result in acculturation variables being confounded with cohort effects: "that is, individuals who arrived during the same period may be more similar to each other" (Oza-Frank and Cunningham, 2010),

and thus the possibility that long-term newcomers were more obese at the time of immigration than more recent immigrants cannot be ruled out (Goel et al., 2004).

Besides, acculturation is a complex process that involves a broad range of changes and, although length of residence is often used as a measure of acculturation, more direct indicators should be utilized (Oza-Frank and Cunningham, 2010). As a result, the consistency of the presumed acculturation effect (weight gain) across immigrant groups, migration background, age at arrival, and gender remain unclear, while the magnitude of the change in weight status, when and why individual changes in diet and physical activity occur, and the existence of a threshold effect are still unanswered questions (Goel et al., 2004; Oza-Frank and Cunningham, 2010).

In conclusion, although increasing obesity with longer duration of residence is concerning, the relationship between obesity, ethnicity, and acculturation is not straightforward and there is not sufficient data on behavioral and metabolic factors that may contribute to the higher prevalence of obesity among minorities (Gatineau and Mathrani, 2011; Hill and Melanson, 1999). Thus, scholars concur that much more detailed research is needed to better understand the extent of ethnic and gender differences in obesity prevalence, and the intricate interaction of factors affecting obesity and its comorbidities in ethnic groups (Gatineau and Mathrani, 2011).

2.7 Obesity among Ethnic Groups in Canada

In Canada, there is limited research on overweight and obesity among ethnic groups, and very few studies have examined the dietary and physical activity profiles of immigrants. Yet, the limited data available shows clear differences. As shown in Figure 1, Latin Americans have the highest self-reported prevalence of overweight and obesity (with the exception of off-reserve Aboriginal groups), and this pattern is confirmed even when considering immigration status (Figure 2) with long-term Latin American immigrants reporting the largest increase in weight status since time of arrival. On the other hand, East/Southeast Asians have the lowest prevalence (22%) of overweight and obesity, and over time their weight status remain low (Tremblay et al., 2005). However, as previously mentioned, the low prevalence of overweight and obesity in East/Southeast Asians may be deceptive, given the well-known inadequacy of body mass index to consider potential ethnic differences in absolute levels of adiposity, body fat distribution, and related health consequences, and the documented higher prevalence of metabolic disorders among Asians with relatively low BMIs of 23 to 24 (Tremblay et al., 2005).

The whole picture becomes less clear when considering physical activity and dietary intake data, since Latin Americans appear to make healthier lifestyle choices than many other ethnic groups. Indeed, Latin Americans are considered to be the group most likely to consume an adequate amount of fruits and vegetables (Quadir and Akhtar-Danesh, 2010), and also as one of the most physically active minorities (Bryan et al., 2005). Data from the 2004 Community Healthy Survey/Nutrition shows that Latin Americans (39%) were the ethnic group most likely to consume five or more daily servings of fruit and vegetable, with other minority groups

reporting significantly lower fruit and vegetable consumption, such as Southeast Asians (13%), Aboriginals (14%), and West Asians (17%) (Quadir and Akhtar-Danesh, 2010). On the other hand, self-reported data from two cycles (2001 and 2003) of the Canadian Community Health Survey shows that the rank order of prevalence of being moderately active by ethnicity was: White (49%), Other (48%), NA Aboriginal (47%), Latin American (40%), East/Southeast Asian (39%), Black (38%), West Asian/Arab (36%), South Asian (34%) (Bryan et al., 2005).



Figure 1 Prevalence of Overweight & Obesity by Ethnicity in Canada, 2001/2003

Source: Tremblay et al. (2005).


Figure 2 Prevalence of Overweight & Obesity by Immigration Status in Canada, 2001/2003

Source: Tremblay et al. (2005).

Interestingly, East/Southeast Asians show opposite trends, since they tend to experience low obesity levels, while being less likely to engage in leisure-time physical activities and consume appropriate amounts of fruits and vegetables (Bryan et al., 2005; Quadir and Akhtar-Danesh, 2010; Tremblay et al., 2005). These studies have significant limitations, and both vegetable and fruit intake and physical activity may have been largely underestimated. In the nutrition study, respondents provided only the frequency and not the quantity of daily fruit and vegetable consumption, and the calculation of overall fruit and vegetable intake did not include

consumption of vegetables in mixed dishes (Quadir and Akhtar-Danesh, 2010). In the physical activity study, physical activity represents only leisure-time (rather than overall daily energy expenditure) and cultural diverse activities, work-related activities, and household chores are not taken into account. Plus, the perception of intensity may vary among ethnic groups, and may be confused with stress levels and level of enjoyment of the activity. Finally, the questionnaires rely on self-reported frequency and duration of physical activities (Bryan et al., 2005). Therefore, more research is needed to reconcile these contradictory results, and shed further light on the lifestyle behaviours and obesity levels of different immigrant and ethnic groups in Canada.

2.8 Research Questions and Objectives

Given the current theoretical uncertainties that still characterize the literature, the main purpose of this dissertation is undertaking a deeper analysis of the propensity of immigrants to become overweight and obese since time of immigration. More specifically, the project has the following key objectives:

• Objective 1:

Test the generalizability of the acculturation hypothesis across immigrant/ethnic groups and gender.

The first goal of this study is to further test the acculturation hypothesis in the Canadian context and examine the effects of length of residence on weight status. This objective is addressed by comparing Hispanics and East/Southeast Asians. These two specific groups

were chosen because they present divergent trends of obesity rates after settling in Canada. As suggested by the literature (see Background Chapter), Hispanics and East/Southeast Asians represent two opposite extremes, and their comparison could provide useful insights in terms of understanding the development of obesity-related disorders.

The main research questions are:

- 1) Do Hispanics and East/Southeast Asians experience statistically significant dissimilar patterns in terms of body mass index status and weight change after settling in Canada?
- 2) Are there any significant differences based on gender and other demographic variables, such as income and education level?

This objective and its related research questions are addressed in the First Manuscript (Chapter 4) through a logistical regression analysis that estimated overweight/obesity risk for the two target groups. In addition, weight-related measures, such body mass index and average weight gain, were compared through parametric (independent t-test) and non-parametric tests (Mann-Whitney test).

• Objective 2:

Examine the association between acculturation, lifestyle behaviors, psychological stress, and obesity.

The second purpose of the present study is to evaluate how acculturation processes and psychological stress mediate post-arrival changes in body mass index status and lifestyle behaviors. The study intends to focus on acculturative stress, which can be defined as the overall reduction in health status (including physical, psychological, and social aspects) of immigrants who are experiencing a cultural adaptation process (Berry J.W., 2006). To accomplish this task, acculturation was measured by adapting an existing multidimensional scale that goes beyond a simplistic proxy measure, such as length of residency.

The main research questions are:

- 1) Do Hispanics and East/Southeast Asians experience statistically significant different acculturation levels?
- 2) Do psychological stress levels significantly differ between the two target groups?
- 3) What is the statistical correlation between psychological stress, acculturation, and weight-related measures?
- 4) Does gender play a statistically significant role in all these associations?
- 5) Are there statistical significant correlations between acculturation and post-settlement behavioral changes?

This objective and its linked research questions are addressed in the Second Manuscript (Chapter 5) through a statistical correlational analysis, and the computation of parametric and non-parametric tests to evaluate the significance of differences in acculturation strategies.

• Objective 3:

Identify the perceived motivations behind post-settlement individual changes in weight status and lifestyles.

As outlined by the literature, the reasons behind individual changes in weight status and weight-related behaviors are not clear yet. Thus, the third main goal of this research effort is exploring the determinants of post-settlement changes in obesity levels from immigrants' own perspective, and trying to identify possible explanations for the differences in obesity prevalence between immigrant/ethnic groups.

In particular, this objective attempts to answer the following research questions:

- 1) What are the motivations that immigrants consider as the most important in terms of weight gains, and changes in food intakes and activity levels?
- 2) What challenges do health professionals regard as more significant?

This objective and its associated research questions are addressed in the Third Manuscript (Chapter 6) through a qualitative analysis of the in-person interviews conducted with study participants and local health professionals.

• Objective 4:

Examine the timing of potential changes in weight status and lifestyle behaviors.

Finally, the last main objective is exploring when post-immigration individual changes in weight status, diet, and physical activity are more likely to occur in order to investigate the existence of a threshold effect, which is still a much debated topic in the literature.

The main research questions are:

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- After settling in Canada, when do immigrants perceive that they start to experience modifications in weight status and lifestyle behaviors?
- 2) Does the timing of potential changes differ between the two target groups?

This objective and its connected research questions are addressed in the Third Manuscript (Chapter 6), which describes the qualitative data collected.

3. Methodology

This chapter briefly overviews the procedures involved in the data collection process, describes how the main variables were measured, and summarizes the methodologies followed to analyze both the quantitative and qualitative data collected. For certain techniques, more details are provided in the manuscripts as noted.

3.1 Data Collection

Data was collected in the Waterloo Region, in Southern Ontario, Canada, between January and July 2015. A 41-item questionnaire was administered in English and/or Spanish by the first author or in Mandarin by a bilingual translator (the English version of the questionnaire is shown in Appendix A). Interviews were also conducted with six health professionals employed in local community health centers (see Appendix B for interview guide).

Most study participants were recruited with the help of seven local immigrant and religious associations, spread throughout the region to enhance the representativeness of the sample. Virtually all participants belonging to these associations were willing to participate and being interviewed. However, other participants (about 20% of the entire sample) were identified through a convenience sampling strategy by approaching immigrants in different local commercial establishments. Even if recording devices were not used to further guarantee confidentiality and make immigrants more likely to participate, several potential respondents refused to be approached, and on average the response rate was about 25%.

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A \$5 Tim Horton's gift card was the only form of remuneration provided. To be eligible, respondents had to be at least 18 years old, and meet two additional criteria: 1) being a first-generation immigrant from either East/Southeast Asia or Latin America, and 2) having been in Canada for at least 6 months.

A total of 100 participants were recruited, 50 in each of the two target groups (East/Southeast Asians and Latin Americans). Participants originated from a wide variety of countries, further enhancing the diversity of the sample. For East/Southeast Asians, this included from China, Taiwan, Hong Kong, South Korea, Japan, Vietnam, Laos, Cambodia, and Thailand; while Hispanic respondents originated from Mexico, Guatemala, Nicaragua, El Salvador, Costa Rica, Cuba, Colombia, Chile, Venezuela, Ecuador, Argentina, Peru, and Uruguay. On average, it took 20 minutes to complete each interview.

The questionnaire was first pilot-tested with 10 Wilfrid Laurier University Hispanic and East Asian graduate students to account for any cultural inconsistencies. The study was approved by the Research Ethics Board of Wilfrid Laurier University. Informed consent was obtained from all participants being included in the study (Appendix C).

3.2 Measures

Body Mass Index (BMI)

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Body mass index was self-reported and calculated by weight in kilograms divided by the square of the height in meters (kg/m²), while World Health Organization (WHO) guidelines, adopted by Health Canada, were used to classify participants as overweight (BMI≥25) and obese (BMI≥30).

• Magnitude of Changes in Weight-related Measures

Participants were asked to recall their height and weight both at the time of arrival to Canada and at the time of data collection.

• Length of Residency

Participants were classified according to their duration of residency in Canada as recent immigrants (less than five years from time of arrival), medium-term immigrants (five to ten years), and long-term immigrants (more than ten years).

Acculturation

Acculturation was measured by adapting D. T. Barry's East Asian Acculturation Measure, which measures the adaptation strategies originally described by J.W. Berry: assimilation, integration, separation, and marginalization (see Table 1 in Second Manuscript).

Psychological Stress

Psychological stress levels were measured through the Kessler Psychological Distress Scale (K6), which includes six questions about an individual's emotional state during the past 30 days.

• Perceived Post-Arrival Behavioural Changes

Sedentary behaviour, physical activity in different settings, and the consumption of a range of food types and beverages were measured by developing and scoring 5-point Likert-type items, categorized as much less, less, no change, more, much more (Appendix A).

• Perceived Diet Similarity

It was measured by developing and scoring a 5-point Likert-type item, classified as exactly the same, very similar, similar, different, and very different (Appendix A).

3.3 Statistical Analysis

Data was analyzed using SPSS statistical software. The following three statistical techniques were implemented:

• Logistic Regression

After creating a dichotomous variable based on study-participants' body mass index (BMI≥25), a logistic regression was performed to estimate obesity risk based on ethnicity, length of residency, and demographic variables.

• Correlation Analysis

Pearson correlation coefficients were calculated to assess the statistical relationship between acculturation strategies, psychological stress, weight-related measures, and perceived changes in lifestyle behaviours.

• Parametric and Non-parametric Tests

Independent t-test and Mann-Whitney test were computed to determine the statistical significance of group-based differences in terms of overweight/obesity rates, changes in weight status, and acculturation levels.

3.4 Qualitative Analysis

The questionnaire administered with study participants included open-ended questions, such as: "If you gained weight since coming to Canada, why is that?" and "If you think that your diet has changed, what are the most important reasons?" (Appendix A). Respondents were also encouraged to expand on subjects of particular interest to them. Interviews with health professionals included the following questions: "What are the main challenges that immigrants face after arriving in Canada in terms of following a healthy diet and being physically active?" and "What could be done to avoid immigrants becoming overweight and obese?" (Appendix B).

During interviews, verbal responses were recorded in field notes, and quotations written verbatim. Transcriptions of interviews were then subject to a content analysis to identify common themes voiced by respondents and their frequency. Tables 3-12 in the Third Manuscript provide examples of supporting quotes organized by themes and sub-themes.

4. First Manuscript

TITLE OF THE ARTICLE:

The Longer the Length of Residency, the Greater the Risk of Obesity? Testing the Generalizability of the Acculturation Hypothesis.

AUTHORS' NAMES:

Mr. Michele Vitale (First Author), Dr. Sean Doherty (Second Author).

ACADEMIC JOURNAL:

Ethnicity & Disease.

ABSTRACT

OBJECTIVES: The acculturation hypothesis assumes a positive relationship between duration of residence and obesity-status; however, its consistency across ethnicity and gender remains unclear. Thus, this study further examines the uniformity of the acculturation assumption by comparing Hispanics and East/Southeast Asians in an urban area of Ontario, Canada.

