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Dietary Intake And Health Status Of Immigrants And Non-immigrants In Ontario And Quebec

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DIETARY INTAKE AND HEALTH STATUS OF IMMIGRANTS AND NON-IMMIGRANTS IN ONTARIO AND QUEBEC

by

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ABSTRACT

Introduction: Dietary intake and health status of immigrants to various countries are often different from those of non- nmigrants living in these countries. Because the diversity of the immigrants and ethnic minorities in Canada is increasing, the association of place of birth with nutrition and health among Canadians needs to be investigated.

Methods: Cross-sectional data from the 1990 Ontario Health Survey (OHS) and the 1990 Quebec Heart Health and Nutrition Survey (QHHNS) were used. A selection of nutritional (dietary, anthropometric, knowledge variables) and health (health problems, lipidemia, consultations with health professionals, cut-down/bed-days, self-perceived health) outcomes were examined among adult respondents (OHS: n=43,292; QHHNS: n=2,316). First, immigrants (defined as individuals born outside of Canada) and sub-groups of immigrants (classified by region, sub-region, country of birth) were compared to non-immigrants (Canadian-born individuals) using multiple logistic and linear regression analyses (backward chunckwise approach), adjusting for covariates. Secondly, the acculturation of immigrants (estimated using reported ethnicity, language spoken at home, time since migration) was investigated. The effect of long-term diet and of dietary covariates was explored.

Results: Overall, immigrants were not at an increased risk of dietary and health problems compared with non-immigrants. In general, they consumed less fat and more carbohydrate than did non-immigrants. However, some immigrant sub-groups, particularly Asian sub-groups, were more likely to have "inadequate" calcium, iron, and vitamin intakes than did non-immigrants. Asians also had a lower likelihood of excess weight and a corresponding greater likelihood of low body mass index. Immigrants were less likely to report a health problem but they had a lower self-perceived health than did non-immigrants. No differences were found for the prevalence of specific health problems. Acculturation rarely affected diet and health.

Conclusion: This research suggests that differences exist in the nutritional and health characteristics of immigrants and non-immigrants in Ontario. More research is needed, including studies of the nutritional and health statuses of sub-groups at high risk, to understand better the differences observed and to help health care providers develop culturally sensitive care.

A Tony, pour l'espoir

"Pour l'enfant, amoureux de cartes et d'estampes,
L'univers est égal à son vaste appétit."

Charles Beaudelaire, *Les fleurs du mal*

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AIDS:	acquired immunodeficiency syndrome
BMI:	body mass index
CFG:	Canada Food Guide
CI:	confidence interval (99%)
effn:	effective sample size
FAO:	Food and Agriculture Organization
HHANES:	Hispanic Health and Nutrition Examination Survey
HIV:	human immunodeficiency virus
HTLV:	human T-cell lymphotropic virus
kJ:	kilojoules
MJ:	megajoules
n:	crude sample size
NE:	niacin equivalent
NHANES:	National Health and Nutrition Examination Survey
NHIS:	National Health Interview Survey
OHS:	Ontario Health Survey
QHHNS:	Quebec Heart Health and Nutrition Survey
RNI:	Recommended Nutritional Intakes (Canadian recommendations)
SIDS:	sudden infant death syndrome
SLE:	systemic lupus erythematous
WHO:	World Health Organization

CHAPTER 1. INTRODUCTION

In 1991, approximately one in six Canadians and one in four Ontarians was an immigrant (Statistics Canada 1993a), i.e., a permanent resident of Canada who did not have Canadian citizenship by birth (White 1990). Because of the relative openness of the Canadian immigration system (Standing Committee on Labour, Employment and Immigration 1990; Employment and Immigration Canada 1991), we can expect that in the following decades we will continue to see profound changes in the composition of the Canadian population: the population is expected to become more pluralistic as the proportions of new immigrants from areas such as Asia, the Caribbean, South America, and Africa increase (Logan 1991).

While few studies of the health and health care needs of immigrants have been completed in Canada, recent American and European investigations have suggested that place of birth and ethnicity can affect morbidity and mortality patterns, often in a negative way (Donovan 1984; Polednak 1989; Ahmad 1989). In addition, diet, which has been known to influence health status (U.S. Department of Health and Human Services 1988), has been shown to vary by place of birth and ethnicity (Freimer et al. 1983; Axelson 1986). Similar comparisons of the dietary intake and health characteristics of Canadian immigrants and non-immigrants are necessary to guide Canadian health service planners in developing new training models for future service providers and in refining models of health care that will meet the requirements of the increasingly multicultural Canadian society (Lechky 1992). To help fill this current need, the association of place of birth with nutritional and health attributes, in Ontarians and Quebecers in 1990, was examined in the present study.

CHAPTER 2. REVIEW OF THE LITERATURE

2.1 Introduction

The association of place of birth, race, and ethnicity with health characteristics has been studied extensively in the past to investigate the cause and prevention of disease (Polednak 1989; Kagan et al. 1974; Salmond et al. 1989; Østbye et al. 1989; Marmot et al. 1984; Hull 1979; Modan 1980). A large proportion of the literature on the subject indicated that some differences exist in the health status of individuals depending on their place of birth, ethnicity, or race. However, some results were contradictory depending on the populations that were examined and the time at which the studies were performed.

Recent waves of immigrants to a number of countries (Standing Committee on Labour, Employment and Immigration 1990; Frank-Stromborg 1991; Krupinski 1984; Bourdillon et al. 1991) have stimulated further interest in the study of the health and disease experiences of migrants. Host countries have been trying to understand the effects of these migration movements on the health status and health care needs of their increasingly heterogeneous populations, thus shedding new light to the study of the relationship between health characteristics and place of birth or ethnicity.

This review of the literature first describes some of the differences in mortality and morbidity by place of birth, ethnicity, and race that were reported in various countries. Secondly, external factors that could have influenced these variations are outlined and exemplified. Special attention is given to the potential effect of diet because diet has been strongly related to place of birth, ethnicity, and health, because dietary habits are potentially amenable to a change through health promotion programs, and also because nutrition is a primary issue in this thesis.

2.2 Mortality and morbidity differences by place of birth, ethnicity, and race

As mentioned above, mortality and morbidity patterns have been reported to vary not only across countries (World Health Organization 1994), but across immigrant, ethnic, and racial sub-groups within these countries (Council on Scientific Affairs 1991; Polednak 1989; Baxter and Baxter 1988; Harwood 1981; Donovan 1984; Adelstein et al. 1984; U.S. Department of Health and Human Services 1985). An extensive list of diseases with relatively high or low frequency in selected racial or ethnic groups (in the country of origin or country of migration; Polednak 1989) is presented in Table A1 of Appendix A. As illustrated below, a large share of the literature on this topic came from the United States and from the United Kingdom. Care must be taken, however, when comparing the studies from different countries because immigrants to one country may have differed from immigrants to another country. In addition, the living conditions and the health care service availability or accessibility may have varied considerably among host countries.

2.2.1 The situation in the United States and in the United Kingdom

In the United States, the association between race and health status has been studied extensively and differences among Whites, Blacks, Hispanics, and Asians have been reported. For example, it has been shown that Blacks, the largest minority group in the United States, have a lower life expectancy than Whites (Markides 1983). They have been found to be more likely than Whites to die from acquired immunodeficiency syndrome (AIDS), cancer, cardiovascular disease, chemical dependency (primarily due to liver disease resulting from alcohol abuse), diabetes, infant mortality, homicide, and unintentional injuries (Nickens 1990). Hypertension was also found to be more frequently encountered in American Blacks than in Whites (Kaplan 1994). Blacks, a relatively homogeneous group, have been in the United States for a long period of time and were less affected by recent immigration waves than were Hispanic and Asian Americans.

As for Hispanic Americans, the second largest minority group in the United States, it has been suggested that they have been found to have a higher risk of dying from AIDS, chemical dependency, diabetes, homicides, and unintentional injuries than do Whites (Nickens 1990). Compared with Whites, they also have a higher risk of obesity, hypertension, tuberculosis, infection, alcoholism, cirrhosis, and some cancers (Pawson et al. 1991; Council on Scientific Affairs 1991). They constitute a less homogeneous group than do Black Americans. Hispanics include more recent immigrants who originated from a variety of countries (e.g., Mexico, Cuba, Central and South America, etc.).

Asian and Pacific Islander Americans also have been found to form a very heterogenous group (Nickens 1990) that includes not only well established American sub-groups (e.g., Japanese), but also recent immigrants (many of them being refugees) from all parts of Asia. While it has been suggested that this minority group has an overall lower mortality rate than do Whites, Pacific Islanders display a high prevalence of health problems such as alpha and beta thalassaemia and haemoglobin E carrier disorder, as well as glucose-6-phosphate dehydrogenase deficiency and lactose intolerance (Lin-Fu 1988). Sub-groups of Pacific Islanders and Filipinos living in Hawaii have also been reported to be affected by diseases of modernization such as coronary heart disease, hypertension, and diabetes (Fitzpatrick-Nietschmann 1983; Anderson 1983). Some cancers have been found more frequently in some Asian groups; for example, it was reported that Chinese Americans have a higher incidence rate of nasopharyngeal and buccal cancers than do Whites (Frank-Stromborg 1991).

The observed higher mortality rate in some minority groups in the United States is important and needs to be examined more closely using more recent mortality data that would account for the important immigrant movements to that country. This has to be done in light of other differences that might exist between minority and non-minority groups. Otten and co-workers (1990) have performed such adjustments. Using data from the First National Health and Nutrition Examination Survey (NHANES) Epidemiologic Follow-up Study, they demonstrated that in individuals between 35 and 54 years of age, 31% of the excess mortality for Blacks, in comparison to Whites, could be explained by smoking, systolic blood pressure, cholesterol level, body mass index (BMI), alcohol intake, and diabetes. An additional 38% could be explained by family income, leaving 31% unexplained. Excess mortality was smaller in individuals 55 to 77 years, and the risk factors mentioned above accounted for the differences observed.