METHODS: A questionnaire was administered with a sample of 100 first-generation immigrants. Participants were classified according to their duration of residency in Canada as recent immigrants (less than five years from time of arrival), medium-term immigrants (five to ten years), and long-term immigrants (more than ten years). BMI was self-reported. Parametric and non-parametric tests assessed group-based differences, while a logistic regression estimated overweight/obesity risk.

RESULTS: By immigrant group, Hispanics exhibited significantly higher BMI levels and larger post-settlement weight-gains. When considering duration of residence, long-term immigrants experienced a nearly fifteen-fold greater risk of being overweight than did recent immigrants; however, overweight risk was nearly nine times higher for Hispanics. Being male was also positively associated with being overweight/obese. In contrast, increasing age and a higher educational level were significantly associated with lower odds of overweight risk.

CONCLUSIONS: Results support the notion that the impact of duration of residence does vary by ethnicity and gender. Prevention efforts should focus on the most at risk immigrant groups, and pay particular attention to less-educated immigrants, who may be more likely to acquire unhealthy habits after settlement.

KEYWORDS: Immigrants; Acculturation; Obesity; Body Mass Index.

INTRODUCTION

Acculturation has been defined as "the process by which immigrants adopt the attitudes, values, customs, beliefs, and behaviors of a new culture" [1, 2]. The acculturation hypothesis speculates that as new immigrants assimilate into a new culture, they acquire the dietary and lifestyle habits of the dominant group [3], such as that the longer the length of residence, the greater their risk of weight gain. Researchers believe that migration from countries of origin to industrialized and more economically developed nations might expose immigrants to more sedentary lifestyles and energy-dense diets high in salt and fat [4], and evidence from various settings seems to confirm the positive relationship between body weight and duration of residence [5]. However, the lack of sufficient data on behavioural and metabolic factors [6] and the difficulty to measure energy balance at the population level make it difficult to confirm how different population groups are adjusting to new obesogenic environments [7]. Thus, the consistency of the presumed acculturation effect across immigrant groups, gender, age at arrival, and acculturation level remains unclear, while the reasons behind individual changes in lifestyle behaviours, and the magnitude of the change in weight status are still unanswered questions [5, 8].

In Canada, although there is limited research on overweight and obesity among ethnic and immigrant groups [9], evidence indicates that obesity rates vary by population subgroups, and the vulnerable situation of Aboriginal men and women is especially worrying [9, 10]. In taking into account birthplace and time since arrival, data suggests the existence of differences among

foreign populations, with East/Southeast Asians reporting the lowest prevalence and Hispanics the highest prevalence of overweight and obesity [9] Thus, not all immigrants experience increasing BMI levels after settling in Canada [11]. Yet, the whole picture becomes less clear when considering physical activity and dietary intake data. For example, Hispanics appear to make healthier lifestyle choices than many other groups, while East/Southeast Asians seem to be less likely to engage in leisure-time physical activities and consume recommended amounts of fruits and vegetables [12, 13, 14]. Building up on this literature, the purpose of this study is to further test the acculturation hypothesis in the Canadian context and examine the effects of length of residence on weight status by comparing two immigrant groups that appear to present divergent trends of post-settlement obesity rates and weight-related behaviours.

METHODS

Participants

Participants were recruited in the Waterloo Region, located about 100 km West of Toronto in Southern Ontario, Canada. European immigrants and refugees have traditionally settled in the area, however, in more recent years, the region has been experiencing a growing number of immigrants coming from Asia, Latin America, and Africa, with the largest number coming from India and China. According to Census data, in 2006, at least five thousand Hispanics and fifteen thousand East/Southeast Asians lived in the area [15]. As a difficult-to-reach population, immigrants were recruited with the help of seven community and religious organizations, geographically spread throughout the region to enhance the overall representativeness of the sample. A total of 100 participants were recruited (50 in each of two target groups), who originated from a wide variety of countries, further increasing the diversity of the sample. For East/Southeast Asians, this included from China, Taiwan, Hong Kong, South Korea, Japan, Vietnam, Laos, Cambodia, and Thailand; while Hispanic respondents originated from Mexico, Guatemala, Nicaragua, Costa Rica, El Salvador, Cuba, Colombia, Venezuela, Ecuador, Chile, Peru, Argentina, and Uruguay. Eligibility criteria included being: A) a first-generation immigrant from either East/Southeast Asia or Latin America, B) over 18 years of age, and C) in Canada for at least 6 months.

Data Collection

A 41-item questionnaire including open-ended and multiple choice questions was administered by the first author in English and/or Spanish, or in Mandarin by a bilingual translator, between January and July 2015. Questionnaires were mostly administered in local partner organizations' venues. Each participant was asked to provide a wide range of information, including selfreported height and weight, migration history, and socio-demographic background. The final questionnaire was pilot-tested with 10 Wilfrid Laurier University Hispanic and East Asian graduate students to account for any cultural inconsistencies. Informed consent was obtained from all participants being included in the study. The study was approved by the Research Ethics Board of Wilfrid Laurier University, and all procedures followed were in accordance with the ethical standards of the Helsinki Declaration of 1975, as revised in 2000.

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Measures

World Health Organization (WHO) guidelines [16], adopted by Health Canada, were used to classify participants as overweight (BMI≥25) and obese (BMI≥30). Body mass index was calculated by weight in kilograms divided by the square of the height in meters (kg/m²), while the magnitude of changes in weight and BMI status was tracked by asking participants to recall their height and weight both at the time of arrival to Canada and at the time of data collection. Participants were classified according to their duration of residency in Canada as recent immigrants (less than five years from time of arrival), medium-term immigrants (five to ten years), and long-term immigrants (more than ten years). Other individual measures included gender (male, female), age, age at arrival in Canada, current education level (categorized as high school or less, and college degree or more), and annual household income.

Statistical Analysis

Data was analyzed using SPSS statistical software. Group means were the parameters used to examine group differences in terms of self-reported overweight-obesity rates and magnitude of weight changes after settlement. Group mean values were compared using both parametric (independent t-test) and non-parametric tests (Mann-Whitney test), which produced identical results. However, given that the assumptions of normality and homogeneity of variance were not met, only non-parametric test results are reported.

After creating a dichotomous variable based on study-participants' body mass index (BMI≥25), a logistic regression was performed to ascertain the effects of ethnicity, gender, age, age at

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arrival, education level, annual household income, and length of residency on the likelihood that study participants were either overweight or obese. Predictors were selected for their theoretical importance in terms of overweight risk as showed by prior literature. Given the theory-testing nature of the study, covariates were added into the model in one block. The assumption of linearity was met for all continuous predictors. Multicollinearity tests were also performed, and both tolerance and variance inflation factor (VIF) values were in an acceptable range.

RESULTS

The two samples were fairly similar in terms of socio-demographic characteristics (see Table 1). On average, East/Southeast Asians were slightly older than Hispanic participants at the time of data collection (45 and 44 years old respectively), while mean age at arrival in Canada was identical for both groups (31 years old). Average household income was marginally higher for Hispanics (\$64,880), whereas average length of residency in Canada was equal (13 years) for both samples. Finally, participants were generally highly educated, and both East/Southeast Asians and Hispanics reported high percentages of respondents holding at least a college degree (76% and 70%).

Whilst similar socio-demographically, the two target groups presented substantial and statistically significant differences in self-reported overweight-obesity levels. The mean current BMI was 27.3 for Hispanics and 22.8 for East/Southeast Asians; among Hispanic participants,

34% exhibited a normal weight (18.5≤BMI≤24.9), while 38% were overweight (25≤BMI≤29.9), and 26% were obese (BMI≥30). In contrast, the clear majority of East/Southeast Asians (68%) reported a healthy weight, with only 18% being overweight and 6% obese (Figure 1). As shown in Table 2, considerable dissimilarities were also noticeable when exploring the magnitude of changes since time of immigration. To begin with, Hispanic participants reported a higher BMI at arrival (23.9) than East/Southeast Asians (21.4). After settling in Canada, the BMI of Hispanic immigrants increased by 10.9%, almost twice as much as East/Southeast Asians (5.6%), with Hispanic newcomers reporting an average weight gain of 8.9 KGs, more than double the mean weight increase experienced by East/Southeast Asians (3.9 KGs). All these differences were found to be highly statistically significant (Table 2).

When classifying study participants by length of residency in Canada (Table 3), recent, mediumterm, and long-term Hispanics reported higher BMIs and average post-settlement weight gains than East/Southeast Asian immigrants in the same categories. In particular, long-term Hispanic newcomers experienced much higher BMI levels (28.7) and larger average weight gains (12.7 KGs) than established East/Southeast Asian immigrants, who instead reported healthy BMI levels (23.2) and only minor weight gains since time of arrival (4.7 KGs). Hispanic respondents also reported increasing values with time since immigration, but this gradient does not hold true for East/Southeast Asians. Statistical tests found the differences between long-term Hispanic and established East/Southeast Asian immigrants to be highly significant (Table 3). The logistic regression model was statistically significant (p<0.000), accounting for 42.8% (Nagelkerke R²) of the variance in overweight/obese, and correctly predicted 71% of the cases (Table 4). Long-term immigrants experienced a nearly fifteen-fold greater risk of overweight than did recent immigrants (OR=14.84). However, the odds of Hispanics being overweight were almost nine times higher than East/Southeast Asians (OR=8.76). Overweight risk was also six times higher for males than females (OR=6.20). On the other hand, a higher educational level and increasing age were associated with lower odds of overweight risk. Age at arrival and annual household income were not significantly associated with the risk of being overweight.

DISCUSSION

Most previous research has relied on the notion that foreign groups are a homogeneous population, and that immigrants' obesity levels are supposed to increase with the duration of residence in the host country [17]. In this study, length of residence in Canada was indeed significantly associated with a higher risk of becoming overweight and obese; however, the results also provided evidence in support of the heterogeneity of the acculturation effects with Hispanic immigrants experiencing a much higher risk of developing obesity after settlement. Unlike other studies that suggest a higher prevalence of female obesity among different foreign populations [18], and the tendency of the BMI of Hispanic female immigrants to converge faster to native-born estimates than among Hispanic male immigrants [19], we found that male migrants are more susceptible to post-settlement risk of weight gain, with both Hispanic and East/Southeast male respondents reporting higher BMIs and larger weight gains than female

participants (Table 5). Contrary to the notion that lower socioeconomic status groups are more at risk of becoming obese [20], in our study a higher income did not seem to be protective and was not associated with lower BMI levels. Instead, we found that less-educated immigrants were more vulnerable to increases in overweight-obesity rates.

Several limitations should be considered when interpreting these results. To begin with, it was a cross-sectional study, and thus a causal relationship between acculturation and weight-status cannot be directly inferred. Second, recall bias may affect results as weight and height were self-reported. Third, length of residency in the host country is a proxy for acculturation, and does not appropriately reflect immigrants' level of cultural assimilation. Finally, the lower prevalence of overweight and obesity in East/Southeast Asians may be deceptive, given the documented higher prevalence of metabolic disorders among Asians with relatively low BMIs [8]. Despite these limitations, this study was able to contribute to the current knowledge of obesity in a number of ways. First, it was consistent with those challenging the uniformity of the presumed acculturation effect and indicating that different immigrant groups experience diverse patterns of adaptation [21], rather than equally converging to the higher BMI levels of the host society. Secondly, it shows that gender disparities in obesity are still largely unclear, supporting the call for more research on the topic given that many developing countries are going through a nutrition transition [19]. Finally, our research highlights the view of obesity as a socio-cultural phenomenon where a higher income-status is not necessarily a protective factor, confirming the findings of those studies that have found decreasing socioeconomic gradients in obesity among immigrant groups [22]. Indeed, our study results are congruent with the belief that acculturation, economic and social conditions are closely connected [23], suggesting that immigrants are particularly at risk to develop obesity when acquire a higher purchasing power without adequate educational advancements and nutrition knowledge, which undermine their capacity to make healthier lifestyle choices.

Future Research

The relationship between obesity, ethnicity, and acculturation is not straightforward. Acculturation may have a protective effect against obesity [24], and a higher degree of acculturation might be associated with an increased level of leisure physical activity, as immigrants adopt new cultural norms and expectations and develop their social networks in the host country [25]. To better understand the extent of ethnic and gender differences in obesity prevalence, future studies should further examine the intricate interaction of acculturation dynamics, cultural factors, socioeconomic background, and genetic predispositions within different foreign populations. Future research should also explore different patterns of cultural adaptation (such as biculturalism), and further investigate how differences in acculturation processes might result in diverse health behaviours and health outcomes. For instance, the lower rates of Chinese immigrants of being overweight and obese (even after years of residence in Canada) is worth particular exploration, and speculation is that this may be related to the fact that Chinese communities are so large, populous and spatially concentrated that the impetus of acquiring typically Canadian ways of living is significantly reduced [26, 27], which may in turn delay or inhibit the acquisition of unhealthy lifestyles. This kind of research would also inform preventive efforts on how to take notice of specific ethnicity groups' needs, such as

eating habits, food preparation, child-feeding practices, and perceptions of body image. In increasingly multiethnic societies, a more systematic monitoring of ethnicity-based obesity differentials would help preventive programs to target the foreign groups most at risk to develop obesity and its associated conditions after settlement, while allowing a more efficient allocation of limited resources for counselling on diet and physical activity. Regardless of nativity status, prevention efforts should focus on less-educated immigrants, who might be more likely to acquire unhealthy habits.

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FIGURES



Figure 1 Self-reported Overweight and Obesity Levels

TABLES

		E/SE Asi		Hispanics			
		(n = 50		(n = 50)			
		Mean (SD)	n	%	Mean (SD)	n	%
Current Age	(years)	45 (14)	50	100	44 (10)	50	100
Age at Arrival	(years)	31 (11)	50	100	31 (8)	50	100
Length of Residency	(years)	13 (12)	50	100	13 (9)	50	100
Household Income	(\$)	63,340 (38,134)	50	100	64,880 (39,805)	50	100
Gender	Male		24	48		18	36
	Female		26	52		32	64
Education	High School or Less		12	24		15	30
	College/University		38	76		35	70

Table 1 Socio-demographic Characteristics of the Study Sample

All Respondents	E/SE Asians	Hispanics	MANN-WHITNEY TEST				
	(n = 50)	(n = 50)					
	Mean (SD)	Mean (SD)	Mean	U-	Z-score	Exact Sign.	Effect Size
			Differ.	test		(2-tailed)	(r)
Current BMI**	22.8 (3.2)	27.3 (5.5)	- 4.5**	579.0	-4.62	.000	46
BMI at Arrival**	21.4 (3.2)	23.9 (3.9)	- 2.5**	690.0	-3.86	.000	38
BMI Change (%)**	5.6 (9.4)	10.9 (11.2)	- 5.3**	859.5	-2.69	.007	26
Weight Change (KGs)**	3.9 (6.7)	8.9 (9.4)	- 5.0**	807.5	-3.05	.002	30
BMI Change (%)** Weight Change (KGs)**	5.6 (9.4) 3.9 (6.7)	10.9 (11.2) 8.9 (9.4)	- 5.3** - 5.0**	859.5 807.5	-2.69 -3.05	.007 .002	2 3

Table 2 Group Comparisons of Weight-related Measures

** Significant at the 0.01 level * Significant at the 0.05 level

	E/3	SE Asians	ns Hispanics		MANN-WHITNEY		WHITNEY TE	ST	
	N	Mean (SD)	N	Mean (SD)	Mean	U-test	Z-score	Exact Sign.	Effect Size
					Differ.			(2-tailed)	(r)
Recent Immigrants									
Current BMI	17	21.7 (3.2)	9	24.8 (4.8)	-3.1	45.0	-1.69	.095	16
BMI at Arrival	17	21.0 (3.7)	9	23.6 (3.9)	-2.5	40.0	-1.96	.051	19
BMI Change (%)	17	3.1 (4.2)	9	3.4 (14.6)	3	73.5	16	.905	01
Weight Change (KGs)	17	1.6 (2.8)	9	3.2 (11.1)	-1.5	72.0	24	.821	02
Medium-Term Immigrants									
Current BMI	7	24.1 (2.0)	16	26.5 (6.4)	-2.4	43.0	86	.413	04
BMI at Arrival	7	22.2 (1.8)	16	24.2 (4.7)	-1.9	38.0	-1.20	.249	02
BMI Change (%)	7	7.3 (9.5)	16	7.8 (7.3)	5	54.0	13	.922	09
Weight Change (KGs)	7	6.0 (8.0)	16	6.0 (6.3)	0	52.5	23	.830	08
Long-Term Immigrants									
Current BMI**	26	23.2 (3.4)	25	28.7 (4.8)	-5.5**	114.0	-3.97	.000	39
BMI at Arrival**	26	21.4 (3.2)	25	23.9 (3.5)	-2.4**	176.5	-2.79	.005	27
BMI Change (%)**	26	6.7 (11.6)	25	15.6 (10.2)	-8.8**	175.0	-2.82	.005	28
Weight Change (KGs) **	26	4.7 (7.8)	25	12.7 (9.1)	-7.9**	153.0	-3.24	.001	32

Table 3 Group Comparisons of Weight-related Measures by Duration of Residence

** Significant at the 0.01 level * Significant at the 0.05 level

MODEL STATISTICS	X²	Sig.	NAGELKERKE R ²	%		
				CORRECT		
	38.526	.000	.428	71.0		
Predictors	В	S.E.	Wald	Sig.	Exp(B)	95% CI
ETHNICITY** (E/SE ASIANS)	2.171	.564	14.806	.000**	8.766	(2.901-26.486)
Gender** (Female)	1.825	.598	9.305	.002**	6.202	(1.920-20.031)
Age*	120	.051	5.633	.018*	.887	(.803979)
Age at Arrival	.112	.059	3.623	.057	1.119	(.997-1.256)
Education Level* (High School or Less)	-1.459	.664	4.828	.028*	.233	(.063854)
Annual Household Income	.000	.000	1.041	.308	1.000	(1.000-1.000)
IMMIGRATION STATUS (RECENT)			6.715	.035		
Medium-Term	1.179	.793	2.212	.137	3.251	(.687-15.379)
Long-term*	2.698	1.043	6.696	.010*	14.849	(1.924-114.602)
Constant	-1.465	1.329	1.214	.270	.231	

Table 4 Logistic Regression Model Results

** Significant at the 0.01 level * Significant at the 0.05 level

Reference categories in parenthesis.

	E/SE Asians					
		Male	Female			
	N	Mean (SD)	Ν	Mean (SD)		
Current BMI	24	24.0 (3.1)	26	21.7 (3.0)		
BMI at Arrival	24	22.4 (3.4)	26	20.5 (2.8)		
BMI Change (%)	24	6.3 (10.0)	26	4.9 (9.0)		
Weight Change (KGs)	24	4.8 (8.1)	26	3.0 (4.9)		

Table 5 Gender Differences in Weight-related Measures

Hispanics

		Female		
	Ν	Mean (SD)	Ν	Mean (SD)
Current BMI	18	28.9 (3.9)	32	26.3 (6.1)
BMI at Arrival	18	25.1 (3.6)	32	23.2 (3.9)
BMI Change (%)	18	12.3 (11.2)	32	10.1 (11.4)
Weight Change (KGs)	18	10.8 (10.0)	32	7.7 (9.1)

5. Second Manuscript

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Acculturation Strategies, Psychological Stress, and Obesity: Examining a Complex Association.

AUTHORS' NAMES:

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ABSTRACT

Although immigrants' obesity risk gradually increases after settling in industrialized nations, it is not clear how acculturation affects this health-transition, mostly because the literature has been dominated by simplistic proxy measures. In this study, we applied J.W. Berry's theoretical framework to examine the association between obesity, acculturation, and psychological stress. The study was conducted in the Waterloo Region, located in Southern Ontario, Canada, and data was collected between January and July 2015. A guestionnaire was administered with a sample of 100 first-generation Hispanic and East Asian immigrants. Body mass index, and changes in weight-status and lifestyle behaviours were self-reported. Acculturation strategies adopted by respondents were measured by adapting D.T. Barry's scale, which is based on a set of attitudinal and behavioural questions related to J.W. Berry's four adaptation strategies (assimilation, integration, separation, and marginalization). Stress-levels were determined by the Kessler Psychological Distress Scale (K6) comprised of six questions about an individual's emotional state. Pearson coefficients were computed to assess correlations, and nonparametric tests were used to evaluate group-based differences. In terms of acculturation strategies, Hispanics were significantly more integrated into society and less separated than East Asians. As to health outcomes, integration was positively correlated with BMI and weightgains, while psychological stress was positively associated with marginalization. Furthermore, participants with severe stress levels reported the highest BMI scores and the largest weight increases since arrival. Perceived changes in recreational and work-related physical activity were positively associated with higher degrees of assimilation, whereas trends for dietary behaviours were not consistent. Overall, results highlight the emergence of acculturative stress

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as a significant risk factor, and suggest that acculturation is a complex process with both beneficial and detrimental changes. Future research should rely on more complex multidimensional conceptualizations of acculturation, and further explore the interrelation between acculturative stress and obesity.

Keywords

Acculturation; Psychological Stress; Body Mass Index; Obesity; Physical Activity; Diet

INTRODUCTION

As a result of self-selection, health screening, and immigration policies, the health status of recent immigrants in Canada is significantly better than that of the Canadian-born population. However, similarly to other industrialized nations, with time, the physical health of immigrants deteriorates and eventually converges to Canadian-born levels [1, 2]. Research indicates that immigration to Canada is associated with an increased prevalence of some specific chronic conditions [3], a higher probability of being overweight or obese [4], and increased rates of depression [5]. Possible explanations for why immigrants' likelihood of becoming overweight or obese gradually increases since arrival include dietary acculturation, lifestyle changes, and the repeated exposure to migration-related psychosocial stressors, such as financial insecurity, language barriers, and social isolation [6]. However, the extent to which these health and behavioural transitions are affected by acculturation is still largely unknown [6].

Indeed, the process by which immigrants' cultural values and associated health behaviours change with greater acculturation remains largely unexplored. This is mostly because research on acculturation and immigrant health continues to rely on simplistic unidimensional models, which typically assume a linear progressive acquisition of the dominant values and attitudes of the host country [7]. Linear models presume that longer duration of residence has the same or similar effects across immigrant groups from different countries of origin, and a consistent impact on culturally-based health behaviours and attitudes [8], such as a uniform acquisition of the energy-dense dietary habits and sedentary lifestyles of the dominant group [9]. For this reason, proponents of the unidimensional models have usually measured acculturation through

proxy measures (such as length of residence, place of birth, and language proficiency) that fail to capture how immigrants may selectively adopt behaviours from the dominant culture, and simultaneously maintain some specific values of their original societies [10]. Recognizing that newcomers may retain their cultural roots implies accepting the possibility of multiculturalism and acknowledging that the effect of acculturation on health outcomes may rely on the degree to which immigrants maintain their culture of origin and at the same time embrace the cultural practices of their new host countries [11].

Thus, the purpose of this paper is to further examine the link between acculturation, lifestyle behaviours, psychological stress, and obesity in a multiethnic and inclusive society such as Canada by adopting the acculturation model developed by J. W. Berry that allows for multiple patterns of adaptation, such as biculturalism, and considers acculturation as a stress-coping mechanism. According to this view, acculturation can have both positive (for example, new opportunities) and negative outcomes (e.g., discrimination), and individuals can experience different levels of acculturative stress as a response to life events resulting from intercultural contact [12, 13]. In particular, Berry has argued that immigrants, depending on a variety of both individual and societal factors, are likely to engage in one of the following adaptation strategies: 1) assimilation: when individuals do not wish to maintain their cultural identity and seek daily interactions with other cultures, 2) integration: immigrants maintain a certain degree of cultural integrity, while becoming an integral part of the larger society, 3) separation: maintenance of ethnic traditions with no wish to interact with others, and 4) marginalization: no cultural or psychological contact with traditional culture or the larger social network [12, 13]. Consistent

empirical findings indicate that the pursuit of integration is least stressful, while marginalization is the most stressful strategy and is often associated with signs of anxiety and depression [13]. In this paper, we examine the association between the four adaptation strategies described by Berry and weight-status measures, psychological stress levels, and perceived post-settlement lifestyle behavioural changes; we also investigate to what extent these adaptation strategies differ between Hispanics and East/Southeast Asians, which were targeted because of the growing number of new immigrants coming to Canada from East Asian and Latin American countries [14], and their supposed contrasting post-settlement trends in obesity rates and lifestyle behavioural patterns [15-18]. To our knowledge, such an analysis represents a unique attempt in the literature to study the connection between acculturation and obesity, as we place acculturation within a theoretical framework, measure it with a multidimensional scale that considers attitudes and behaviours in a variety of situations, and correlate acculturation scores with indicators of weight status, mental health, and behavioural changes.

METHODS

Data Collection

The study was conducted in the Waterloo Region, in Southern Ontario, Canada, which is located about 100 km West of Toronto and includes the cities of Cambridge, Kitchener, and Waterloo. According to the 2006 Census, 1.7 percent of all Canadian immigrants reside in the area, and while immigrants and refugees have been traditionally of European origin, in more recent years the region has been experiencing an increasing number of immigrants coming from Asia, Latin America, and Africa, and predominantly from India and China [19]. Study participants were recruited with the help of seven local immigrant and religious associations, spread throughout the region to enhance the representativeness of the sample. A total of 100 participants were recruited, 50 in each of the two target groups (East/Southeast Asians and Latin Americans). Participants originated from a wide variety of countries, further enhancing the diversity of the sample. For East/Southeast Asians, this included from China, Taiwan, Hong Kong, South Korea, Japan, Vietnam, Laos, Cambodia, and Thailand; while Hispanic respondents originated from Mexico, Guatemala, Nicaragua, El Salvador, Costa Rica, Cuba, Colombia, Chile, Venezuela, Ecuador, Argentina, Peru, and Uruguay. To be eligible, respondents had to be at least 18 years old, and meet two additional criteria: 1) being a first-generation immigrant from either East/Southeast Asia or Latin America, and 2) having been in Canada for at least 6 months. A 41item questionnaire was administered in English and/or Spanish by the first author or in Mandarin by a bilingual translator, between January and July 2015. The questionnaire was first pilot-tested with 10 Wilfrid Laurier University Hispanic and East Asian graduate students to account for any cultural inconsistencies. The study was approved by the Research Ethics Board of Wilfrid Laurier University.

Measures

Acculturation was measured by adapting Barry's East Asian Acculturation Measure (EAAM) [20], which measures the adaptation strategies originally described by Berry [13], and includes both attitudinal and behavioural aspects of social interaction and communication styles (Table 1). For each of the four adaptation strategies (assimilation, 8 items; integration, 5 items; separation, 7

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items; and marginalization, 9 items), items are scored using a 7-point Likert-type scale (strongly disagree, disagree somewhat, neutral, agree somewhat, agree, agree strongly), while the total score is obtained by summing up the scored items; high scores indicate elevated degrees of assimilation, integration, separation, and marginalization [20].

Since direct measurements were not possible or feasible, body mass index was self-reported and calculated by weight in kilograms divided by the square of the height in meters (kg/m²) [21]. Participants were also asked to recall their height and weight at the time of arrival in order to estimate the magnitude of post-settlement changes in body mass index and weight status.

Psychological stress levels were measured through the Kessler Psychological Distress Scale (K6), which includes six questions about an individual's emotional state during the past 30 days. Each question is scored from 0 (none of the time) to 4 (all of the time). Scores of the six questions are then summed, yielding a score with a range of 0 to 24; high scores indicate high levels of psychological distress [22]; K6 scores were also classified into low stress (0-5), moderate stress (6-12), and severe stress (13-24) by applying cut-off points previously reported in the literature [23]. It is important to notice that the K6 scale was intentionally developed to limit the impact of socio-cultural differences by including items that function similarly across subgroups in terms of the expression of psychological stress on the reported distress score [24].

Perceived post-arrival behavioural changes, such as daily time spent sitting, physical activity in different settings (workplace, commuting, home, recreational), portion size, meal frequency,

and the consumption of a range of food types and beverages, were measured by developing and scoring 5-point Likert-type items (much less, less, no change, more, much more). In contrast, perceived diet dissimilarity was classified as exactly the same, very similar, similar, different, and very different, with higher scores indicating diets as being perceived as more different.

Individual measures included gender, age, age at arrival in Canada, and current education level and annual household income. SPSS statistical software was used to analyze the data. Pearson correlation coefficients were calculated to assess the statistical relationship between variables. Mean acculturation strategy values were compared by computing parametric (independent ttest) and non-parametric tests (Mann-Whitney), which produced identical results. However, as the assumptions of normality and homogeneity of variance were not met, only non-parametric test results are reported.