In the United Kingdom, differences between the health experiences of minority groups and of the general population have also been reported. Adelstein et al. (1984) showed that in the early 1970s, immigrants from the Indian sub-continent to England and

Wales had high risks of death from diabetes, hypertensive diseases, ischemic heart disease, and motor vehicle accidents compared with non-immigrants; however, they had a lower risk of dying of cancer. Immigrants from the Caribbean also exhibited higher mortality rates from diabetes and hypertensive diseases than did non-immigrants; their risk of dying of cancer, ischemic heart disease, or motor vehicle accidents was lower. Immigrants from the Caribbean, Africa, and the Indian sub-continent also demonstrated high mortality ratios for cirrhosis, genito-urinary diseases, maternal mortality (complications of pregnancy, childbirth, puerperium), perinatal and neonatal death than did non-immigrants.

Grulich et al. (1992) studied cancer mortality in African and Caribbean migrants to England and Wales for the 1970 to 1985 period. They reported that overall mortality rates from cancer were significantly lower among male and female immigrants from the Caribbean and from East Africa and higher among West African males than among non-immigrants; no significant difference was found between West African females and non-immigrant females. When they examined specific types of cancer, differences in mortality rates between immigrants and non-immigrants were also observed for a variety of sites, depending on place of birth and gender. For Caribbean immigrants, adjustment for social class (derived from occupation recorded on death certificates) reduced the relative risk of cervical cancer, but not the risk of stomach and lung cancer. This result indicated, once more, the importance of considering the factors that could explain part of the differences in health status and mortality risks between immigrants and non-immigrants.

2.2.2 The situation in Canada

In Canada, a number of studies have looked at the association of place of birth or ethnicity with mortality and morbidity. Some of these studies investigated the relationship between cancer mortality and place of birth or ethnicity.

In 1972, Cook et al. reported that cancer morbidity in Ontario was associated with ethnicity (Italian, Polish, French, and other ethnicity). Ethnic origin was defined using surnames recorded on hospital discharge reports and not by reported ethnicity; consequently, this may have led to some misclassification bias.

For the 1969 to 1973 period, Newman and Spengler (1984) also observed some differences in mortality from stomach, colorectal, lung, prostate, and breast cancer among six immigrant groups living in Ontario (individuals from the United Kingdom, Italy, the Netherlands, Poland, and the former Soviet Union). Information on place of birth, year of death, age at death, gender, and site of cancer was obtained from death certificates. In comparison to Canadian-born males and females: 1) male and female individuals born in the United Kingdom had a high standardized mortality ratio for stomach and lung cancer, and females had an excess of deaths from breast cancer; 2) Italian-born subjects had higher rates of death from stomach cancer but lower rates from colorectal, lung, prostate, and breast cancer; 3) rates of death from colorectal and breast cancer were lower among females from Germany; 4) individuals born in the Netherlands had higher mortality rates from stomach cancer and lower mortality rates from colorectal cancer; 5) male and female subjects born in Poland had an excess of deaths from stomach cancer but a lower mortality rate from prostate or breast cancer, males also had a higher risk of dying from lung cancer, and females a lower risk of dying from lung or colorectal cancer; and 6) male and female individuals born in the former Soviet Union had higher mortality rates from stomach cancer but lower rates from colorectal cancer, and females also had lower rates from breast cancer.

Thouez and Ghadirian (1991) studied cancer mortality among Canadian immigrants for the 1969 to 1973 period; mortality rates were compared with that of the general population of Canada by gender and age group (35 to 44, 45 to 54, 55 to 64, 65 to 74, and 75 years and over). One of their principal results indicated that, compared with the general Canadian population, South European immigrants showed lower mortality rates from different types of neoplasm: males from South Europe had low standardized mortality ratios for larynx, trachea, bronchus, and lung cancer (males between 45-74 years of age), for bowel cancer (55-64 years), and for urinary organs (65-74 years), while South-European women had a lower risk of death from bowel cancer (females 55 years and over), bone, connective tissue and skin cancer (35-74 years), and from breast cancer

(55-64 years). Immigrants from East Europe also had lower mortality rates for some cancers. Among males, mortality rates were lower for buccal cavity and pharynx cancer (75 years and over), for larynx, trachea, bronchus, and lung cancer (45-55 years), and for bone, connective tissue, and skin cancer (75 years and over). Among East European women, lower risks were found for bowel cancer (65 years and over), for bone, connective tissue, and skin cancer (45 years and over), and for breast cancer (35-44 years). However, among East European males the risk of dying from stomach cancer (35-44 years) and from larynx, trachea, bronchus, and lung cancer (75 years and over) was higher than that of the general Canadian population. Finally, immigrants from West Europe, Britain, and Asia had higher standardized mortality ratios for some cancer, in comparison to the population of Canada: 1) Asian males had higher mortality rates for biliary passages and liver cancer (45 years and over); 2) mortality from larynx, trachea, bronchus, and lung cancer was higher among British male immigrants (55 years and over), while mortality from these types of cancer and from bone, connective tissue, and skin cancer was higher among British females (55-64 years); and 3) West European males (75 years and over) had an increased risk of dying from larynx, trachea, bronchus, and lung cancer. Some differences were observed between the Canadian provinces.

Wang and colleagues (1989) reported that between 1980 and 1984, Canadian Chinese immigrants had an overall higher mortality rate from all types of cancer than did Canadian-born individuals. High mortality rates were observed particularly for nasopharynx cancer, but also for liver or gallbladder cancer, and for lung cancer in both males and females. Chinese-born males also had high stomach, intestine or colon, and rectum cancer mortality rates compared to males born in Canada; however they had relatively lower mortality rates from prostate cancer. The mortality rate from cervix cancer was high among Chinese-born females but mortality rates from breast and ovary cancer were low in comparison to rates found among Canadian-born females. Archibald et al. (1993) also observed, for the 1985 to 1988 period, that the incidence of cervical cancer was higher among Chinese women living in British Columbia (particularly among women 40 years and over) than among Caucasian women living in this province.

Among Canadian males of Italian ethnicity living in Montreal, higher incidence rates of stomach, colon, and rectum cancer, and lower rates of lung and prostate cancer were observed in comparison to males of other ethnicities (Terracini et al. 1990). Ethnicity was assessed using questions on place of birth, country of birth of mother and father, and ethnic community in Montreal in which the individual had grown up.

In addition to cancer, cardiovascular disease has been associated with place of birth and ethnicity in Canada. Abu-Zeid et al. (1978) looked at differences in mortality rates from ischemic heart disease, in Manitoba between 1960 and 1962, according to place of birth and ethnicity; during that period, both place of birth and ethnicity were recorded on death certificates in Manitoba. Mortality from ischemic heart disease was found to be higher in males born in Ireland, England, Scotland, and East Europe, as well as in females born in Italy and Ireland, than in Canadian-born males and females respectively. Analyses based on ethnicity (for both immigrants and non-immigrants) demonstrated high standardized mortality ratios from ischemic heart disease for Jewish, Scottish, and English males and for Jewish and English females; the reference category included all Manitobans (regardless of their ethnic origin). Low standardized mortality ratios were observed for Ukrainian, German, Austrian, and Native Indian males, and for German and Austrian females.

For the 1984 to 1988 period, Nair and co-workers (1990) examined the age-standardized cardiovascular mortality rates in different Canadian groups (age 35 years and over) classified according to their region of birth (Scandinavia, Western Europe, South Asia, Eastern Europe, Africa, North America, China, and Latin America). They found that the lowest rates were for immigrants from China, Latin America, and South Asia. The highest rates were for those born in Africa, followed by those originating from Scandinavia. Rates were similar for individuals born in North America, Eastern and Western Europe. The authors also reported that cardiovascular mortality rates generally decreased in each group studied between 1969-1973 and 1984-1988, except Africa.

Ethnic-group differences in the incidence of insulin dependent diabetes mellitus among children aged 0 to 14 years living in Montreal (for the years 1971 to 1985) were also reported by Siemiatycki et al. (1988). Incidence rates, adjusted for gender, age, and socioeconomic status, were the highest among children of Jewish and of British origins, followed by children of Italian origin and then of French origin.

The preceding examples suggest that morbidity or mortality, at least for certain health problems, can be related to place of birth and ethnicity in Canada. However, the results of the 1987 Quebec Health Survey indicated no significant difference in the global health status of immigrants and native-born Quebecers (Cousineau 1990). The global health status score (mean "ridit"; Belloc et al. 1971) was based on the ability to perform certain daily activities, on the presence of chronic conditions or impairments, and on the subjective rating of general energy level.

Results from the 1985 Statistics Canada's General Social Survey (Parakulam et al. 1992) also showed that the health status of Canadian male and female immigrants was better, overall, than the health status of non-immigrants; health status was based on the presence of a chronic illness, the use of health care facilities or consultation with health professionals for a health reason during the previous year, and the degree of activity limitation or disability. Male immigrants between 15 and 59 years of age (classified in three age groups: 15 to 29 years; 30 to 44 years; 45 to 59 years), and female immigrants between 15 and 44 years (in two age groups: 15 to 29 years; 30 to 44 years) tended to report a better health status than did their Canadian-born counterparts. However, a reverse pattern was found among older males (60 years and older) and females (45 to 59 years and 60 years and older), with immigrants being less healthy than non-immigrants. Among the immigrants, those who had migrated in or after 1970 were in general healthier than those who had migrated before 1970, except for young males (15 to 29 years), adult females (30 to 44 years), and elderly males and females (60 years and over).

The studies described in the previous two paragraphs compared non-immigrants with *all* immigrants. Differences between non-immigrants and certain immigrant sub-groups may thus have been masked.