RESULTS

Table 1 shows the 29 specific items that comprise the four acculturation scales and their average scores for both target groups. The correlations among the scales (Table 2) are theoretically coherent and consistent with J.W. Berry's model [13]. Assimilation and integration were positively associated with each other (r=.44; p<.01), same for marginalization and separation (r=.27; p<.01). In contrast, significant negative correlations were found between assimilation and separation (r=-.45; p<.01), integration and separation (r=-.33; p<.01) and integration and marginalization (r=-.32; p<.01). Length of residency was positively associated

with integration (r=.31; p<.01), but also with separation (r=.20; p<.05), which suggests that a longer duration of residence did not necessarily imply a higher degree of socio-cultural integration. Besides, the strength of the correlations was not univocal when taking into account ethnicity; for instance, the association between length of residence and integration was significant only for Asians (r=.42; p<.01), and not for Hispanics.

As shown in Table 3, the two target groups varied considerably in terms of acculturation strategies, and the tests performed found these differences to be statistically highly significant. Although assimilation scores were similar, Hispanic participants were more integrated (mean=26.4, SD=4.4) than Asians (mean=22.5; SD=5.8), whereas Asian immigrants reported being more separated (mean=31.1; SD=8.1) than Hispanics (mean=27.8; SD=5.8). Differences by gender were even more pronounced. Female East/Southeast Asians were significantly more marginalized (mean=27.1; SD=10.6) than Hispanic women (mean=19.0; SD=7.4), while, regardless of ethnicity, males tended to be more assimilated and integrated, even though these differences were more evident for Asian participants.

In Table 4, acculturation scores and weight-related measures by psychological stress status are listed. Study participants classified in a severe psychological stress status reported the highest marginalization scores, as well as the largest BMI levels and weight gains since time of arrival. Besides, in congruence with J.W. Berry's notion of acculturative stress, marginalization was significantly positively associated (r=.32; p<.01) with distress levels (Table 5), supporting the hypothesis of an unfavourable mutual interaction between sociocultural isolation, mental

health, and obesity. However, while assimilation and integration appeared to be a protective factor against psychological stress, current BMI (r=.26; p<.01), percentage change in BMI (r=.21; p<.05), and average weight change in kilograms (r=.23; p<.05) were all significantly positively associated with integration, which suggests that the relationship between acculturation, stress, and obesity is complex, and may be mediated by several individual and contextual factors.

A wide range of additional correlations were explored in Table 5. Integration was positively associated with household income (r=.37; p<.01) and negatively associated with age at arrival (r=-.24; p<.05), indicating that immigrants with a higher income status and those ones who arrived in Canada at a younger age were more likely to integrate into mainstream society. In terms of perceived changes in lifestyle behaviours, assimilation was positively correlated with all four kinds of physical activity analyzed (Table 5). In particular, higher assimilation scores were significantly associated with perceived increases in physical activity at work (r=.20; p<.05) and in recreational physical activity (r=.20; p<.05). At the same time, more assimilated participants were more likely (r=-.22; p<.05) to perceive that their daily time spent sitting decreased after settlement.

When it comes to dietary patterns, we found that diet dissimilarity was positively associated with both assimilation (r=.27; p<.01) and integration (r=.26; p<.01), and negatively associated with separation (r=-.23; p<.05), which implies that immigrants with a higher degree of integration were more likely to perceive that their diets had changed since arriving in Canada. No significant correlations were found for daily portion size and meal frequency, and overall the

correlations for dietary patterns and food consumption were less consistent. For instance, separation was positively associated with both healthy perceived changes, such as an increase in fruits and vegetables consumption (r=.22; p<.05), and unhealthy changes, like an increased consumption of fast-foods (r=.27; p<.01) and sugary foods (r=.28; p<.01).

DISCUSSION

Several limitations should be considered when interpreting these results. To begin with, although findings can be used to generate hypotheses about causation, the data analysis was correlational and results should be interpreted as preliminary, and in need to be tested in a longitudinal design. Also, recall bias may affect results, as anthropometric measures were self-reported, and previous research has shown that in self-reported measures height tends to be overestimated, weight and BMI underestimated, and that demographic characteristics may influence the degree of reporting error [25]. Similarly, individual changes in lifestyle behaviours were not directly measured, but based on personal judgements and perceptions, and therefore subject to inaccuracies.

Despite these limitations, this study was able to contribute to the current literature in a number of ways. First, it supports the belief that immigrant groups may experience different patterns of cultural adaptation, and confirms the limitations of the most common proxy measures used in the public health research, as they may mask underlying differences in acculturation processes along ethnic, gender, and demographic lines. For this reason, our study supports the call for a more pervasive utilization of multidimensional acculturation scales that assume a greater individual degree of freedom, when it comes to the acquisition of the values of the dominant culture, and include a variety of attitudes, values, and behaviours related to the acculturation process [7, 10, 12].

Second, similarly to several previous studies [26], our findings indicate the existence of a positive association between higher degrees of acculturation and body weight measures. However, study results also show that acculturation may be linked to positive changes, such as an increased level of recreational physical activity, probably because over time immigrants improve their financial status, expand their social networks, and get exposed to new cultural norms and expectations [27]. In addition, acculturation was associated with perceived changes in traditional dietary practices. However, even though the literature has considered maintaining a traditional diet as a protective factor, the effects of nutrition transition are not clear yet [28], and a number of study participants reported following a healthier diet since arrival due to the positive influence of the Canadian culture. The inconsistency of the results in terms of dietary habits reaffirms the view of dietary acculturation as a complex, dynamic, and multidimensional process that can result in both detrimental and beneficial nutritional changes [29].

Finally, study results support the belief that balancing integration into the host culture with the preservation of the culture of origin is likely protective against psychological distress [30]. More generally, our findings substantiate the presumed association between mental health disorders and obesity [31]. As recently suggested, the genesis of obesogenic illnesses could depend on the cumulative exposure to long-term psychosocial stressors through the biobehavioral process

of allostatic load, resulting in excessive production of cortisol, increased blood pressure, and the consequent deposition of fat in the abdomen [32]. Therefore, our results draw special attention to the significance of the stressful life-experiences associated with the resettlement process, as they may worsen the mental health of immigrants [33], and eventually increase their risk of developing obesity through both physiological and behavioural processes.

CONCLUSIONS

Acculturation is not a univocal process. Rather than identically converging towards cultural assimilation and uniformly adopting unhealthy behaviours, individuals and ethnic groups may experience different adaptation processes. However, it is not clear yet how different degrees of sociocultural integration translate into obesity-related outcomes, and how these mechanisms are mediated by individual, group-based, and contextual factors.

To address these gaps, a more comprehensive measurement of acculturation is required. Future research should rely on more complex multidimensional conceptualizations of acculturation, and develop scales that capture a broad variety of cultural practices, include questions on attitudes about daily-life food habits and physical exercise, and assess to what extent immigrants identify with their native culture, use their native language, eat ethnic foods, and interact with members of their community.

Future quantitative but also qualitative studies should further explore the interrelation between acculturative stress and obesity, and the mechanisms that may induce immigrants to

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perform unhealthy stress-coping behaviours, such as emotional eating and the consumption of fatty foods [34]. Equally important is studying the intervening role played by ethnicity and race, as previous research has found that the relationship between mental health and overweight status differ according to ethnic group [35, 36].

The adoption of multidimensional models of acculturation and considering acculturative stress as an additional risk factor could also have significant clinical applications for preventive efforts [37]. For instance, this could assist in identifying socially marginalized immigrants who may be more vulnerable to post-immigration distress, or in expanding the scope of obesity preventive programs beyond just improving lifestyle behaviours to include helping immigrants build a social network and manage post-settlement-related feelings of anxiety and depression.

RESEARCH HIGHLIGHTS

- A more pervasive utilization of multidimensional acculturation scales is needed.
- Acculturation may be associated with increased levels of physical activity.
- Post-immigration dietary changes might be both detrimental and beneficial.
- Acculturative stress may increase the risk of developing obesity after settlement.

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TABLES

Table 2 Scale Items by Acculturation Strategy

ACCULTURATION STRATEGIES	HISPANICS	E/SE ASIANS
ASSIMILATION (8 items)	Mean (SD)	Mean (SD)
I write better in English than in my native language	2.46 (1.19)	2.40 (1.48)
When I am in my apartment/house, I typically speak English	2.86 (1.81)	2.84 (1.69)
If I were asked to write poetry, I would prefer to write it in English	2.08 (1.08)	2.54 (1.61)
I get along better with Canadians than with Asians/Hispanics	3.70 (1.54)	3.30 (1.58)
I feel that Canadians understand me better than Asians/Hispanics do	3.20 (1.49)	2.78 (1.40)
I find it easier to communicate my feelings to Canadians than to Asians/Hispanics	2.80 (1.42)	3.16 (1.57)
I feel more comfortable socializing with Canadians than I do with Asians/Hispanics	3.54 (1.47)	3.54 (1.71)
Most of my friends at work/school are Canadian	4.44 (1.78)	3.80 (2.05)
Total Score	25.1 (7.2)	24.4 (8.2)
INTEGRATION (5 items)	Mean (SD)	Mean (SD)
I tell jokes both in English and in my native language	4.22 (1.18)	4.02 (1.80)
I think as well as in English as I do in my native language	4.48 (1.72)	3.18 (1.79)
I have both Canadian and Asian/Hispanic friends	5.86 (1.06)	5.24 (1.50)
I feel that both Asians/Hispanics and Canadians value me	5.86 (1.19)	5.10 (1.24)
I feel very comfortable around both Canadians and Asians/Hispanics	5.94 (0.81)	4.96 (1.97)
Total Score	26.4 (4.4)	22.5 (5.8)
SEPARATION (7 items)	Mean (SD)	Mean (SD)
Most of the music I listen to is Asian/Hispanic	4.28 (1.80)	4.46 (1.96)
My closest friends are Asians/Hispanics	5.32 (1.57)	5.72 (1.10)
I prefer going to social gatherings where most of the people are Asian/Hispanic	4.32 (1.42)	4.80 (1.66)
I feel that Asians/Hispanics treat me as an equal more so than Canadians do	3.84 (1.46)	4.12 (1.72)
I would prefer to go out on a date with an Asian/Hispanic than with a Canadian	4.04 (1.60)	4.68 (1.59)
I feel more relaxed when I am with an Asian/Hispanic then when I am with a Canadian	4.64 (1.15)	4.98 (1.63)
Asians/Hispanics should not date non-Asians/Hispanics	1.38 (0.69)	2.38 (1.57)
Total Score	27.8 (5.8)	31.1 (8.1)
MARGINALIZATION (9 items)	Mean (SD)	Mean (SD)
Generally, I find it difficult to socialize with anybody, Asian/Hispanic or Canadian	1.98 (0.95)	2.86 (1.56)
I sometimes feel that neither Canadians nor Asians/Hispanics like me	2.16 (1.23)	2.32 (1.20)
There are times when I think no one understands me	2.66 (1.68)	2.52 (1.37)
I sometimes find it hard to communicate with people	2.58 (1.43)	2.84 (1.63)
I sometimes find it hard to make friends	2.32 (1.30)	2.96 (1.73)
Sometimes I feel that Asians/Hispanics and Canadians do not accept me	1.98 (1.15)	2.26 (1.24)
Sometimes I find it hard to trust both Canadians and Asians/Hispanics	2.54 (1.54)	2.66 (1.50)
I find that both Asians/Hispanics and Canadians often have difficulty understanding me	2.38 (1.33)	2.90 (1.61)
I find that I do not feel comfortable when I am with other people	1.84 (0.93)	2.36 (1.13)
Total Score	20.4 (8.3)	23.7 (9.8)

	ASSIMILATION	INTEGRATION	SEPARATION	MARGINALIZATION
ALL PARTICIPANTS				
Assimilation	1	.446**	454**	.003
Integration	.446**	1	331**	321**
Separation	454**	331**	1	.271**
Marginalization	.003	321**	.271**	1
Length of Residence	.072	.310**	.208*	022
E/SE ASIANS				
Assimilation	1	.501**	466**	.031
Integration	.501**	1	278	309*
Separation	466**	278	1	.242
Marginalization	.031	309*	.242	1
Length of Residence	.185	.425**	.263	168
HISPANICS				
Assimilation	1	.399**	446**	013
Integration	.399**	1	270	239
Separation	446**	270	1	.241
Marginalization	013	239	.241	1
Length of Residence	102	.177	.108	.204

Table 3 Correlations between Acculturation Strategies and Length of Residence

** Correlation is significant at the 0.01 level (2-tailed).*. Correlation is significant at the 0.05 level (2-tailed).

	E/	SE ASIANS	н	SPANICS	MANN-WHITNEY TEST		TEST	
ASSIMILATION	N	Mean (SD)	N	Mean (SD)	Mean Differ.	U-test	Z-score	Exact Sign. (2-tailed)
All Participants	50	24.4 (8.2)	50	25.1 (7.2)	72	1181.5	47	.636
Male	24	26.3 (8.7)	18	25.4 (6.7)	.93	204.0	30	.767
Female	26	22.5 (7.6)	32	24.8 (7.5)	-2.37	353.0	986	.329
INTEGRATION	N	Mean (SD)	N	Mean (SD)	Mean Differ.	U-test	Z-score	Exact Sign. (2-tailed)
All Participants**	50	22.5 (5.8)	50	26.4 (4.4)	-3.86**	769.0	-3.33	.001
Male*	24	23.6 (4.7)	18	26.5 (4.1)	-2.93*	135.5	-2.05	.039
Female**	26	21.4 (6.6)	32	26.2 (4.7)	-4.78**	247.0	-2.65	.007
SEPARATION	N	Mean (SD)	N	Mean (SD)	Mean Differ.	U-test	Z-score	Exact Sign. (2-tailed)
All Participants**	50	31.1 (8.1)	50	27.8 (5.8)	3.32**	865.0	-2.65	.008
Male	24	31.2 (6.8)	18	28.5 (5.3)	2.65	152.5	-1.61	.108
Female*	26	31.0 (9.4)	32	27.4 (6.1)	3.67*	290.5	-1.96	.049
MARGINALIZATION	N	Mean (SD)	N	Mean (SD)	Mean Differ.	U-test	Z-score	Exact Sign. (2-tailed)
All participants	50	23.7 (9.8)	50	20.4 (8.3)	3.24	1041.5	-1.45	.147
Male	24	19.9 (7.2)	18	22.9 (9.4)	-2.98	160.0	-1.45	.148
Female**	26	27.1 (10.6)	32	19.0 (7.4)	8.08**	227.5	-2.96	.003