A study from the Community Health Department of St-Luke's Hospital in Montreal also suggested that applicants for refugee status, between August 1985 and March 1986, had a generally satisfactory state of health (Thonneau et al. 1990). Overall, 87% of the applicants were in good health (no major disturbances, serious illness, or severe biological abnormalities), 10% were in poor health, and 3% had a major handicap or chronic illness; treponematosis, intestinal parasitosis, minor betathalassemia, and nutritional deficiencies were detected in some cases. Health problems among the refugees studied may have been underestimated, however: 1) all medical tests were not performed on all individuals; 2) the medical follow-up was about one month, a time period that may have been insufficient for the onset of certain health problems; and 3) some individuals dropped out of the study and moved to other regions. In addition, this study was based primarily on immigrants from a few countries or regions (Iran; Sri Lanka; Dominican Republic; El Salvador; Central America; South America; Haiti; Afghanistan, and Pakistan); consequently, the sample may not have been representative of all refugee applicants to the province of Quebec during the selected time period. Finally, the ability to communicate in French or English varied considerably between individuals, and this may have affected the reporting of health problems (Saldov and Chow 1994).

At the present time, the comparison of the health status of immigrant and non-immigrant Canadians remains fragmentary. More research is consequently needed to provide additional evidence about the influence of place of birth on the health of Canadians, while taking into consideration factors (see next section) that could explain part of the gap in the health of non-immigrant and immigrant sub-groups.

2.3 Factors influencing health differences between immigrant or ethnic groups

Some researchers have attempted to define which factors govern the variations in the frequency of disease among racial or ethnic groups. These factors can be divided into five general categories (Polednak 1989): errors of measurements; demographic factors; body constitution factors; genetic factors; and environmental factors. Examples within each category are described in Table 2.1. Most of the categories are closely related and difficult to isolate in practice.

Table 2.1 Explanations for differences in mortality or morbidity among racial, ethnic, and immigrant sub-groups.

Category	Examples
Errors of measurements	*Inadequate or insufficient information *Differential access to medical care *Differential use of available facilities *Differing fashions of diagnosis *Problems of diagnosis associated with racial/ethnic group
Demographic factors	*Differences in age, gender, marital status *Differences in socioeconomic status *Differences in ethnicity or immigrant class
Body constitution factors	*Anatomical differences (e.g., weight, height, waist and hip circumference, skinfold thicknesses, fat mass, etc.) *Differences in growth and development *Physiologic and biochemical differences (e.g., blood parameters, blood pressure, etc.)
Genetic factors	*Effects of consanguinity, differences in mutation rate, natural selection, random genetic differences
Environmental factors	*Climatic and geographic differences and their effects *Dietary intake and nutritional status *Differences in personal customs or health behaviours (e.g., reproductive, breast feeding and lactation pattern, smoking, alcohol use, sexual practices, physical activity, knowledge of disease prevention) *Differences with respect to personality development, family dynamics, psychological stress or acculturation, social support, language and communication problems, racism *Differences in practices and attitudes towards health *Religious and cultural beliefs

2.3.1 Errors in measurements

The first category includes the possible inaccuracies in morbidity and mortality data. Some studies have reported that access to medical care or the use of the health care system (and hence the probability of diagnosis of an existing disease), the number of physician office visits or screening procedures (Uba 1992; Solis et al. 1990; Estrada et al. 1990), the propensity to seek professional help (Takeuchi et al. 1988), the reporting of symptoms and diseases (Mechanic 1963; Greenwald 1991), and the satisfaction with health care may differ by racial or ethnic group, and thus create misleading associations between health parameters and race or ethnicity.

2.3.2 Demographic factors

The relationship between demographic factors and health is well known (Susser et al. 1985). Various studies have also indicated that demographic and socioeconomic differences exist among ethnic and immigrant sub-groups within countries (Ahmad 1989; Polednak 1989; Badets and Chui 1994). In the United Kingdom and in the United States, for example, it has been suggested that some groups of immigrants are affected by poverty and high unemployment rates, have a poor educational status, and occupy substandard housing often located in crowded inner-city areas (Ahmad 1989; Donovan 1984; McKenna 1989; Lin-Fu 1988; Nickens 1990). The situation in Canada may, however, be quite different from the situation prevailing in these countries, and care must be taken when comparing immigrant populations between countries.

In Canada, results from the 1991 census (Badets and Chui 1994) indicated that some differences exist in the demographic and socioeconomic status of immigrants and non-immigrants. Immigrants are in average older than non-immigrants and are more likely to be married. As well, higher proportions of immigrants than non-immigrants tend to live in large urban areas and to have a university degree. Immigrants are slightly less likely than Canadian-born individuals to be in the labour force. Immigrant men are more likely than non-immigrant men to be working in professional, managerial and administrative, service, product fabricating, and processing occupations, while a higher proportion of immigrant women than non-immigrant women work in service, processing, and product fabricating occupations.

These observations indicate that the potential confounding effect of demographic factors on the relationship between place of birth or ethnicity and health needs to be carefully addressed.

2.3.3 Body constitution factors

This category includes anthropometric traits (e.g., height, weight, fat distribution, etc.) and biochemical and physiologic characteristics determined by complex interactions between genetic and environmental factors (e.g., blood parameters, blood pressure, etc.). Some of these parameters (e.g., overweight, hyperlipidaemia, hypertension, glucose intolerance, insulin resistance, etc.) are important risk factors for many health problems including cardiovascular disease and diabetes (Smith and Pratt 1991; Pi-Sunyer 1991; Negri et al. 1988) and tend to vary by place of origin. For example, weight, height, BMI, and percentage of body fat have been associated with place of birth and ethnicity (Laurier et al. 1992; McGinnis and Ballard-Barbash 1991; Nichaman and Garcia 1991; Wang et al. 1994; Netland and Brownstein 1985). Laurier and co-workers (1992) indicated that among the individuals between 16 and 50 years of age, obesity was more prevalent in the United States than in France or in the United Kingdom; obesity was also more prevalent in the United Kingdom than in France. In the United States, it has been reported that Black and Hispanic women age 20 years and over, American Indians, and Alaska natives are at an increased risk of obesity than are Whites (McGinnis and Ballard-Barbash 1991; Nichaman and Garcia 1991). The risk of developing diabetes and cardiovascular disease associated with upper body obesity was also shown to be more detrimental in White women than in Black women living in the United States (Dowling and Pi-Sunyer 1993).

The choice of the methods used to assess obesity may need to be adjusted to the ethnic group studied. For example, it has been shown that Asian Americans (between 19 and 94 years) had a lower BMI but a higher percent body fat (measured by dual-photon absorptiometry) than did Whites (Wang et al. 1994). Netland and Brownstein (1985) also noted that elderly Asian Americans (over 65 years of age) had lower weight and height, and lower weight for height than did Caucasian Americans; however, elderly Asians were more likely to be obese than did Caucasians when obesity was assessed using skinfold measurements.

Other biochemical and physiological parameters have been related to place of birth and ethnicity. Among these we find glycaemia and insulinaemia. The prevalence of impaired glucose tolerance in adults was found to vary considerably worldwide (King et al. 1993). It has been reported to be highest among female Muslim Asian Indians in Tanzania and among urban male Micronesians in Kiribati. Hyperinsulinaemia and insulin resistance have also been associated with ethnicity, and they have been shown to be frequent among South Asians (McKeigue et al. 1991; Knight et al. 1993).

Blood lipids and blood pressure are also influenced by ethnicity and place of birth. Results from the Second NHANES and from the American Hispanic Health and Nutrition Examination Survey (HHANES) have indicated that Mexican Americans between 25 and 65 years of age had lower systolic and diastolic blood pressures than did Whites, and that Blacks had higher blood pressures than did Whites (Sorel et al. 1991); the percentage of hypertensive Whites and Blacks was almost two and three times, respectively, the percentage of Mexican Americans. These differences were unchanged after adjustment for age, gender, BMI, and education. In addition, the prevalence of high serum cholesterol among Hispanic Americans was found to be lower than that reported for non-Hispanic Whites and for Blacks (Fanelli-Kuczmarski and Woteki 1990).

Choi et al. (1990) also indicated that a group of elderly Chinese immigrants to the United States (age 60 to 96 years) had lower mean blood pressure and lower mean blood levels of total, low-density lipoprotein, and high-density lipoprotein cholesterol than did elderly Whites. Similar characteristics were found by Knight and co-workers (1993) when they compared Asian and non-Asian male manual workers aged 20 to 65 years living in the United Kingdom: Asians had lower systolic blood pressure, total cholesterol, low-density and high-density lipoprotein cholesterol than did their non-Asian counterparts.

2.3.4 Genetic factors

It was reported that genetic factors could explain some of the disparities in disease frequency among racial or ethnic groups (Polednak 1989). The contribution of genetics to the etiology of certain health problems has been suggested (Morton 1982), but the relative contribution of genetics to health differences between minority and non-minority groups has not been well understood yet. However, Hitman et al. (1992), for example, have suggested that among South Asians, non-insulin-dependent diabetes is likely to be a polygenic disease; associations with the insulin gene and the apolipotrotein D gene have been suggested.

2.3.5 Environmental factors

From the point of view of prevention or intervention, the knowledge of the environmental factors modulating health is particularly important because some of these factors are potentially amenable to a change. The observation of high frequencies of a detrimental factor such as smoking among some ethnic/immigrant groups could lead to specific prevention, detection, or treatment programs directed towards these groups. Diet is a good example of an environmental factor that is amenable to a change and that has been associated with place of birth and ethnicity. Food intake has also been associated with various health problems (U.S. Department of Health and Human Services 1988).

2.3.5.1 Dietary intake

2.3.5.1.1 Association with place of birth, ethnicity, and race

Dietary habits are strongly influenced by culture, ethnicity, and place of birth (Trémolières et al. 1980; Freimer et al. 1983; World Health Organization 1990). They are known to differ, sometimes substantially, between countries and to evolve with time. The affluent diet prevailing in many developed or industrialized countries is usually characterized by an excess of energy-dense foods, rich in fat and free sugars, and by a deficiency of complex carbohydrate rich foods. Diets in developing or low-income countries, however, usually contain less fat and more complex carbohydrates (World Health Organization 1990; Posner et al. 1994a). In addition, some developing countries are still fighting the lack of adequate food supply for their population, as well as nutritional deficiencies (World Health Organization 1990).

At the present time, developing countries are seeing the most important changes in the composition of their diets: a gradual westernization of dietary habits tend to accompany demographic and economic transformations such as lower fertility, lower mortality, and higher socioeconomic status (Popkin 1994; World Health Organization 1990). Nevertheless, in developed countries, food intake is also changing because of a better understanding of the effects of diet on health and because of the arrival of migrants who bring their own food habits with them. However, after migration, these newcomers may have to or want to modify their eating practices to comply with those prevalent in their host country, and this for environmental, economical, and acculturative reasons (Al-Mokhalalati 1982; Harding et al. 1986; Marmot and Syme 1976).

Acculturation has been defined by Redfield et al. (1936) as:

> ... those phenomena which result when groups of individuals having different cultures come into continuous first-hand contact, with subsequent changes in the original culture patterns or either or both groups ... under this definition acculturation is to be distinguished from culture change, of which it is but one aspect, and assimilation, which is at times a phase of acculturation. It is also to be differentiated from diffusion, which while occurring in all instances of acculturation, is not only a phenomena which frequently takes place without the occurrence of the types of contact between peoples specified in the definition above, but also constitutes only one aspect of the process of acculturation.

Acculturative dietary changes have been reported to be of importance in the study of several diseases including dental caries, cardiovascular disease, non insulin-dependent diabetes mellitus, and hypertension (Freimer et al. 1983). The study of the migration of Tokelau Islanders (central Pacific Ocean) from a traditional atoll to urban New Zealand, for example, has suggested that the increased energy, carbohydrate, and alcohol intakes, as well as the reduced level of physical activity among migrants, are potential contributors to the observed changes in the health status of migrant Tokelauans (versus non-migrant Tokelauans). Changes in health status included: 1) an increase in body mass, systolic and diastolic blood pressures, LDL-cholesterol and triglyceride levels among male and female migrants; 2) an increase in the prevalence and incidence of gout and of non-insulin-dependent diabetes mellitus; and 3) a decrease in HDL-cholesterol among male migrants (Harding et al. 1986; Salmond et al. 1989; Østbye et al. 1989; Stanhope et al. 1981).

Even if diet acculturation among immigrants tends to make dietary intake of immigrants and non-immigrants within a country more comparable, various differences in dietary habits, food beliefs and taboos may remain between the two groups (Stephens et al. 1982; Freimer et al. 1983; Ludman and Newman 1984). Indeed, dietary patterns have been reported to vary by place of birth and ethnicity within countries. For instance, in the United States, it was reported that ethnicity was the most important predictor of the frequency of food consumption (other predictors studied being age, sex, education level, income, and birthplace) in group a of elderly low-income residents of the San Antonio barrio (Bartolomew et al. 1990). Kumanyika (1993) and Fleming and Heimbach (1994) also showed that American Blacks, Hispanics, and American Indians had, in general, a higher prevalence of high fat, high salt, and low calcium intakes than did American Whites. In addition (Kumanyika 1993), Blacks had a higher likelihood of low intakes of fibre, fruits, and vegetables than did Whites, while Hispanics had lower intakes of vitamin A, fruits, and vegetables than did Whites. As for Asians and Pacific Islanders, they were more likely to have a high salt and low calcium consumption than did Whites but less likely to have a diet high in fat or low in vitamin A (Kumanyika 1993). Kim and colleagues (1984a) also observed that the calcium intake of elderly Korean Americans was low and they indicated (Kim et al. 1993) that elderly Chinese, Korean, and Japanese Americans were at high risk of calcium deficiency. Finally, vitamin and mineral supplements consumption tend to vary by race in the United States, with Blacks consuming supplements less regularly than do Whites (Subar and Block 1990). Some of these observations were confirmed by the recent Third NHANES which compared the nutritional intake of White, Black, and Mexican Americans (McDowell et al. 1994; Alaimo et al. 1994).

In the United Kingdom, McKeigue et al. (1985) found that East Asian immigrants living in London consumed less saturated fat and cholesterol and more polyunsaturated fat and fibres than did the general population of the city. Silman et al. (1985) also observed that a small group of adult Bangladeshi male immigrants between 35 and 69 years of age and living in East London had a high fat intake (216 g/day or nearly 57% of total energy intake) equivalent to twice the 1982 estimated United Kingdom daily intake (in g/day). Other investigations performed in London showed that a group of South Asian males (Indian, Pakistani, and Bangladeshi) between the ages of 40 and 69 years were consuming less energy and fat but more starch, polyunsaturated fat, and dietary fibres than did European-born individuals (Sevak et al. 1994). A small group of adult (45 to 54 years of age) West Indians also had a lower fat intake, a higher polyunsaturated to saturated fat ratio, and a lower alcohol intake than did their European counterparts (Miller et al. 1988); in addition, they were less likely to be obese compared with European-born subjects. Finally, Carlson et al. (1982) reported that Vietnamese living in the United Kingdom or in the United States consumed less fat and more carbohydrate than did the general population of these countries.

Some nutritional deficiencies have been reported to occur more frequently among ethnic minorities than among non-ethnic minorities living in the United Kingdom or elsewhere. In England, rickets and osteomalacia have been found in some Asian and West Indian children, and sometimes in older individuals of these ethnicities (Robertson et al. 1982). Abraham et al. (1987) also noted that a group of pregnant Asian women (particularly Hindu vegetarian women) had lower average vitamin D and B_{12} intakes than did their European-born counterparts. In Canada, Gibson et al. (1987) reported that a group of 113 East Punjabis living in the Guelph and Kitchener-Waterloo regions of Ontario had lower serum vitamin D status (25-hydroxyvitamin D) than did Caucasian adults of comparable age; of the women examined, 22% (compared to 9% of Canadian Caucasian post-menopausal women) had serum 25-hydroxyvitamin D levels below the range considered normal for Caucasian adults (Gibson et al. 1986).

Sub-optimal iron status and anaemia have also been found among some migrant groups. In Canada, Bindra and Gibson (1986) found that iron deficiency was high among East Indian female immigrants (18 to 64 years of age); the researchers attributed this problem to the low available dietary iron intake and to the high fibre, phytate, and tannin content of the diet; these food components tend to reduce iron absorption. In the United Kingdom, iron deficiency anaemia was also observed in Asian and West Indian infants in London and Bradford, and megaloblastic anaemia due to a deficiency of folic acid or vitamin B_{12} was found among some strict lacto-vegetarian Asians (Robertson et al. 1982). In Manchester, D'Souza et al. (1987) also noted, in a group of hospitalized children between the age of 7 months and 14 years, that ferritin serum levels were lower among Asians than among White Caucasians. In South Africa, iron-deficiency anaemia has been commonly found among Indians living in Natal, potentially because of high dietary phytate and low calcium intakes (Mayet et al. 1972). Finally, in the United States, Meyers et al. (1983) noted that Blacks had a higher risk of iron deficiency (using data from the First NHANES), and Looker et al. (1989) observed that Hispanic American females 20 to 44 years of age had a higher prevalence of impaired iron status than did non-Hispanic White and Black females (using data from the HHANES).

These examples show that in different countries dietary intake as well as nutritional status varies by place of birth and ethnicity. Because diet has also been related to health status (see next section), we can hypothesize that it could explain part of the differences observed in the prevalence of certain health problems between immigrants and non-immigrants. A better understanding of the variations in dietary intake among non-immigrants and immigrant sub-groups would not only help health professionals identify sub-groups at a high risk of nutritional problems, but would help researchers ascertain the potential confounding effect of diet in the study of the association of place of birth and ethnicity with health status.

2.3.5.1.2 Association of dietary intake with health parameters

The association between dietary factors and diseases has been acknowledged around the world and different nutrients have been implicated in the prevention or in the development of numerous health problems (Helzlsouer et al. 1994; Willett and MacMahon 1984a, 1984b; U.S. Department of Health and Human Services 1988; Klurfeld and Kritchevsky 1986). In developed countries such as Canada, these health problems are mostly chronic diseases of the non-nutritional-deficiency type (World Health Organization 1990; Klurfeld and Kritchevsky 1986), that is, health problems such as obesity, cardiovascular disease, diabetes, and cancer. The nutritional parameters most often associated with coronary heart disease, stroke, atherosclerosis, cancer, diabetes, and digestive disease are energy, fat, fibre, and salt (Garrow 1991; Nestle 1992). Because of the growing importance of non-communicable diseases in Canada and in other industrialized countries (Brancker and Lim 1992; Litvak et al. 1987), the factors that modulate these health problems, including nutritional parameters, need to be identified to help prevent such diseases and reduce the health care costs associated with illness.

2.3.5.2 Other health behaviours and health knowledge

It has been suggested that differences in health behaviours other than diet, and in personal customs and habits, could also explain some of the disparities in the health status of ethnic and immigrant population sub-groups (Polednak 1989). Among others, alcohol consumption (Small 1984/1985; McKeigue and Karmi 1993), smoking (Edwards and MacMillan 1990; Klatsky and Armstrong 1991; Rice and Kulwicki 1992; Winkleby et al. 1993), and physical activity (Hazuda et al. 1983; Shea et al. 1991; Bild et al. 1993; Knight et al. 1993), have been shown to be influenced by ethnicity and place of birth, and to be risk factors for various health problems (Kannel 1983; Willet 1984a, 1984b; Mao et al. 1988).