Table 4 Ethnic and Gender Differences in Acculturation Strategies

** Correlation is significant at the 0.01 level (2-tailed).*. Correlation is significant at the 0.05 level (2-tailed).

Table 4 Psychological Stress, Weight-related Measures, and Acculturation Strategies

PSYCHOLOGICAL STRESS STATUS

ALL RESPONDENTS	LOW STRESS	MODERATE STRESS	SEVERE STRESS	
(N = 100)	(N = 51)	(N = 44)	(N = 5)	
PSYCHOLOGICAL STRESS	Mean (SD)	Mean (SD)	Mean (SD)	
Kessler Scale (K6) Score	2.4 (1.7)	8.1 (1.9)	17.4 (3.7)	
WEIGHT-RELATED MEASURES	Mean (SD)	Mean (SD)	Mean (SD)	
Body Mass Index (BMI)	25.0 (4.7)	24.8 (5.6)	26.9 (3.8)	
Body Mass Index Change (%)	8.3 (10.1)	7.8 (11.1)	12.1 (14.8)	
Weight Change (KGs)	6.3 (8.5)	6.0 (8.0)	10.0 (13.0)	
ACCULTURATION STRATEGIES	Mean (SD)	Mean (SD)	Mean (SD)	
Assimilation	25.2 (7.4)	24.5 (7.4)	21.2 (12.9)	
Integration	24.7 (5.2)	24.6 (5.5)	19.4 (6.9)	
Separation	28.6 (7.0)	29.9 (6.9)	33.8 (11.4)	
Marginalization	19.7 (8.3)	24.0 (9.3)	28.0 (11.5)	

ALL RESPONDENTS (N=100)	ASSIMILATION	INTEGRATION	SEPARATION	MARGINALIZATION	LENGHT OF RESIDENCY
DEMOGRAPHIC VARIABLES					
Age	.015	.081	.085	056	.675**
Age at Arrival	066	240*	105	034	201*
Education Level	034	078	253*	148	541**
Household Income	.127	.377**	128	293**	.326**
PSYCHOLOGICAL STRESS					
Kessler Scale (K6) Score	146	156	.166	.322**	075
WEIGHT-RELATED MEASURES					
Body Mass Index (BMI)	.079	.268**	.040	053	.184
BMI Change (%)	.040	.218*	.182	.115	.357**
Weight Change (KGs)	.076	.238*	.125	.066	.344**
CHANGES IN PHYSICAL ACTIVITY					
Physical Activity at Work	.204*	012	.081	.015	.154
Commuting-related Physical Activity	.179	048	242*	042	072
Physical Activity at Home	.103	.010	211*	113	.078
Recreational Physical Activity	.202*	.028	087	147	.036
Time Spent Sitting	224*	.036	.033	069	022
CHANGES IN EATING HABITS					
Diet Dissimilarity	.274**	.261**	236*	082	026
Portion Size	035	.080	.119	013	.169
Meal Frequency	047	.072	.080	.006	.077
Vegetables	020	057	.113	090	.107
Fresh Fruits	028	065	.221*	.008	.182
Sugar	154	102	.110	.077	257**
Deserts/Sweets	252*	121	.288**	041	082
Convenience Foods	063	.093	.024	048	112
Fried Foods	186	146	.187	.108	163
Fast-foods	175	.057	.274**	.045	.045
Soft Drinks	140	194	.101	.142	236*

Table 5 Correlations between Acculturation, Demographic Variables, Psychological Stress,Weight-related Measures and Perceived Changes in Lifestyle Behaviours

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

6. Third Manuscript

TITLE OF THE ARTICLE:

Exploring the Determinants of Weight Gains After Settlement in Canada: A Qualitative Study.

AUTHORS' NAMES:

Mr. Michele Vitale (First Author), Dr. Sean Doherty (Second Author).

ACADEMIC JOURNAL:

Ethnicity & Health.

ABSTRACT

Objectives. The main goal of this paper is to explore the perceived determinants of obesity and changes in lifestyles in East/Southeast Asian and Hispanic immigrants in an urban area of Ontario, Canada.

Design. Semi-structured interviews were conducted with 100 first-generation immigrants (50 for each target group), and 6 local health professionals. Open ended questions were meant to investigate immigrants' personal experiences in terms of post-arrival changes in weight status and lifestyle behaviours, and consider health professionals' views concerning the development of obesity among immigrant groups. Interview transcripts were analyzed to identify response themes.

Results. Due to working long and irregular shifts, both groups regarded lack of time as the most significant determining factor for post-arrival weight gains and detrimental changes in lifestyle behaviours. However, dietary adaptation clearly differed upon ethnicity; the majority of East Asians perceived their current dietary habits as similar to the ones in their home countries, while Hispanics were more likely to believe that their diets had changed since time of arrival. Hispanics were also much more likely to consider stress and depression as one of the main causes of weight gains, and described how feelings of loneliness and isolation led to increased consumption of sugary and fast foods. Regardless of ethnicity, weight gains appear to be more likely to happen during the first five years of residence.

Conclusion. Future research should further explore whether ethnicity and race play a role when it comes to the biological, physiological, and behavioural responses to stress, depression, and the alterations of circadian clocks. More qualitative and quantitative studies are needed to investigate the extent to which different patterns of cultural adaptation might result in diverse health behaviours and outcomes. Future preventive efforts should focus on those immigrants who work at nights or on rotating shifts, and include social integration strategies.

KEYWORDS: Obesity; immigration; shift work; stress; depression.

INTRODUCTION

Obesity is a very complex condition, and numerous uncertainties still characterize its current epidemiological and biomedical knowledge [1, 2]. The causal pathways that lead to obesity and link adiposity to health status are still unclear. The thrifty genes hypothesis assumes that over time the human body became very efficient in preventing weight loss, but somehow ineffective in avoiding weight gain; eventually the exposure to modern obesogenic environments of industrialized nations created a biology-environment mismatch, which caused genetically predisposed individuals (who may possess the thrifty genes) to become obese[3].However, the relative contributions of genetic predispositions remain in dispute, and most scholars agree that environmental, social, and genetic factors operate in a complex combination [4], which results in an increasing energy imbalance [5]. As suggested by ecological models, individual attributes (biological characteristics, psychological traits, personal attitudes, age, gender, income, education) mediate socio-political factors and contextual features, and shape weightrelated behaviours; nevertheless, the patterns and the underlying reasons of all these associations are not clear yet, and require further investigation [6, 7].

In addition, the overall level of uncertainty becomes even higher when considering ethnicity and acculturation. First of all, ethnic differences in body conformation (such as, bone density, chest width, pattern of gluteal-femoral fat) question the validity of body mass index (BMI) as a universal measurement of obesity [8]. Data suggests that different population groups may have different physiological responses to fat storage, and researchers now agree that there is no optimal BMI value that can be applied worldwide, as shown by people of South Asian ethnicity who tend to carry more adipose tissue (for the same level of BMI) then the general population, which may lead to an underestimation of obesity among South Asian groups [9]. Even though comparisons across ethnic groups are problematic, research shows that the prevalence of overweight and obesity varies by ethnic group, and obesity in ethnic minorities normally exceeds that observed in white populations, with the largest disparities observed especially among adult women [10].

There are also ethnic differences in the prevalence of health complications associated with obesity. For instance, in the United States, the estimated prevalence of insulin resistant syndrome tends to be greater in Mexican-Americans and African-Americans than in Caucasians, while the prevalence of obesity-related hypertension occurs at higher rates among African-Americans [11]. In terms of acculturation, evidence from various settings confirms that there is a positive relationship between body weight and time since immigration, however, research also suggests that the impact of duration of residence on weight status may vary by age at arrival, sex, and ethnicity, while the magnitude of weight gains, the timing, and the reasons behind changes in individual lifestyles remain elusive [12, 13].

In Canada, there is limited research on overweight and obesity among ethnic and immigrant groups; yet, the limited data available shows clear differences, and evidence indicates that the vulnerable situation of Aboriginals is particularly worrying. When considering birthplace, Hispanics have the highest self-reported prevalence of overweight and obesity, and this pattern is confirmed even when accounting for immigration status, with long-term Hispanic immigrants reporting the largest increase in weight status since time of arrival. Conversely, East/Southeast Asians have the lowest prevalence of overweight and obesity, and over time their weight status tends to remain low [14].

There is consensus among researchers that to better understand the statistical trends and associations found by quantitative studies, more qualitative approaches are needed; nevertheless, only few studies have documented the development of overweight with greater acculturation from immigrants' own perspectives [15].Hence, in this study, we investigated the perceived determinants of obesity in a sample of Hispanic and East Asian immigrants, in an urban area of Ontario, Canada. The aim was encouraging immigrants and local health professionals to discuss the motivations behind post-arrival changes in weight status and lifestyles, in order to identify possible explanations for the ethnicity-based differences found in the literature. The insights obtained can inform future obesity prevention efforts.

METHODS

Setting and Recruitment

The study was conducted in the Waterloo Region, an area located approximately 100 km West of Toronto, in Southern Ontario, Canada, which includes the cities of Cambridge, Kitchener, and Waterloo. The region has a long-established history of immigrant and refugee settlements and, according to the 2006 Census, is home to 1.7 percent of all Canadian immigrants, making it the ninth largest in terms of national share. Despite the traditional dominance of European-origin groups, in more recent years the region has been experiencing a growing number of immigrants from Asia, Latin America, and Africa, with the largest number coming from China and India [16]. Respondents were recruited with the help of seven local immigrant and religious associations, spread throughout the region to enhance the overall representativeness of the sample. Eligibility criteria included: 1) minimum of 18 years of age, 2) being a first-generation immigrant from either East/Southeast Asia or Latin America, and 3) having been in Canada for at least 6 months. The Research Ethics Board of Wilfrid Laurier University approved this study; informed consent was obtained from all respondents.

Data Collection

Personal semi-structured interviews were held between January and July 2015. Interviews were conducted by the lead author in English and/or Spanish, or by a bilingual translator of Chinese descent in Mandarin. Most interviews took place at local partner organizations' venues. Other locations included informal settings, such as commercial establishments where immigrants tend to congregate, and respondents' homes. A total of 100 immigrants, 50 in each of the two target groups, were interviewed to explore their personal experiences in relation to changes in weight status and lifestyle behaviours after arrival in Canada. Participants originated from a wide variety of countries, further enhancing the diversity of the sample. For East/Southeast Asians, this included from China, Taiwan, Hong Kong, South Korea, Japan, Vietnam, Laos, Cambodia, and Thailand; while Hispanic respondents originated from Mexico, Guatemala, Nicaragua, El Salvador, Costa Rica, Cuba, Colombia, Chile, Venezuela, Ecuador, Argentina, Peru, and Uruguay. Open-ended questions included: *"If you gained weight since coming to Canada, why is that?*"

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and "If you think that your diet has changed, what are the most important reasons?" Respondents were encouraged to expand on subjects of particular interest to them.

To acquire their qualified opinions regarding the development of obesity among immigrant groups, interviews were conducted with six health professionals employed in local community health centers, including family outreach and peer health workers, registered dieticians, and a psychotherapist. Questions included: "What are the main challenges that immigrants face after arriving in Canada in terms of following a healthy diet and being physically active?" and "What could be done to avoid immigrants becoming overweight and obese?"

During interviews, verbal responses were recorded in field notes, and quotations written verbatim. Transcriptions of interviews were then subject to a content analysis to identify common themes voiced by respondents and their frequency. Themes are italicized in the text for emphasis. Example supporting quotes are provided to illustrate the themes. Participants also provided information on demographic background and perceived diet similarity, which was measured through a Likert-type scale, and classified as exactly the same, very similar, similar, different, and very different.

RESULTS

As shown in Table 1, the two samples were socio-demographically comparable. Median age and age at arrival were quite similar, and both groups reported high percentages of respondents holding at least a college degree. Median household income was marginally higher for Hispanic respondents, while average length of residency in Canada was identical (13 years). Response themes and the corresponding frequencies and percentages of both Hispanic and East Asian participants reporting them are presented in Table 2, while Tables 3-12 illustrate supporting quotations, which are tagged with codes (e.g. R20M-H: Respondent 20, Male, Hispanic; HP06: Health Professional 6).In Tables 3-12, supporting quotes are also divided into several subthemes.

Response Theme: Time Constraints

For both target groups (74% of Hispanic and 36% of Asian respondents), time constraints were the most frequently reported cause for weight gains and changes in lifestyle behaviours. These results suggest that, right after arrival, immigrants report the need to focus on other priorities in order to manage the challenges posed by the settlement process, which leaves little time and energy for making healthy food choices and exercising (Table 3).Besides, after settling down, immigrants are more likely to find low-wage and demanding jobs that often lead to unhealthy eating and exercise habits. For instance, a number of respondents described how working long shifts and irregular schedules might limit the time available for recreational physical activity and food preparation, which may eventually induce detrimental meal patterns, such as, consuming pre-made meals and fast-foods, having dinner too late, and snacking on the go too often (Table

3).

Response Theme: Cold Weather

Immigrants seem to struggle to adapt to the cold Canadian winters, especially those from tropical countries. Indeed, 58% of Hispanic respondents, and 20% of Asians, reported at least one classic symptom of seasonal affective disorder, such as increased appetite, craving sugary foods, and loss of interest in outdoor recreational activities (Table 4). In addition, even when immigrants do not get discouraged by the weather and would like to be active, they may not have the practical skills and the equipment required to engage in typical Canadian winter sports, such as skating, skiing, and hockey.

Response Theme: Adapting to Obesogenic Environments

The more pervasive diffusion of unhealthy food options was a challenge for 52% of Hispanics, but only 20% of Asian respondents. As described by the supporting quotes in Table 5, highly processed foods and soft drinks are perceived to be relatively less expensive and more physically accessible. Immigrants also reported an increased exposure to unhealthy food advertising, coupled with a desire to try new foods, mostly fast-foods and sweets. Similarly, Hispanics (34%) were more likely than Asians (12%) to highlight the difficulty to find fresh fruits and vegetables, while finding traditional ingredients seemed to be an issue mainly for the most recent newcomers, still unfamiliar with local ethnic grocery stores. Overall, dietary adaptation clearly differed upon ethnicity. As shown in Figure 1, East Asians were more likely to perceive that their diets in Canada were similar to their traditional eating habits, and 58% of them considered their current diets as similar, very similar, or even identical to the ones in their home countries. Several East Asian respondents explained how the widespread diffusion of

ethnic grocery stores and supermarkets allows them to easily acquire traditional ingredients, while the facility to develop ethnic social networks promotes the preservation of their Asian food cultures through social gatherings and the celebration of festivities (Table 6). In contrast, the majority of Hispanic respondents (72%) perceived their eating patterns as different or very different, and health professionals emphasized the propensity of Hispanic immigrants to adjust quicker than other groups to a typical North American diet (Table 6). Finally, a comparable percentage of Asian (34%) and Hispanic respondents (30%) outlined the increased need to drive to reach their workplaces and run daily errands, when compared to their home countries where they used more active forms of transportation, like walking and biking.