For instance, Williams et al. (1994) reported that a group of South Asians between 30 and 40 years of age living in Glasgow (United Kingdom) were less likely to smoke but were more likely to be inactive than was the general population of the city. Armstrong et al. (1983) observed that Italian male adult migrants (20 to 79 years) to Australia were more likely to be smokers and to drink alcohol more frequently than did age-matched native-born Australians (of Australian, British or New Zealand parentage); the opposite was true for females. In Canada, it was reported that immigrants, overall, were less likely to be smokers than were non-immigrant Canadians (Millar 1992).

Knowledge of cardiovascular health prevention also varies by ethnicity. Hazuda and colleagues (1983) reported that Mexican Americans age 25 to 64 years (excluding pregnant women) were less informed about coronary heart disease than were non-Hispanic Caucasians. Ford and Jones (1991) also observed that White Americans aged 18 years and older had a higher cardiovascular disease knowledge index than did Hispanic or Black participants in the 1985 Health Promotion and Disease Prevention Supplement of the National Health Interview Survey (NHIS). Finally, in the United Kingdom, Bhopal (1986) noted that Asian adults had a low knowledge of the health hazards of cigarettes and alcohol, and of the prevention of heart disease.

2.3.5.3 The migration process

Some authors have commented on the complex dynamics of the migration process and on its effects on the physical and mental health of immigrants (Kasl and Berkman 1983; Canadian Task Force on Mental Health Issues Affecting Immigrants and Refugees 1988). Numerous factors such as host country (Kagan et al. 1974), year of migration or age at migration (Albanes et al. 1987), length of time in the new country, immigration class (Sundquist 1994; e.g., economic, family reunification, refugee), precipitating factors that stimulated migration, self-selected characteristics related to migration, adaptability, and acculturation (Kasl and Berkman 1983; Marmot et al. 1984; Estrada et al. 1990; Solis et al. 1990; Padilla 1980) have been shown to affect the health status of immigrants.

The influence of acculturation (see definition of acculturation in section 2.3.5.1.1) on the health of immigrants has been explored in several studies. The Japanese American Coronary Heart Disease Study, for example, examined the effect of acculturation on the health of Japanese men living in Japan, Hawaii, and California (Kagan et al. 1974; Marmot and Syme 1976). The results of this investigation indicated that there was a gradient in the occurrence of coronary heart disease: it was lowest in Japan, intermediate in Hawaii, and highest in California. This trend did not appear to be completely explained by differences in dietary intake, serum cholesterol, blood pressure, and smoking. However, there was a strong negative association between the retention of traditional Japanese ways of life and prevalence of coronary heart disease.

The influence of acculturation on Hispanic Americans has also been studied and results from the HHANES suggested that less acculturated Hispanics between 20 and 74 years of age encountered more barriers in obtaining the health care they sought than did acculturated individuals (Estrada et al. 1990). Marks et al. (1990) also noted that acculturation level was positively correlated with alcohol use (particularly for females) and negatively correlated with dietary balance (for Mexican American men and women). Psychological distress was reported to increase with acculturation in young Mexican Americans and decrease with acculturation in older adults (Kaplan and Marks 1990).

2.3.5.4 Other environmental factors

Other factors that may affect the relationship between place of birth/ethnicity and health include place of living, work environment, difficulties and stress associated with relocation of immigrants to a foreign country (Lipson and Omidian 1992; Lipson and Meleis 1985; Laffrey et al. 1989), language and communication problems with health professionals (Hill et al. 1990; Wright 1983; Ramakrishna and Weiss 1992), social support networks (Lipson and Meleis 1985; Kuo and Tsai 1987), and racial discrimination (Freeman 1993).

The views of the functional importance of the family and its role during illness (Gold 1992; Lipson and Meleis 1983; Yim-San et al. 1980), the practices and attitudes towards health and health care (e.g., folk practices, religious and cultural beliefs, values and taboos), and pain perception (Ramakrishna and Weiss 1992; Lin-Fu 1988; Snow 1983; Hill et al. 1990; Kraut 1990; Greenwald 1991) could also influence the way immigrants and non-immigrants deal with diseases and use health services (Kraut 1990).

2.4 Conclusion

Differences in the dietary habits and health status of population sub-groups by place of birth, ethnicity, and race are now acknowledged in various countries. However, studies performed in the past did not always account for potential confounders (including demographic, body constitution, genetic, and environmental factors) that could have explained, at least partially, the observed disparities.

Differences in the dietary intake and health status of immigrants and non-immigrants are not well understood yet in Canada. For this reason, and because of the openness of the Canadian immigration system, Canadian studies that include information on potential confounders are needed to gain a better understanding of the association of place ...th with dietary intake and health in Canada.

CHAPTER 3. RESEARCH QUESTIONS

3.1 Goal of the research

The main goal of this research project was to evaluate if place of birth was associated with the nutritional and health characteristics of the population of Ontario (main focus of the study), as well as Quebec, using data from the 1990 Ontario Health Survey (OHS) and the 1990 Quebec Heart Health and Nutrition Survey (QHHNS). This investigation included two primary, one secondary, and two exploratory research questions. Each of these questions included a number of specific sub-questions. The use of a broad range of research questions was made because very few information is available in this area of research in Canada.

3.2 Primary research questions

This study includes two primary research questions.

1. After adjusting for relevant covariates (including ethnicity, demographic, nutritional, and health related attributes), is *place of birth* associated with:

   a) *dietary intake* (recommendations of the 1992 Canada Food Guide, fat, saturated fat (QHHNS only), polyunsaturated fat (QHHNS only), fibre, calcium, cholesterol, energy, carbohydrate, protein, alcohol, iron, vitamin C, thiamin, riboflavin, niacin)?

   b) *anthropometric traits* (BMI, obesity, overweight, low BMI, waist-to-hip circumference ratio (QHHNS only), differences between reported and measured height and weight (QHHNS only))?

   c) *nutritional knowledge* (QHHNS; general knowledge of the influence of fat, cholesterol, and salt intakes on health)?

2. After adjusting for relevant covariates (including ethnicity, demographic, nutritional, and health related attributes), *is place of birth* associated with:

a) *health problems* (number of health problems (OHS only), cardiovascular diseases, hypertensive diseases (OHS only), hypertension (QHHNS only), knowledge of own hypertension (QHHNS only), diabetes mellitus, digestive diseases (OHS only), gastro-intestinal ulcer (OHS only), cancer (OHS only))?

b) *blood lipids* (QHHNS only: total-cholesterol, LDL-cholesterol, HDL-cholesterol, total-cholesterol-to-HDL-cholesterol ratio, triglycerides, knowledge of own high total cholesterol)?

c) *number of consultations* with health professionals and with general practitioners and specialists (OHS: during the past twelve months; QHHNS: during the past three months)?

d) *sum of cut-down days and bed-days* during the past two weeks (OHS only)?

e) *self-perceived health* (OHS only)?

3.3 Secondary research question (OHS only)

Our secondary research question was related to the association of the acculturation of immigrants with a selection of dietary, anthropometric, and health outcomes.

3. After adjusting for relevant covariates (including place of birth, demographic, nutritional, and health related attributes), is *acculturation* (measured using ethnicity, language spoken at home, and time since migration), among immigrants, associated with:

a) *dietary intake* (fat, fibre, calcium)?

b) *anthropometric traits* (BMI, obesity, overweight, low BMI)?

c) *health characteristics* (number of health problems, cardiovascular diseases, hypertension, number of consultations with health professionals and with general practitioners and specialists, sum of cut-down days and bed-days, self-perceived health)?

3.4 Exploratory research questions

Two additional research questions were explored in an attempt to understand more fully the relationships being studied. However, because of limitations in the data and design used to answer these research questions, they were considered exploratory only and for this reason, they are discussed in separate chapters of the thesis.

4. After adjusting for relevant covariates (including ethnicity, demographic, nutritional, and health related attributes), and after selecting *only* the individuals whose dietary pattern has not changed over time, is place of birth still associated with anthropometric and health characteristics (same characteristics as those specified in research question 2; OHS only)?

5. How is the association of place of birth and acculturation with anthropometric and health characteristics modified when no adjustment is made for dietary covariates?

CHAPTER 4. METHODOLOGY: PRIMARY AND SECONDARY RESEARCH QUESTIONS

4.1 Introduction

This chapter gives a brief description of the study design and data sources used to answer the primary and secondary research questions. Selection procedures used to construct the study groups are then presented and the selected variables are described. Finally, statistical methods are outlined and ethical considerations are discussed.

4.2 Choice of the study design

Various study designs are used in epidemiological research (Kelsey et al. 1986a; MacMahon and Pugh 1970) and a number of them have been employed to study the association of place of birth, ethnicity, and race with dietary intake and health. For example, the comparison of the mortality experiences of non-immigrant and immigrant sub-groups within countries have helped identify the mortality risks of immigrants to different countries (Abu-Zeid et al. 1978; Marmot et al. 1984; Newman and Spengler 1984; Wang et al. 1989; Nair et al. 1990; Grulich et al. 1992; Thouez and Ghadirian 1991). Numerous migrant studies, which typically compare mortality (or morbidity) rates among the migrants, the individuals in the native country, and those in the host country (Kasl and Berkman 1983; Kotin 1970; Kmet 1970), have also been performed to better understand the relative influence of heredity and environment on disease development (Kagan et al. 1974; Adelstein et al. 1984; Kasl and Berkman 1983; Østbye et al. 1989). These two study types, however, often do not account for factors that may have contributed to the differences observed between immigrants and non-immigrants (see section 2.3).