Response Theme: Stress and Depression

Interviews with immigrants and health professionals indicate the absolutely critical role played by stress and depression. However, only a small percentage (4%) of Asians perceived mental health as an issue in terms of weight gains, compared to 38% of Hispanic respondents. As shown in Table 7, the stressful situations faced during the settlement process affect immigrants' mental health, and respondents described numerous psychological stressors, such as: a still precarious immigration status, lack of English proficiency, the need to adjust to a new culture and cold climate, a reduced socioeconomic status, a faster work pace, feelings of loneliness, isolation, homesickness, and boredom. Especially, Hispanic respondents reported to compensate their anxiety, unhappiness, and depression by eating emotionally, and/or to try to improve their emotional states by increasing the consumption of 'comfort foods', such as high fat and/or high-sugar foods. Less physical activity and reduced sleep were also mentioned as common obesity-leading stress-coping behaviours. Health professionals outlined the existence of other common serious chronic stressors, like perceived discrimination, domestic violence, conflicting parent-child relationships, and post-traumatic stress, and explained that although refugees coming from war-torn countries are more likely to suffer of post-traumatic stress disorders, landed immigrants are more inclined to experience depression, since their higher expectations of a better quality of life in Canada are frequently not met (Table 8). Most concerning is that the depression-obesity cycle tends to be self-reinforcing (Figure 2), and both respondents and health professionals explained how gaining weight may affect immigrants' self-esteem and self-perception, which in turn worsens the depression symptoms and increases the risk of becoming overweight (Table 8). When interpreting these results, it is important to highlight the overall reluctance showed by East Asian respondents to admit mental health issues, which may at least partially explain the differences found in this study in terms of stress and depression.

Response Theme: Financial Constraints

For 20% of Hispanics and 8% of Asians, the higher cost of fresh fruits and vegetables in Canada was a deterrent to purchasing these items, often replaced by an increased consumption of fast foods and canned foods. As health professionals have underlined (Table 9), when facing financial insecurity, economic convenience, rather than nutritional quality, is often the criterion that dictates immigrants' food choices. Nevertheless, even a higher income may be insufficient in absence of adequate nutritional information, since above all immigrants with a lower

educational attainment may be likely to spend their additional earnings on high-calorie foods, whose consumption is associated with social status in their home countries.

Response Theme: Social Norms

As shown in Table 10, the two target groups described different social norms defining acceptable body weight ranges. Overall, Hispanic respondents tended to show more positive attitudes towards overweight, explaining how the importance of eating as a source of socialization in their cultures may encourage them to maintain their weight. On the contrary, East Asians were more likely to highlight the need to conform to idealized thin body weights. However, the exposure to social pressure to be thin from media, peers, and relatives was mostly reported by young women, and in particular by female university students.

Response Theme: Health Literacy

Regardless of ethnicity, health professionals highlighted how lack of heath information often prevents immigrants to access social and health services and make healthier choices (Table 11). Because of language and cultural barriers, low educational level, and unfamiliarity with the Canadian health system, immigrants are frequently unable to acquire the information needed to prioritize nutrition and physical activity. The situation is particularly concerning for immigrant families with children, as especially less-educated parents may lose control over their children's food consumption and be unable to restrain their growing preference for unhealthy snacks and beverages.
Response Theme: Timing of Weight Gains

The first years after arrival appear to be crucial for both groups. As shown in Figure 3, 44% of Hispanic respondents (and 6% of Asians) stated to have started to gain weight during the first five years of residence. Overwhelmed and distressed by settlement issues, recent immigrants tend to overlook their health conditions, and often do not realize that their eating and exercise habits have been deteriorating since time of arrival (Table 12). Typically, immigrants become more health conscious only after experiencing negative physical symptoms or being diagnosed with an obesity-related condition, such as diabetes and hypertension. In other cases, it is the need to be a positive role model for their children's health that persuades immigrants to seek professional help and educate themselves on how to follow a healthier lifestyle.

DISCUSSION

To our knowledge, this qualitative study is the first in Canada to provide a detailed exploration of the causal mechanisms responsible for post-arrival weight gains by assessing and comparing individual perceptions in two immigrant groups that appear to present divergent trends of postsettlement obesity rates. Although the sample is of modest size and from only one region, such studies are most valuable in exploring causation and framing future studies on new topics of exploration such as this.

The qualitative analysis of the results allows the formulation of hypothetical explanations for the observed differences in obesity levels. Lack of personal time due to working long, demanding and irregular shifts was regarded by both target groups as the most significant cause of changes in lifestyles and weight status. Studies have found higher BMI levels and weight gains among late and rotating shift workers than daytime workers [17, 18], and, although the motivations for the correlation between shift work and obesity are still unclear, it is likely that several mechanisms are at play, such as alterations of eating patterns (eating more sugary foods, having a late daytime meal, tendency to nibble more frequently), lower physicals exercise, changes in sleeping habits, and the disruption of the normal circadian rhythm [19]. The circadian rhythm is synchronized around a 24-hour period, and ensures that various behavioural and physiological processes in the human body (such as the sleep-wake cycle, feeding behaviour, cortisol hormone secretion, and body temperature) occur at the most appropriate time[20].Recently, researchers have discovered circadian clock genes that regulate circadian rhythms [21] and the existence of genetic variations in a number of core clock genes across ethnic groups, probably related to the dissimilar conditions of natural lightning under which different populations have evolved [22]. A possibility is that the diverse distribution of circadian clock genes among ethnic groups may be a contributor to racial/ethnic disparities in obesity levels, and future research should explore whether different ethnic groups may experience different physiological and behavioral responses to the disruption of circadian clocks.

Another possible explanation for the differences in obesity prevalence might be related to the process of dietary adaptation. In this study, East Asian respondents were much more likely to perceive that their eating habits had not changed since time of arrival, given the pervasive diffusion of ethnic grocery stores and the easiness to keep ethnic social networks. This finding is

compatible with the idea that the lower obesity rates of Chinese immigrants in Canada might be the result of the large population and spatial concentration of their communities, which may reduce the likelihood to acquire unhealthy Canadian lifestyles [23, 24].Nevertheless, even if maintaining a traditional diet has been regarded as a protective factor, the effects of nutrition transition are still unclear [25], and dietary acculturation may determine both detrimental and beneficial nutritional changes[26]. Thus, future studies should further investigate how different patterns of cultural and dietary adaptation might result in diverse health behaviours and health outcomes.

Ethnicity-based differences in obesity prevalence could also be explained by mental health issues. Interviews highlighted the significance of the stressful life-experiences associated with the resettlement process, confirmed the high prevalence of psychological stress among immigrants and refugees [27], and supported the existence of a reciprocal link between depression and obesity that may operate through both psychological and biological pathways [28]. Indeed, research suggests that the origins of obesogenic illnesses among minority groups could be determined by the repeated exposure to long-term psychosocial stressors, which may trigger (via the bio-behavioural process of allostatic load) an excessive production of cortisol, and result in the deposition of fat in the abdomen [29]. Previous research has also found that the relationship between mental health and obesity differ according to racial/ethnic status and nativity [30, 31]. Thus, future studies should further investigate the intervening role played by ethnicity and race, and verify whether ethnic groups may experience different physiological responses to chronic stress. Equally important is studying the mechanisms that may induce

immigrants to perform unhealthy stress-coping behaviours, such as emotional eating and the consumption of fatty foods [32].

Finally, a significant finding regards the timing of post-arrival weight gains. Contrary to other studies that have found the existence of a threshold effect indicating a substantial increase of body mass index only after ten years of residence [33], our results suggest that weight gains are more likely to happen in the first five years after settlement, and that this trend appears to be consistent across ethnic groups.

CONCLUSIONS

In an increasingly diverse and multiethnic Canada, understanding ethnic-specific risk factors is a prerequisite for developing effective obesity intervention strategies and targeting the foreign groups most at risk to develop obesity disorders and associated conditions. Yet, regardless of ethnicity, future prevention efforts should focus on those immigrants who work at nights or on rotating shifts in order to provide appropriate recommendations on food choices, meal/snack times, time management, sleep habits, and exercise. Obesity preventive programs should also provide mental health support. It is important to assess and monitor individual stress levels, and include social integration strategies to link families to their communities and build up a social network. Also important would be providing adequate nutrition information and paying special attention to immigrants with a lower educational background. Finally, efforts should be made to ensure that appropriate interventions are implemented early in the resettlement

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process, which may greatly help prevent the development of obesity among recent immigrants to Canada.

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TABLES

		E/SE Asians				Hispanics			
		(n = 50)			(n = 50)				
		Mean	SD	n	%	Mean	SD	n	%
Current Age (years)		45	14	50	100	44	10	50	100
Age at Arrival	(years)	31	11	50	100	31	8	50	100
Length of Residency	(years)	13	12	50	100	13	9	50	100
Income	(\$)	63,340	38,134	50	100	64,880	39,805	50	100
Gender	Male			24	48			18	36
	Female			26	52			32	64
Education	High School or Less			12	24			15	30
	College/University			38	76			35	70

Table 5 Demographics Characteristics of the Study Sample

	HISPANIC	S	E/SE ASIANS			
	(n = 50)		(n = 50)			
Response Themes	Frequency	%	Frequency	%		
Time Constraints	37	74	18	36		
Cold Weather	29	58	10	20		
Unhealthy Food Options	26	52	10	20		
Stress & Depression	19	38	2	4		
Hard to Find Traditional/Fresh Foods	17	34	6	12		
Need To Drive Everywhere	15	30	17	34		
Expensive Healthy Options	10	20	4	8		
Winter Activities Less Accessible	9	18	0	0		
Desire To Try Something New	7	14	4	8		
Eating Outside As Less Convenient	0	0	18	36		

Table 6 Motivations for Weight Gains and Behavioural Changes.

Table 3 Supporting Quotations: Time Constraints.

Need to focus on other priorities.

- "When you first arrive here, you tend to focus on other issues, like housing and finding a job; so, you do not focus enough on eating healthy and exercising. Only after dealing with those issues, being healthy and active becomes a priority" (R20M-H).
- "When I got here, I had to take care of more important things; this is why I did not pay too much attention to exercising. There are other priorities, and money is spent on more important issues, rather than for instance buying a gym membership" (R25F-H).

Working long shifts.

- "Hispanics in Canada gain a lot of weight. They have jobs in factories that do not give them the time to exercise and eat healthy. Because they do not speak English well, they have to accept any kind of job, which kill them physically and emotionally" (R37F-H).
- "When we [Hispanic immigrants] get here in Canada, we do not have time to play sports and eat healthy, because we have to focus on working long shifts" (R09M-H).

Having dinner too late.

 "Here in Canada, eating times are different; I feel there is no order. I have to adjust the time of our meals to my husband's job schedule. For us, the problem is having too much food for dinner. It is too late, and there is no time to burn those calories, because after dinner, we go straight to bed" (R57F-H).

Eating and snacking too often.

- $\circ~$ "In Canada, people eat more often; Canadians eat all the time. Instead, in Guatemala, we have only three meals' (R18M-H).
- "I do not like when Canadians have their meals; I am not used to it. Because of my job, I cannot be disciplined, and I always end up eating and snacking too often; it is not healthy" (R12F-H).

Faster work pace& fast-foods.

 Here in Canada, they push us [Vietnamese workers] a lot. At work, you have always to be on time and productive. I work too much here. This is why people here have fast-food so often; because it is faster. I do the same thing" (R74M-A).

Table 4 Supporting Quotations: Cold Weather.

Cold weather & seasonal depression.

- "I believe that depression is also caused by the weather. Many immigrants come from tropical countries and never had to deal with such a cold weather. They have no ideas of what is going on" (HP06, peer health worker).
- "The cold weather is a big challenge for many Hispanic immigrants, and seasonal depression is a very common disorder" (HP03, psychotherapist).

Cold temperatures & eating more.

"After arriving in Canada, I did gain weight because here it is cold and it made me feel like I wanted to eat more often" (R89F-A).

Feeling too cold to exercise.

- "When I got here, the new life emotionally affected me. The change was terrible; I was sad, I felt homesick, and I missed my family. I come from a warm country, and I was not used to go out in winter time. I did not feel like exercising. Now, I do not care about it anymore, and I go out even when it is very cold" (R24F-H).
- "I believe that I exercise less in Canada because of the cold. In Cuba, we are almost always outside on the beach. You sweat a lot and burn lots of calories. Here, I do not spend much time outside" (R15M-H).
- "In my opinion, the main reason why immigrants become overweight is because of their sedentary lives. The winter here it too long, and many immigrants are not used to it and spend so much time in their house" (HP06, peer health worker).

Lack of skills to practice winter activities.

 "At the beginning, my wife and I did not have the skills and the equipment required to exercise during the winter time (for instance, skiing and skating). We also felt that it was too cold to be active during the winter. Only after three years, we started to exercise. We became determined to learn and bought the equipment" (R06M-H).

Table 5 Supporting Quotations: Adapting to Obesogenic Environments.

Unhealthy options are more accessible.

- "Here in Canada, unhealthy options, like fast-foods, are more accessible both economically and physically. There is also much more advertising of those options, and when you arrive here you feel like trying something different. Only after a while, you realize that those options are not healthy`` (R06M-H).
- "Here in Canada, the eating culture is different. There are sweets and soft drinks everywhere. In Taiwan, it is different. For instance, when you go to a restaurant, they always serve tea" (R92F-A).

Desire to try new food items.

- "When I got here, I wanted to try foods that were new to me, like donuts, muffins, and maple syrup. I also got used to eat more. Only after going back to Chile for the first time, I realized that I was gaining too much weight" (R14F-H).
- "When I arrived in Canada, I discovered Harvey's and poutine. I loved having burgers and poutine; I was kind of addicted" (R39F-H).
- "When I got here, I loved McDonald's; I used to go there a lot. It was something new, and I wanted to try. After a while, I started to gain weight and feel bad physically. After six months, I changed my behaviour. I started to read articles and talk to people about how to follow a healthy diet. Even now, I keep trying to educate myself on how to be healthier" (R22F-H).

Table 6 Supporting Quotations: Adapting to Obesogenic Environments.

Keeping traditional diets.

- "In my opinion, there is no overweight or obesity in the Vietnamese community, because we keep eating exactly the same way as in Vietnam. We buy raw ingredients from two local Vietnamese stores, and then we cook them at home" (R74M-A).
- "I have the impression that in Canada Chinese people try to stick with their traditional diet, because they think it tastes better. Food is very important in our culture. Instead of going out we prefer to get together and cook Chinese food" (R01F-A).
- "My wife and I prefer home cooking, because at home we can cook Vietnamese food. So, we try to cook at home as much as possible; it is tastier, healthier, and less expensive" (R81M-A).

Easy to find traditional ingredients.

 "My diet has not changed much, because here there are many Chinese grocery stores. It is very easy to find traditional ingredients; you can almost get anything from China easily" (R11M-A).

Ethnic social networks.

"Here in Canada, most of my friends are Chinese; so, it is very easy to maintain our traditions. I love cooking Chinese food, and I am not interested in Western cuisine" (R02M-A).

Hispanics tend to diversify their diet the most.

 "My impression is that Hispanics are the immigrants who tend to diversify their diet the most. They seem to be more likely to adjust to a typical North American diet. When they access our food program, usually they tend to pick precooked foods, craft dinners, and canned foods. On the other hand, Asian immigrants tend to be more strict, and are more likely to stick with their traditional diets" (HP05, food program coordinator).

Table 7 Supporting Quotations: Stress and Depression.

Settlement-related stress.

 "For the first three/four years, all the stress associated with settling in Canada, like learning English and getting the papers to apply for a humanitarian visa, made me gain more weight. When we finally settled down, I started to feel calmer. My meal schedule became normal again, and I started to lose weight" (R37F-H).

Struggling to find an adequate job.

 "In Colombia, I had my family and friends, a good job, and a different social level. We had to leave because of the violent political situation. Here in Canada, I struggle with depression and anxiety every day. I started to get anti-depressants. I do not have a real job; I feel lonely. I spend a lot of time by myself; so, I just have time to eat`` (R44F-H).

Loneliness and eating sweets.

 "When I arrived in Canada, I could not speak English. I felt lonely, because I did not know anybody. It was a psychological shock. I started to eat sweets and cookies. The first two months, I gained seven KGs. Then, I got diagnosed with diabetes, and I had to change my diet and physical activity" (R05F-H).

Boredom and eating sweets.

 "When I arrived in Canada, I felt like a baby. People used to treat me like I knew nothing. Everything was more difficult: the cold, the isolation, the boredom. I used to spend lots of time by myself at home. So, I started to kill time by cooking and eating cookies, cakes, and empanadas" (R14F-H).

Loneliness and eating emotionally.

- "I know that I eat emotionally. I feel homesick, and I miss my family. I feel that this situation is affecting the way I eat. I spend more time in my house by myself, and whenever I do it, I eat more" (R30F-H).
- "When I got to Canada, I felt lonely and depressed. I missed my family, my culture, and my friends. So, I gratified myself by eating more. Even now, I feel this is a problem for me" (R31F-H).

Table 8 Supporting quotations: Stress and Depression.

Landed immigrants vs. refugees.

- "It is important to make a distinction between refugees and landed immigrants. The general perception is that only refugees have problems, but in my experience, this is not true. Most refugees come from very difficult situations, and thus coming to Canada cannot be any worse. On the other hand, landed immigrants chose to come here, and they do so with very high expectations, which eventually are not met. To begin with, for landed immigrants, it is much harder to get any kind of financial support from the government. Besides, psychologically, it is more difficult for them, because if they do not find a job, they cannot blame anyone. It is just because they do not know how to speak English well" (HP06, peer health worker).
- "While refugees have no choice, independent newcomers come here to improve their lives based on their own decisions. However, they are not psychologically prepared. Once they arrive here, many of them are able to find only survival jobs, despite their educational background. For them, it might be a huge disappointment. Their expectations are not met, and their lifestyles can be even worse than in their home countries. Eventually, some of them decide to go back" (HP04, family outreach worker).

Depression-overweight as a vicious cycle.

- "Cheap and unhealthy foods make immigrants become overweight, which in turns makes them feel sad. At the same time, they also feel sad because they cannot provide healthy options to their kids. It is a vicious cycle. Tell me, how can immigrants not become depressed?" (HP06, peer health worker).
- "Psychological distress is very common among immigrants. The impact of settlement has a huge effect on immigrants' well-being. Eventually, they start to eat emotionally; it is like a domino effect. Finally, gaining weight affects their self-perception and self-esteem, which in turn worsens their depression" (HP02, community health worker).
- "When I was in Mexico, I never worried about my weight. In Canada, I think about it every day. I went to see a naturopath, and I got several books on nutrition. I keep trying to lose weight, but I cannot make it. I feel frustrated, because I keep gaining weight, and this affects my self-esteem" (R30F-H).

Table 9 Supporting Quotations: Financial Constraints.

Healthy food options are more expensive.

"When we arrived in Canada, everything was much more expensive. So, my wife and I started to eat a lot of canned foods, because it was cheaper. As a result, in the first eighteen months, both my wife and I gained weight. Eventually, we made a conscious decision to change our diets, and consume less canned foods and salt" (R20M-H).

Expensive healthy options as a source of stress.

 "When I go to buy food, I get stressed, because it is very expensive to follow a healthy lifestyle. So, I always end up buying cheaper foods, which makes me worry about my health and the health of my kids" (R30F-H).

Quantity vs. quality

• "For immigrants, the financial component is crucial. Usually, they do not care about the quality of food, but rather the quantity. It is cheaper to get a large bag of chips than healthier food items" (HP02, community health worker).

Higher income as a negative factor.

 "Food here in Canada makes you get fat faster, because we [immigrants] have more access to fast food restaurants. On average, our income is higher here in Canada than what it was in El Salvador; now we have the opportunity to eat out more often, but because of lack of education, we make unhealthy food choices" (R26M-H)

Table 10 Supporting Quotations: Social Norms.

Being overweight as socially acceptable.

- "In Mexico, a healthy kid is a chubby kid. Besides, in our culture, once you get married, there is no need to worry about your weight" (R20M-H).
- "Among Hispanics, eating is something social; we prefer the socialization of food. It is an inseparable relation. If the consequence is being overweight, it is not a big deal. It is socially acceptable to be overweight. However, at the same time, the media promote the idea of an ideal weight. So, there is a contradiction, especially for women" (R21M-H).
- "For Hispanics, eating is a pleasure. Going all together to have dinner out, cooking together, bringing food to social gatherings. Food is a source of socialization. It is not part of our culture to pay attention to what we eat" (R22F-H).

Peer pressure to lose weight.

- "In China, appearance is very important for a girl, especially to find a good job and a husband. Guys like very skinny girls: the skinnier, the better. So, girls fight all the time with their weight. Whenever you meet up with a girlfriend, weight is always one of the first topics of conversation. Teenagers feel ashamed of being overweight, because people would make fun of you" (R01F-A).
- "In China, people judge you based on your weight, and this is true especially for girls. Guys have ideal weights for girls. There is lots of pressure from social media and peers, much more than here in Canada. In China, whenever people have a conversation, it is very common to ask each other's weight" (R40F-A).
- "In China, people are always talking about weight. You feel like an indirect pressure from your peers to be skinny. Here in Canada, I do not feel the same pressure (R51F-A).
- "In South Korea, it is very important to be skinny and in shape. I feel that here in Canada, it does not matter that much (R79F-A).

Table 11 Supporting Quotations: Health Literacy.

Language barriers to access social & health services.

 "In my opinion, lack of information is the biggest struggle for newcomers, especially for those ones with a low educational level. Since they often face significant language barriers, newcomers frequently do not know what social and health service are available to them" (HP02, community health worker).

Lack of familiarity with the Canadian health system.

 "Another issue is that our Canadian health system is increasingly based on a selfmanagement concept. People need to be in charge of their health, and whenever they go to see a doctor, they have to be informed and prepared. In this view, the individual lifestyle assumes a crucial importance. However, this is a totally new approach for many newcomers, who are used to a more passive approach" (HP02, community health worker).

Parents' lack of nutritional information.

 "Parents are very concerned about their children's eating behaviours, because they do not know the nutritional value of foods that are new to them. For immigrants, it is even harder than the rest of the population to access nutritional info and understand what food options are available to them" (HP01, registered dietician).

Children's preference for unhealthy foods.

- "For younger Vietnamese, like the ones who were born here in Canada, it is different. They love fast food, pizza, and coke. They do not want to eat traditional Vietnamese food. We, the older generations, usually cook rice and fish, but the younger generations prefer Canadian foods" (R74M-A).
- "Keeping traditional diets becomes more difficult for some families, because their children want to keep up with the Canadian culture and have typical Canadian foods. Children tend to like chips, pop, and most of frozen processed pre-packaged foods. These foods are basically everywhere, and food companies market these foods especially to kids (HP01, registered dietician).

Table 12 Supporting Quotations: Timing of Weight Gains.

First years are crucial.

- "The first two years, I gained 5 KGs. I wanted to try something new, especially sweets. Whenever we had a social gathering, I used to eat a lot of donuts and brownies, and drink soda. I was also not exercising enough. After a while, I started to notice that I was not eating properly. So, I decided to change my diet and exercise more" (R25F-H).
- "When we arrived in Canada, for the first two months, we lived in a refugee shelter, where we had mostly canned foods; so, I gained 5 KGs" (R37F-H).

Becoming more health conscious.

- "During the first five years, I did not exercise. My diet was based on fried and canned foods, and pasta. I had to eat outside a lot because of my work. My weight was more than 100 KGs; I felt bad physically, and I could not even breathe. I needed help, and my wife convinced me to consult a nutritionist. Since then, my wife and I spend a lot of money on healthy foods and try to follow a healthier diet" (R23M-H).
- "I started to become more health conscious only after having health problems because of my unbalanced diet. I understood that I had to be proactive. So, I started to pay much more attention to what I was eating. My father helped me a lot. Now, I keep reading to educate myself" (R24F-H).
- "I started to be more health conscious three years ago, because I was gaining too much weight. I wanted to break this process and be a good example for my kids. I wanted to change my diet. I started to read online on how to follow a healthy lifestyle. I also started to ask questions to my Canadian colleagues. Now, I feel that I am more responsible, and have more vegetables and fruits" (R39F-H).

FIGURES



Figure 1 Perceived Diet Similarity.

Figure 2 Psychological Stress & Depression: a Reciprocal Cycle





Figure 3 Reported Timing of Post-arrival Weight Gains.

7. Conclusions

This final chapter first summarizes the principal findings related to each research objective, and then outlines the main implications for future research and preventive efforts.

6.1 Summary of Findings

When considering the first objective (Objective 1: testing the generalizability of the acculturation hypothesis), results supported the existence of a positive relationship between duration of residence and obesity, but also provided evidence in support of the heterogeneity of the acculturation effects along both ethnic and gender lines, with Hispanic and male immigrants experiencing a higher risk of developing obesity after settling in Canada. Besides, results showed that less-educated immigrants were more vulnerable to increases in post-arrival obesity rates, while a higher income did not seem to be protective.

In terms of the second objective (Objective 2: examine the association between acculturation, psychological stress, and obesity), results support the belief that acculturation is not a univocal process, and that different immigrants groups may experience diverse patterns of acculturation dynamics, which might lead to heterogeneous adaptation processes that do not necessarily imply the adoption of unhealthy behaviours. Overall, research findings indicate the existence of a positive association between higher degrees of acculturation and body weight measures, but also that acculturation may be linked to positive adjustments, such as an increased level of recreational physical activity and some beneficial nutritional changes. Finally, results support

the presumed association between adverse resettlement life-experiences, psychological stress, and obesity, as more socially marginalized immigrants reported higher stress scores and larger BMI levels and weight gains since time of arrival.

The investigation of the determinants of post-settlement changes in obesity levels and lifestyle behaviours (Objective 3) revealed that the observed differences in obesity levels among ethnic groups could be related to the complex interplay of a multiplicity of factors, such as different physiological and behavioral responses to the disruption of circadian clocks and chronic stress, and diverse processes of dietary adaptation. More generally speaking, interviews highlighted how lifestyle behaviors are affected by the need to adjust to unfamiliar weather conditions and food environments, financial constraints, social norms defining acceptable body weight ranges, and the lack of health literacy.

Finally, the examination of the timing of post-arrival weight gains (Objective 4) showed that changes in weight status and lifestyle behaviours are more likely to occur during the first five years of residence, when immigrants tend to overlook their physical and mental health, and dedicate their limited time and energy to deal with resettlement issues. This trend seems to be similar for both target groups.

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6.2 Summary of Theoretical Implications

The overall main theoretical implication of the results of this dissertation is that the relationship between obesity, ethnicity, and acculturation is not straightforward and unilateral as suggested by most of the current literature in the field. Indeed, individuals and immigrant groups may experience different adaptation processes, while a higher degree of acculturation might be associated with both detrimental and beneficial changes.

What is still unclear is how different degrees of sociocultural integration translate into different obesity-related outcomes and lifestyle behaviours, and how these mechanisms are mediated by individual, group-based, and contextual factors. To better understand differences in obesity prevalence, future research should pay particular attention to the complex interaction between behavioural and physiological factors, and examine how acculturation dynamics, demographic variables, mental health, and genetic predispositions are interrelated with each other.

In particular, future studies should rely on more complex conceptualizations of acculturation, consider different patterns of cultural adaptation, and develop multidimensional scales able to capture a multiplicity of cultural and social practices. Equally important is the combination of qualitative and quantitative methodologies in order to implement a methodological pluralism approach, in which quantitative techniques are integrated and supplemented by qualitative methods to support a logic of triangulation. For instance, quantitative measures can guide the choice of subjects for a more in depth-qualitative investigation by identifying individuals/groups more at risk to develop obesity, while qualitative methods can facilitate the interpretation of

statistical relationships, and help to identify the causal mechanisms responsible for weight gains and changes in lifestyle behaviours.

6.3 Summary of Implications for Future Preventive Efforts

The research findings of this dissertation call for a more systematic monitoring of ethnicitybased obesity differentials. Collecting more precise information on immigrants' obesity trends would help future preventive programs to target the foreign groups most at risk to develop obesity and its associated conditions after settlement, while allowing a more efficient allocation of limited resources for counselling on diet and physical activity. Regardless of ethnicity status, prevention efforts should especially focus on less-educated immigrants, who might find it harder to access nutritional information and be more likely to acquire unhealthy lifestyle habits.