To allow for a precise control of confounders, an ideal scenario would be a cohort study in which a group of immigrants would be followed over time before and after migration and compared with a group of individuals born in the host country (also followed over time). Strengths of this design include: 1) exposure (place of birth and previous migrations) could be measured more accurately; 2) risk factors (and changes in the risk factors) for the selected outcomes could be measured regularly and then adjusted for in the statistical analysis; and 3) the temporal sequence of events and causal relationships could be determined with greater confidence. However, this type of study would be very long and costly, would likely be subject to severe loss-to-follow up, and would not be very efficient for rare diseases. For these reasons, cross-sectional studies, including large American surveys such as the NHANES, HHANES, and NHIS have also frequently been used to investigate differences in the prevalence of health problems and the use of health care services by place of birth, ethnicity, and race (Solis et al. 1990; Marks et al. 1990; Espino et al. 1991; Pawson et al. 1991).

Cross-sectional studies have the advantage of having a relatively low cost, they can be done in a short time period, and because they are usually based on samples of the general population, their generalizability is a considerable strength (Kelsey et al. 1986b; Mausner and Kramer 1985; Kish 1987). According to Kish (1987), surveys not only allow for clear statistical inferences to defined populations, but the measurements performed in surveys are often made in the natural settings of these populations; this represents an additional advantage compared with design experiments.

However, the most important limitation of cross-sectional studies is that since exposure status, confounders, and outcome status are measured at one point in time (or over a short period of time), causal inferences from cross-sectional data cannot be inferred with great confidence (Kelsey et al. 1986b; Lilienfeld and Lilienfeld 1980); the sequence of events cannot be determined as in prospective studies. Nevertheless, cross-sectional investigations are used for etiological studies, particularly to investigate the risk factors for health problems of slow onset and long duration for which medical care is not sought until the problem reaches an advanced stage (e.g., osteoarthritis). They are also used in epidemiologic research to help generate hypotheses and provide etiological leads for future investigations. Kelsey et al. (1986b) also report that standard statistical methods for the control of confounders can be applied to cross-sectional data.

Because few studies of the association of place of birth with dietary intake and health characteristics have been performed in Canada, secondary analysis of available cross-sectional data (that include information on potential confounders) appeared as a reasonable approach to gain a better understanding of this association for the development of future longitudinal studies in this area of research in Canada. Consequently, data from the OHS and QHHNS were used.

The advantages of secondary analysis have been reviewed by Hyman (1972) and Dale et al. (1988). These benefits first entail the general economy of time, money, and personnel. The use of large government surveys such as the American NHANES, NHIS, and HHANES, and in Canada the Nutrition Canada Survey, the 1987 Quebec Health Survey, and more recently the 1990 Ontario Health survey, represents a unique opportunity to researchers: these surveys have a large sample size, they include high quality data, careful questionnaire design, fieldwork, and methodological development, and they usually allow for the investigation of a wide variety of research topics. Secondary analysis can also be useful to perform comparative analysis (nationally, cross-nationally, or over time) and analyses of time trends, to investigate relationships that were unforeseen at the time of data collection, to use various approaches to answer a research question, as well as to develop new research hypotheses.

4.3 Sources of data: OHS and QHHNS

Although this study used data from both the OHS and the QHHNS, the primary data source for this thesis was the OHS. The main reason for this was the large overall sample size of the OHS (see section 4.3.1) and the fact that it included a large number of individuals born outside of Canada, i.e., individuals we were interested in studying. Because of its relatively small sample size (overall, and more specifically the small number of individuals born outside of Canada), the QHHNS was used *only* to complement OHS data (the proportion of immigrants living in Ontario is also larger than it is in Quebec). Consequently, the analyses used for the QHHNS data were kept as similar as possible to those used for the OHS.

4.3.1 OHS

The OHS was conducted from January to November 1990 (Ontario Ministry Health 1992a) to provide data on demographic and socioeconomic characteristics, lifestyle risk factors, and health status of the population of all ages in the province of Ontario (excluding natives on reserves and individuals in institutions).

The OHS used a multi-stage cluster design to select a sample of households from each of 42 geographic clusters (public health units; PHU). Each PHU was further stratified into urban (urban core and urban fringe components of any Census Metropolitan Areas or Census Agglomeration present in the PHU) and rural (remainder of the PHU) strata. Sampling was a two-stage process. At the first stage, a sample of enumeration areas (EA; smallest geographical unit for which census counts can be retrieved by automatic means; 1986 Census data was used) was selected from the urban and rural strata of each PHU. A sufficient number of EA (on average 46) was sampled from each PHU to obtain close to the desired 760 dwellings. A list of up-to-date counts and addresses was then made for each EA. Each identified dwelling was given a unique listing number and was further identified by its street address and description. At the second sampling stage, a sample of dwellings was selected from the EA list. The same number of dwellings was selected from each enumeration area for a given stratum within a PHU (approximately 15 dwellings from each urban EA and 20 from each rural EA). The selected EAs were randomly divided over the four quarters of the survey time period. Each selected dwelling was assigned to a survey month for the interview to be conducted.

Within each household, a personal interview with a knowledgeable member solicited information for the entire household (topics included: demographic and socioeconomic characteristics, contacts with health professionals, two-week disability, use of medication, medical insurance, accidents and injuries, health status, restriction of activities, and chronic health problems). The interview was conducted in English or in French. Self-administered questionnaires, available in English, French, Italian, Portuguese, and Chinese, and covering health and lifestyle factors, were left by the interviewers to be completed by all household members age 12 years and over (topics included: smoking, alcohol intake, physical activity, nutrition, general health, medicine and drugs, family relationships, dental health, life in general, driving and safety, women's health, sexual health, and occupational health; sections on occupational health, driving and safety, women's health, sexual health, and social support were excluded from the self-completed questionnaire used for respondents 12 to 15 years old). No physical examination data or biological samples were collected as part of the OHS.

The overall response rates were 87.5% for the interview and 77.2% for the self-completed questionnaire. The survey included information on 61,239 individuals (representing 9,743,720 persons). The OHS dataset included 1,262 variables (1,016 raw variables and 246 derived variables) from which 90 were selected for this study (used directly or to derive other variables). An *OHS SAS-Unix dataset* was created from raw data stored on a magnetic tape with some additional variables on one floppy disk provided by the Ontario Ministry of Health in August of 1993.

4.3.2 QHHNS

The QHHNS was conducted from September to December 1990 (Santé Québec 1991). This survey contains information on the presence of risk factors for myocardial infarction and cerebrovascular accidents in the Quebec population aged 18 to 74 years, as well as information on their knowledge of these risk factors, on dietary intake, and on demographic and socioeconomic traits. Participants were chosen from the list of all registered members of the Quebec Health Insurance Program (Régie de l'Assurance Maladie du Québec), using a multi-stage stratified random sampling procedure (Santé Québec et al. 1994). Stratification was according to geographic region, age, and sex.

The QHHNS included (Santé Québec 1990a, 1990b, 1991; Santé Québec et al. 1994): 1) a home interview conducted by a nurse who also did blood pressure measurements; 2) a visit to a clinic (including anthropometric measurements, blood sample, and blood pressure measurements); 3) a self-completed questionnaire on nutrition; and 4) a home interview on dietary intake, performed by a dietitian. Interviews and questionnaires were available in French and English.

Of the 3,058 individuals contacted, 2,354 persons between 18 and 74 years of age agreed to participate. Response rates were: 77.0% for the home interview; 68.6% for the clinic visit; 67.2% for laboratory data; and 69.3% for the dietary interview. The QHHNS dataset included 721 variables (raw or derived) from which 65 were selected for this study. A *QHHNS SAS-Unix dataset* was created from a set of SAS-PC and SPSS-PC datasets supplied by Santé Québec in February 1993 and September 1994.

4.4 Representativeness of the surveys in terms of immigration attributes

As a means of assessing the representativeness of the survey samples in terms of immigration attributes (country of birth, year of migration, age at migration, and current age of immigrants and non-immigrants), the OHS and QHHNS respondents were compared to those of the general population of Ontario and Quebec, using 1991 Canada census data (Statistics Canada 1993a). Because published data on immigration from the 1991 census are available for *all* Ontarians (not by age groups), all respondents to the OHS from *all* age groups were included in this comparison. The QHHNS included only respondents from 18 to 74 years of age. For this reason the comparison of census data (population of *all* ages in Quebec) with this survey was less precise.

Statistics Canada (1993a) defines as non-immigrants the individuals who are Canadian citizens by birth, and immigrants as individuals who are, or have been, landed immigrants in Canada. Landed immigrants are individuals who are not Canadian citizens by birth, but who have been granted the right to live in Canada permanently by Canadian immigrant authorities. Because we did not have information on the immigration status of OHS and QHHNS respondents, the following definitions were used in this study:

1) **non-immigrants**: individuals who were born in Canada;

2) **immigrants**: individuals who were born outside of Canada.

We have decided not to consider only recent immigrants (who may be different from long-term immigrants) in this study for three reasons. First, it would have required setting an arbitrary cut-off point to define "recent" immigrants; the influence of time since migration was instead included in research question 3. Secondly, we wanted to use a definition that was as close as possible to the definition used by Statistics Canada.

Thirdly, we wanted a more general overview of the characteristics of the overall immigrant population and not of recent or long term immigrant sub-groups.

As shown in Table 4.1, the distribution of all OHS respondents by place of birth, as well as the age distribution of immigrant and non-immigrant respondents to the OHS, were similar to those found in the 1991 Census for the province of Ontario (Statistics Canada 1993a). This observation gave us more confidence in the representativeness of the sample for these variables. Age at migration was also close to census results, but proportionally more immigrant participants in the OHS migrated to Canada before reaching the age of 20 years. Periods of migration for the OHS respondents also differed slightly from census data: compared with the overall immigrant population of Ontario, a higher proportion of immigrant respondents migrated before 1961, and fewer migrated between 1988 and 1991.

Results from the QHHNS (Table 4.2) indicated that the distribution of the immigrants by region of origin was comparable to census results, although the proportion of immigrants in the QHHNS was slightly lower than the overall proportion of immigrants in the province of Quebec in 1991 (Statistics Canada 1993a). As was the case for the OHS, the year of migration differed somewhat from census data: a higher proportion of immigrant respondents migrated before 1970, and a smaller proportion of recent immigrants were found in the QHHNS than in the immigrant population of Quebec. In addition, a higher proportion of OHS immigrant respondents migrated when they were 20 years of age or older.

The lower proportions of recent immigrants in both surveys compared with census data may have been affected by the fact that the surveys were performed in 1990 and, consequently, they did not include as many very recent (1990 to 1991) immigrants as the 1991 census. In the OHS, for example, the proportion of immigrant respondents who migrated in 1990 was less than half the proportion of immigrants who migrated in the previous years (1.2% of all immigrant respondents migrated in 1990, 2.5% in 1989, and 3.3% in 1988).

Table 4.1 Comparison of the OHS study group with 1991 Census data.

Variables	OHS data[1] %	'91 Census Ontario[1,2,3] %
Region of birth	effn[4]=12,314	n=9,850,890
Canada	76.7	76.0
North America	1.1	1.0
Europe	14.1	13.9
Asia	4.6	5.3
Caribbean	1.4	1.6
Africa	0.7	0.8
Central/South American	1.5	1.3
Oceania	0.1	0.1
Year of migration	effn[4,5,6]=2,817	n=2,369,170
<1961	33.9	28.7
1961-70	19.3	20.1
1971-80	23.0	23.0
1981-87	13.8	14.4
1988-91	10.0	13.9
Age at migration	effn[4,6]=2,817	n=2,369,175
0-4 years	12.8	10.6
5-19 years	29.3	27.6
20+ years	57.9	61.8
Age of immigrants	effn[4]=2,883	n=2,369,175
<15 years	4.9	5.2
15-24 years	9.8	9.1
25-44 years	37.4	37.2
45-64 years	31.3	31.8
65+ years	16.7	16.7
Age of non-immigrants	effn[4]=9,431	n=7,481,715
<15 years	24.8	25.6
15-24 years	16.7	15.8
25-44 years	32.3	32.8
45-64 years	16.6	16.6
65+ years	10.1	9.3

[1] For individuals of all ages.
[2] Some totals vary because of the rounding of census data.
[3] Census data based on a sample of 20% of the population.
[4] effn: effective sample size (sample size adjusted for statistical weight and design effect, see section 4.7.2).
[5] Does not include 1991.
[6] Some missing data for this variable.

Table 4.2 Comparison of the QHHNS study group with 1991 Census data.

Variables	QHHNS data[1] %	'91 Census Quebec[2,3,4] %
Region of birth	effn[5]=1,175	n=6,766,335
Canada	92.4	91.3
North America	0.3	0.4
Europe	3.9	4.2
Asia	1.5	1.9
Caribbean	0.5	0.8
Africa	1.0	0.7
Central/South America	0.4	0.6
Oceania	0.0	0.0
Year of migration	effn[5,6,7]=89	n=591,210
<1961	27.7	23.2
1961-70	31.7	19.9
1971-80	18.5	24.0
1981-87	12.6	17.2
1988-91	9.4	15.8
Age at migration	effn[5,7]=89	n=591,210
0-4 years	10.3	9.6
5-19 years	23.0	26.4
20+ years	66.7	64.0
Age of immigrants	effn[5]=90	n=591,210
<15 years	-	6.6
15-24 years	6.6	10.0
25-44 years	49.7	37.0
45-64 years	34.4	30.9
65+ years	9.2	15.5
Age of non-immigrants	effn[5]=1,085	n=6,175,125
<15 years	-	21.6
15-24 years	14.0	13.9
25-44 years	50.3	34.3
45-64 years	26.6	20.3
65+ years	9.1	9.9

[1] For individuals 18 to 74 years of age.
[2] For individuals of all ages.
[3] Some totals vary because of the rounding of census data.
[4] Census data based on a sample of 20% of the population.
[5] effn: effective sample size (sample size adjusted for statistical weight and design effect; see section 4.7.2).
[6] Does not include 1991.
[7] Some missing data for this variable.

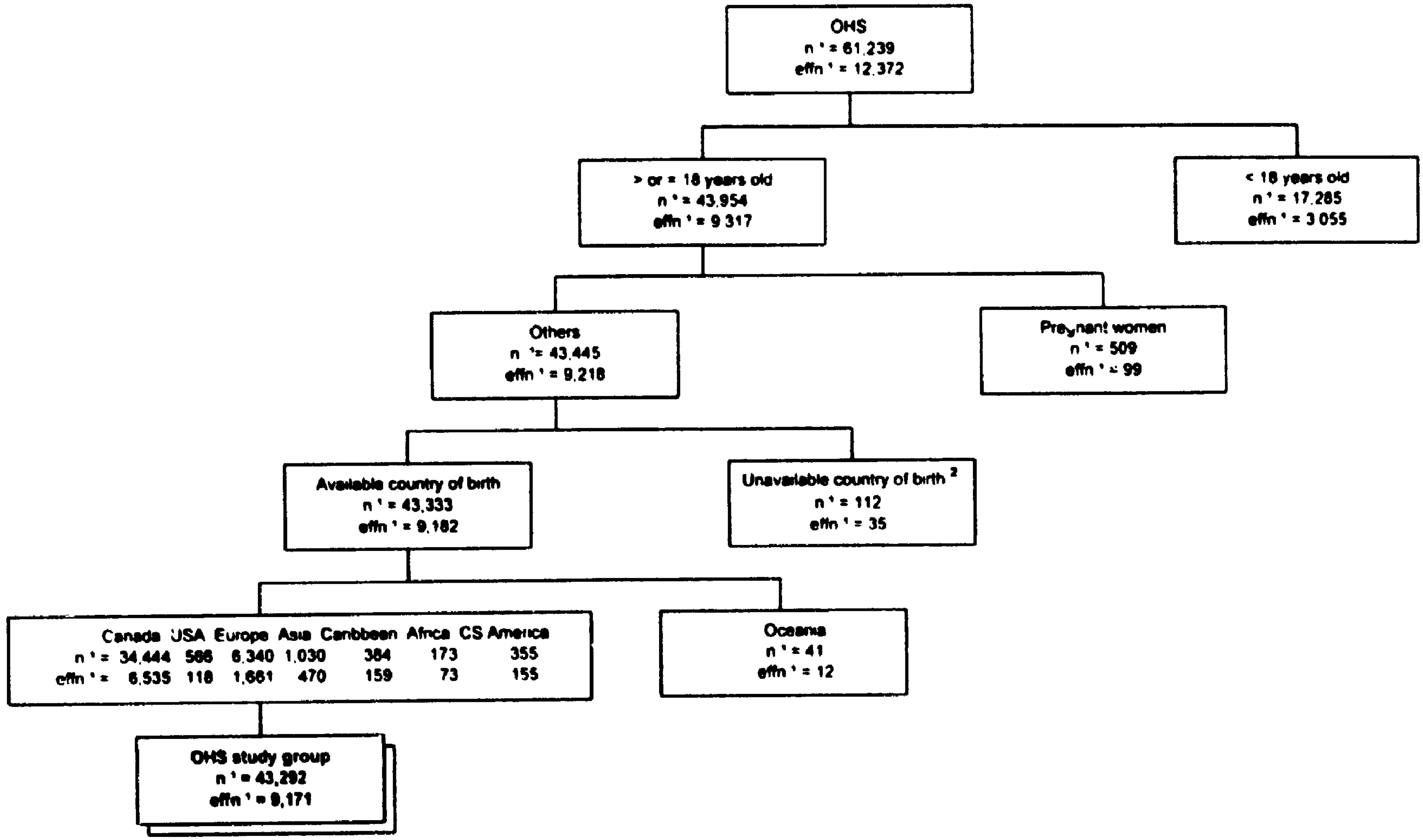
For the QHHNS, the difference may also be due to the age restriction used in this survey. A higher proportion of recent immigrants may also have refused to participate to the survey because of communication problems (Wright 1983). In addition, even if the lists of counts and addresses in each enumeration area selected for the OHS were updated before the survey (Ontario Ministry of Health 1992b), very recent immigrant dwellings may not have been identified before the survey; however, this could also have occurred to non-immigrants who recently moved to a new area of Ontario. In the QHHNS, this problem is less likely to have happened since the Quebec health insurance database, from which sampling was done, is updated continuously. Misclassification by place of residence may have happened, however, if some Quebecers did not inform the Ministry of Health of a change in residence.

4.5 Study groups: inclusion and exclusion criteria

The present investigation included two study groups. The first group was constructed from the respondents in the OHS and the second from the respondents in the QHHNS. The selection procedure is summarized in Figures 4.1 and 4.2.

Individuals 18 years of age and older were included in the study groups. Adolescent participants were excluded because adolescents present a large individual variability in growth patterns and, consequently, in nutritional needs and dietary intake; this makes chronological age a poor index for estimating nutritional requirements (Gong and Heald 1994). As well, the OHS food frequency questionnaire was not tested on an adolescent population (Bright-See et al. 1994). The age limit of 18 years was selected to correspond to the lower age limit used in the QHHNS.