In an increasingly diverse and multiethnic Canada, understanding ethnic-specific risk factors would also inform preventive efforts on how to take notice of specific ethnicity groups' needs (such as eating habits, food preparation, child-feeding practices, and perceptions of acceptable body weight ranges), help both recent and long-term immigrants to become more aware of obesity and overweight related issues, and thus facilitate the adoption of healthier lifestyles after arriving in Canada.

Research findings also imply that since immigrants are likely to face stressful resettlement circumstances, health-care personnel should pay particular attention to the development of more comprehensive obesity preventive programs that include social integration strategies (to help newcomers to build up a social network right after settlement), and assess and monitor individual stress levels. Indeed, expanding the scope of obesity preventive programs beyond just improving lifestyle behaviours should be aimed at promoting the utilization of psychological techniques able to strengthen self-esteem and manage post-settlement-related feelings of anxiety and depression. These techniques would help immigrants to avoid frequent unhealthy stress-coping behaviors, such as the consumption of sugary high-calorie foods, emotional eating, reduced sleep, and physical inactivity.

Research findings support the implementation of obesity preventive efforts that take notice of acculturation levels in order to identify socially marginalized immigrants (who may be less likely to adhere to Western-based medical interventions, and also more likely to experience postimmigration psychological stress), and focus on those immigrants who work at nights or on rotating shifts. Finally, regardless of ethnicity, efforts should be made to make sure that appropriate interventions are implemented early in the resettlement process.

More generally speaking, a more in depth study of immigrants" obesity determinants has the potential to confute common negative stereotypes. Some scholars have pointed out that blaming obesity on individual choices might "reinforce moral boundaries against minorities and the poor [...], such as the belief that all these groups are lazy and lack self-control and will power" (Campos et al., 2006). However, although it is true that obese people can become even more a stigmatized group as a result of social norms and social disapproval, this process can be reversed if "the public understands and accepts that people need adequate resources [...] to

engage in health-promoting behaviors (Adler and Stewart, 2009). Thus, rather than reinforcing a 'blaming the victim' perception, a more widespread ethnicity-based obesity research can help clarify the numerous challenges that disadvantaged groups face in order to make healthy choices (especially, during a transitional phase, like the acculturation process), and better advocate for policies that empower minorities and enable free choice.

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Appendices

Appendix A. Questionnaire

Page 1

Immigrants are at particular risk of developing obesity and overweight after settling in Canada, and the purpose of this study is to better understand how and why physical activity, diet and weight change after arrival in Canada.

As an immigrant, who settled in Canada, we are asking you to complete this survey.

It is going to take you only 15 / 20 minutes to fill it out. Thank you for participating in our survey. Your feedback is very important.

Page 2

We will start by asking few questions about your life before moving to Canada.

- 1. In which country were you born?
- 2. When did you arrive in Canada? Year / Month
- 3. How old were you when you arrived in Canada?
- 4. Under which immigration program did you arrive in Canada?
 - Federal Skilled Worker Provincial Nominee Temporary Foreign Worker Federal Skilled Trades Person Start-Up Visa Canadian Experience Class Candidate Sponsored Family Member Student Visa Self-Employed Person Refugee Other (please specify)

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5. In your life, in which countries did you live for at least one year? (Include your native country, and list countries starting from the most recent one)

Page 4

Now, we would like to ask you questions about your height and weight.

6. What is your current weight? (Indicate your weight in Kilograms).

7. Right before moving to Canada, what was your weight?(Indicate your weight in Kilograms).

8. How tall are you? (Indicate your height in Meters and Centimeters).

9. Right before moving to Canada, how tall were you? (Indicate your height in Meters and Centimeters).

10. Do you currently consider yourself?

Underweight Overweight Just about right

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The following questions are about your diet and the way you prepare food since coming to Canada.

11. Has your general portion size changed since coming to Canada? (A portion size is how much you eat in one meal).

Much Smaller Smaller Same Amount Bigger Much Bigger

12. How often do you have meals in a typical day since coming to Canada?(Include all meals and snacks you eat in one day).

Much Less Often Less Often No Change More Often Much More Often

13. How has your method of food preparation changed since coming to Canada?

(Much Less Often / Less Often / No Change / More Often / Much More Often) Stir Frying Deep Frying Boiling Steaming Baking Grilling / BBQ Microwaving Adding Creamy Salad Dressings Flavoring Food with Salt

Page 6

14. How has your food consumption changed since coming to Canada?

(Eat Much Less / Eat Less / Same Amount / Eat More Eat / Much More) Vegetables **Fresh Fruits** Sugar (in food and beverages) Whole Milk Skim/Non-fat Milk Dark Bread (whole Wheat) White Bread Potatoes (baked, boiled, mashed) Rice Tortilla Noodles Pasta Cheese / Cheese Spread (regular fat) Fresh Fish White Meat (chicken, turkey) Red Meat (beef, pork, lamb, duck, veal) Convenience Foods (frozen foods, chips, canned vegetables) Fried Foods (bacon, French fries, fried chicken) Deserts / Sweets (cookies, cakes, donuts, brownies, candy bars)

15. How has your beverage consumption changed since coming to Canada?

(Drink Much Less / Drink Less / Same Amount / Drink More / Drink Much More) Soft Drinks(Coca Cola, Sprite, etc.) Coffee Tea Alcohol (beer, wine, and liquors) Fresh Fruit Juice Tap Water

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16. How often do you have meals outside your home since coming to Canada? (Much Less Often / Less Often/ No Change / More Often / Much More Often) Restaurants and Buffets Fast Food Restaurants (McDonald`s, Tim Horton`s, etc.) 17. How often do you prepare meals for yourself at home since coming to Canada? (Much Less Often / Less Often / No Change / More Often Much / More Often)
 Breakfast at Home
 Lunch at Home
 Dinner at Home

18. How similar is your current diet to the one in your native country?

Very Similar		
Similar		
Exactly the Same		
Different		
Very Different		

19. If you think that your diet has changed since coming to Canada, what is the most important reason?

Page 8

The following questions are about your physical activities here in Canada.

20. When compared to your native country, what is your level of physical activity here in Canada?

(Much Less Active / Less Active / No Change / More Active / Much More Active)

Physical Activities at Work

(Such as, farming, construction, studying, volunteer work).

Walking and Biking To and From Places

(Such as, to go to work, the market, places of worship).

Physical Activities at Home

(Such as, gardening, cleaning, washing clothes, and caring for your family).

Recreational Physical Activities

(Such as, playing football, running, swimming, or bicycling).

21. When compared to your native country, how much time do you spend sitting here in Canada?(For example, time spent sitting in a office, sitting at a desk using a computer, sitting with friends, travelling by car/bus, or watching television).

Much Less Less No Change More Much More

22. If you think that your levels of physical activity and exercise have changed since coming to Canada, what is the most important reason?

Page 9

The following questions are about your physical and mental health.

- 23. What would you say your physical health was in your native country?
 - Poor Fair Good Very Good Excellent

24. Now that you are here in Canada, what would you say your physical health is?

Poor Fair Good Very Good Excellent

25. When you were in your native country, did you smoke tobacco?

Yes, on a daily basis Yes, but less than daily Not at all

26. Now that you are here in Canada, do you smoke tobacco?

Yes, on a daily basis Yes, but less than daily Not at all

- 27. Do you currently suffer of any of these conditions?
 - Heart Disease Asthma Liver Condition High Blood Pressure Cancer Arthritis Kidney Failure Diabetes Not at all Other (please specify)

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28. The following questions are about how you have been feeling during the past 30 days. About how often during the past 30 days did you feel:

(None of the time / A little of the time / Some of the time / Most of the time /All of the time) Nervous Hopeless Restless or Tired So Depressed That Nothing Could Cheer You Up Everything Was an Effort Worthless

Page 11

The following questions are about your life here in Canada. (Strongly Disagree / Disagree / Somewhat Disagree / Neutral / Somewhat Agree / Agree / Strongly Agree)

29. Acculturation

I write better in English than in my native language When I am in my apartment/house, I typically speak English If I were asked to write poetry, I would prefer to write it in English I get along better with Canadians than Asians I feel that Canadians understand me better than Asians I find it easier to communicate my feelings to Canadians than to Asians I feel more comfortable socializing with Canadians than I do with Asians Most of my friends at work/school are Canadian

30. Separation

Most of the music I listen to is Asian My closest friends are Asians I prefer going to social gatherings where most of the people are Asian I feel that Asians treat me as an equal more than Canadians do I would prefer to go out on a date with an Asian than with a Canadian I feel more relaxed when I am with an Asian than with a Canadian Asians should not date non-Asians

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31. Integration

I tell jokes both in English and in my native language

I think as well as in English as I do in my native language

I have both Canadian and Asian friends

I feel both Asians and Canadians value me

I feel very comfortable around both Canadians and Asians

32. Marginalization

Generally, I find it difficult to socialize with anybody, Asian or Canadian I sometimes feel that neither Canadians nor Asians like me There are times when I think no one understands me I sometimes find it hard to communicate with people I sometimes find it hard to make friends Sometimes I feel that Asians and Canadians do not accept me Sometimes I find it hard to trust both Canadians and Asians I find that both Asians and Canadians often have difficulty understanding me I find that I do not feel comfortable when I am with other people

Page 13

To end the survey, we would like to ask some simple questions about you.

- 33. What is your gender?
- 34. In which year were you born?
- 35. What is your current marital status?
 Single, never legally married
 Single, cohabitating with a significant other
 In a civil union
 Legally married (and not separated)
 Separated, but still legally married
 Divorced
 Widowed
- 36. How many children do you have?
- 37. If you do have children, how old are they?
- 38. What is your highest level of formal education?
 - Elementary School Some Middle School Middle School Diploma Some High School High School Diploma Some College / University College / University Degree Graduate School Degree

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39. What is your current occupational status? Employed Full Time Employed Part Time Self-employed Retired Unemployed Student Housewife Volunteer Work Other (please specify)

40. What is your current occupation?

41. What is your annual income?

(Include the income of all your relatives, such as husband, wife, parents, if they live with you).

Appendix B. Health Professionals Interview Guide

- 1) Based on your professional experience, how concerning are overweight and obesity in newcomers? Which immigrant groups seem to be most affected?
- 2) Based on your professional experience, what are the main challenges that immigrants face after arriving in Canada in terms of following a healthy diet and being physically active?
- 3) Do you believe that different immigrant groups face diverse challenges? If so, why?
- 4) What could be done to avoid newcomers becoming overweight and obese?
- 5) Do you know other health professionals/community social workers I could talk to?

Appendix C. Participant Informed Consent Statement

Project Title:	Post-Immigration Changes in Weight Status and Weight-related Behaviors: Comparing Latin Americans and East-Southeast Asians in the K-W Region, Ontario, Canada.
Principal Investigator:	Michele Vitale, PhD candidate, Wilfrid Laurier University Department of Geography & Environmental Studies
Project Supervisor:	Dr. Sean Doherty, Professor, Wilfrid Laurier University
Researchers:	Dr. Alison Mountz, Associate Professor, Wilfrid Laurier University Dr. Daniel Rainham, Professor, Dalhousie University Dr. Margaret Walton-Roberts, Associate Professor, Wilfrid Laurier University

You are invited to participate in a research study. It is well known that immigrants and ethnic minorities are at particular risk of developing obesity and overweight after settling in Canada, and the purpose of this study is to better understand how and why physical activity, diet and weight change after arrival in Canada. We are recruiting immigrants who have settled in Canada in order to identify the motivations behind possible changes in weight status, physical activity levels and dietary intakes.

All participants will be asked to complete a general survey to answer a variety of questions on if, how and why their diet and physical activity levels have changed after immigrating to Canada. We believe that about 20/25 minutes will be required to complete the survey.

INFORMATION

RISKS

There is the possibility that completing the survey might make you feel nervous and anxious. Some participants might feel uncomfortable and regretful when revealing personal information on current weight status, physical activity, and dietary behaviors. If you experience any adverse psychological effect, just remember that participation in this study is voluntary, and you can withdraw from the study at any time without penalty.

BENEFITS

We hope that the information provided by the participants will help public health officials to develop better obesity prevention strategies that have the potential to positively affect a large and increasing number of immigrants to Canada.

CONFIDENTIALITY

To maintain anonymity and ensure confidentiality, names of participants will be separated from survey results. Survey information and notes will be stored both in a locked filing cabinet in a secure location, and in a password protected computer belonging to the principal investigator. Only myself (as the principal investigator), and other researchers under my direct supervision, will have access to the data. No identifying information (names, addresses) will be used when presenting study results. Quotes from participants may be used in write-ups, articles, and/or presentations. However, participants will not be identifiable, and participant names will not be related to direct quotes. You have the right to prohibit any quotation, and you may participate to this project even without being quoted. If you prefer not being quoted just let the interviewer know anytime during the interview.

CONTACT

If you have questions at any time about the study or the procedures (or you experience adverse effects as a result of participating in this study), you may contact the principal investigator, Michele Vitale, via email (vita0720@mylaurier.ca) or by phone (519-884-1970, ext. 3288). This project has been reviewed and approved by the University Research Ethics Board. If you feel you have not been treated according to the descriptions in this form, or your rights as a participant in research have been violated during the course of this project, you may contact Dr. Robert Basso, Chair, University Research Ethics Board, Wilfrid Laurier University (519-884-1970, ext. 4994 [5] or rbasso@wlu.ca).

PARTICIPATION

Your participation in this study is voluntary; you may decline to participate without penalty. If you decide to participate, you may withdraw from the study at any time without penalty and without loss of benefits to which you are otherwise entitled. If you withdraw from the study, every attempt will be made to remove your data from the study, and have it destroyed. You have the right to omit any question(s)/procedure(s) you choose.

FEEDBACK AND PUBLICATION

We expect results to be available by the end of 2015. The results will be published in several academic journals that usually accept articles on immigrant health, obesity, and lifestyle behaviors. We are also planning to disseminate information on recorded obesity rates, and perceived physical activity and dietary changes by delivering several presentations to local organizations that work with immigrant groups in the K-W Region. All participants will be welcome to attend.

CONSENT

I have read and understand the above information. I have received a copy of this form. I agree to participate in this study.

Participant's signature	Date
Investigator`s signature	Date