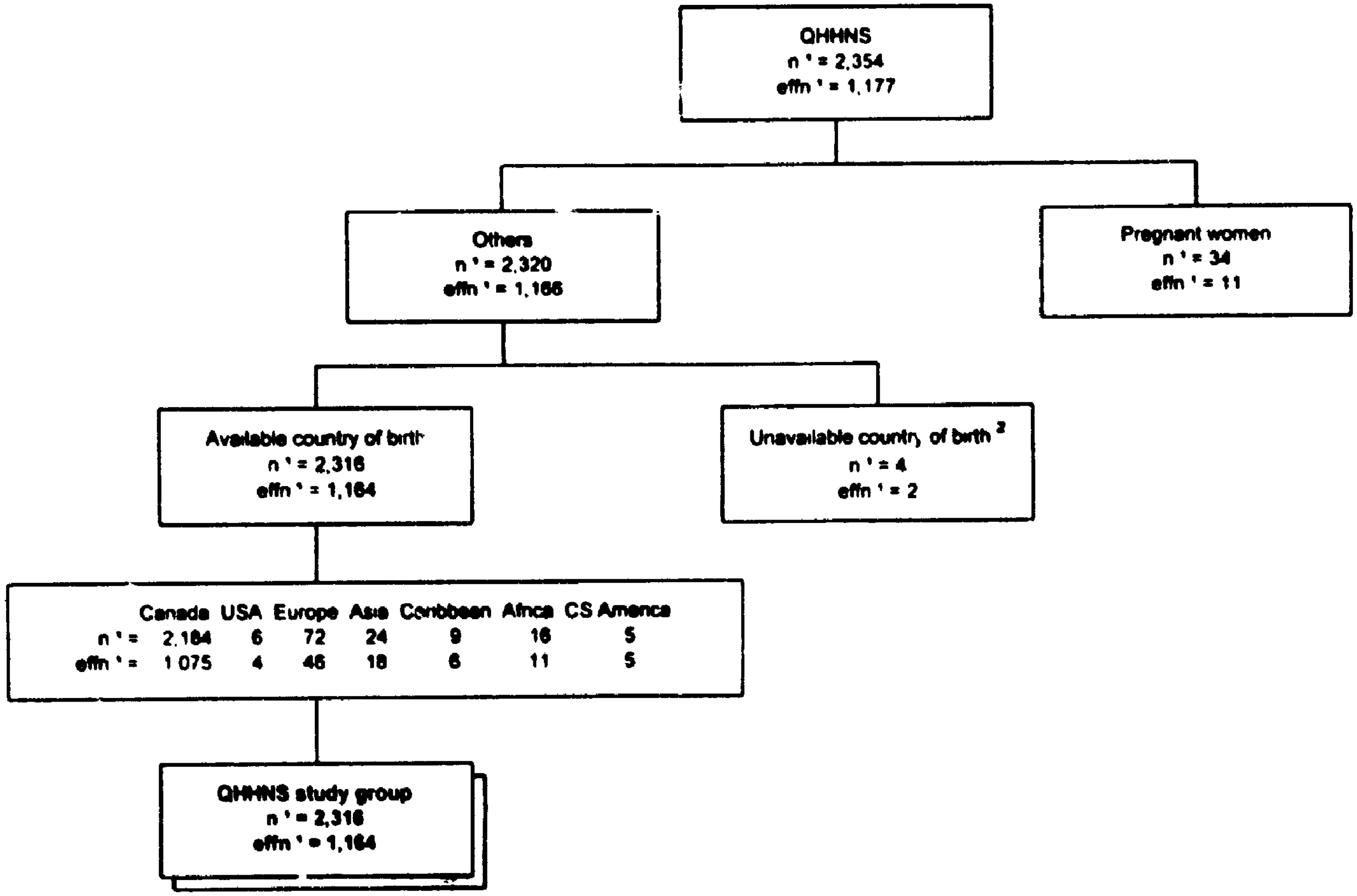
Pregnant and lactating women need to modify their dietary intake in order to cope with increased energy and nutrient requirements (McGanity et al. 1994). They also present special health status considerations. They would therefore need to be treated as a sub-group of respondents. However, it was decided that pregnant women would be excluded from this study. First, in both surveys, the number of pregnant women was relatively small: 509 OHS female respondents age 18 years or over (2.2% of all females



¹ n = crude sample size , effn = effective sample size

² Of those Don't know n=16 , effn=5 · Not stated n=93 , effn=30 · Unidentifiable n=3 , effn=1

Figure 4.1 Selection of the OHS study group



¹ n = crude sample size effn = effective sample size

² Of those Don't know n=2 effn=1 - Not stated n=2 , effn=2

Figure 4.2 Selection of the QHHNS study group

age 18 years and over), and 34 QHHNS female respondents (4.3% of all female subjects) reported being pregnant at the time of the interview. Such small numbers would have created problems when stratifying by place of birth and other covariates in the statistical analysis. Secondly, BMI is not a valid estimate of overweight in pregnant women (Health and Welfare Canada 1988a). Thus, it would not have been possible to use BMI as a risk factor for nutritional and health outcomes for these women. Pregnant women were excluded from the analyses and all other female respondents were assumed to be non-pregnant.

In contrast to pregnancy status, lactation at the time of the survey could not be assessed because no specific question on current lactation was included in either survey. Consequently, lactating women could not be excluded from the study groups. This may have biased the results in favour of higher nutrient intakes (more likely to meet dietary recommendations) and higher likelihood of overweight in some women. However, we assumed that this bias did not likely affect the final results. If we assume that the number of women who could have been breast-feeding is equal to the number of pregnant women in the survey, and knowing (Craig 1993) that approximately 62% of the babies born in Canada during the 1980s (from women 15 years and over) had been breast-fed, then the number of lactating women in this survey is expected to be relatively small.

Because place of birth was the main exposure of interest in this study, respondents who did not give their country of origin or who gave an unidentifiable place of birth were excluded from the study groups. These individuals represented less than 0.3% of OHS respondents 18 years and over (after excluding pregnant women), and 0.2% of QHHNS respondents (after excluding pregnant women). OHS respondents born in Oceania were also excluded from our OHS study group because of their small number (*crude* sample size=41, i.e., sample size *un*adjusted for statistical weights and design effect --see section 4.7.2) relative to other geographical region (Figure 4.1).

We compared the general characteristics of the OHS respondents excluded from the OHS study group on the basis of their place of birth (unknown, not stated, and unidentifiable countries, and Oceania) to the characteristics of the respondents included in the OHS study group (Table 4.3).

Table 4.3 Basic demographic and socioeconomic characteristics of the OHS respondents included in and excluded from the OHS study group on the basis of their place of birth.

Variable	Status		Statistic	p-value
	included[1] (effn[2,3])	excluded[1] (effn[2,3])		
Gender (%)				
Male	48.9 (4,490)	47.9 (22)	χ^2_1<0.001	0.996
Female	51.0 (4,681)	52.2 (24)		
Age in years (mean ± SD)	44 ± 18 (9,171)	44 ± 20 (47)	$F_{1,43,444}$ =0.046	0.923
Stratum (%)				
Urban	87.2 (7,998)	93.7 (44)	χ^2_1=1.217	0.270
Rural	12.8 (1,172)	6.3 (3)		
Marital status (%)				
Married	69.1 (6,307)	60.5 (28)	χ^2_3=1.844	0.398
Single	20.0 (1,828)	27.5 (13)		
Separated/divorced/widow(er)	10.9 (995)	12.0 (6)		
Education (%)				
Primary/less	5.7 (526)	15.6 (7)	χ^2_4=10.961	0.027
Some secondary	14.6 (1,335)	3.6 (2)		
Completed secondary	23.4 (2,140)	26.3 (11)		
Some post-secondary	18.6 (1,703)	17.5 (8)		
Completed post-secondary	37.6 (3,445)	36.9 (16)		
Income[4] (%)				
Low income	13.4 (1,047)	15.5 (5)	χ^2_2=0.335	0.846
Not low income but <$50,000	40.0 (3,132)	35.1 (11)		
≥$50,000	46.6 (3,646)	49.4 (15)		
Ethnicity[5] (%)				
Canadian/Canadian+other eth.	62.3 (5,694)	28.6 (9)	χ^2_1=13.562	<0.001
Other ethnicity(ies)	37.7 (3,040)	71.4 (22)		
Language at home (%)				
English/French	88.9 (8,132)	28.6 (26)	χ^2_1=2.634	0.105
Other	11.1 (1,014)	71.4 (7)		

[1] Included (in the OHS study group): individuals with known place of birth; excluded (from the OHS study group): individuals with unknown, not stated, and unidentifiable places of birth, and individuals born in Oceania.

[2] effn: effective sample size (sample size adjusted for statistical weight and design effect (see section 4.7.2).

[3] Totals vary because of rounding and missing information.

[4] See section 4.6.2.

[5] See section 4.6.3.

We observed that individuals who were excluded were fairly similar to those excluded. However, they tended to have a lower education (primary or less) than those who were included in the OHS study group. They also less frequently reported a Canadian ethnicity or a combination of Canadian and any other ethnicity than did the subjects who were not excluded from the study group. This last observation suggests that there may be more immigrants than non-immigrants who did not report their country of origin and who consequently were excluded from the present study. However, we hypothesized that this did not affect the results in a major way because of the very small number of respondents with an invalid place of birth response. Similar comparisons were not made for the QHHNS study group because too few respondents were excluded on the basis of their place of birth (unknown/not stated: *crude* number=4).

4.6 Selected variables

A summary of the variables selected and of their role(s) in the analyses (exposure, covariate, or outcome) is presented in Table B1 of Appendix B. The choice of the variables varied somewhat according to study group (OHS/QHHNS). However, variables from the QHHNS were selected to be as similar as possible to those selected from the OHS (see section 4.3).

The overall proportions of respondents in the OHS and QHHNS study groups with valid information for the selected variables are presented in Table B2. Only variables with at least 80.0% of the answers being non-missing, overall, were included in this study. Except for a few variables, the categories "Don't know" and "Not stated" were treated as missing information.

For the OHS, the variable with the lowest overall proportion of non-missing answers was energy expenditure (80.8%), and the second lowest was dietary intake (84.2%). Only these two variables as well as household income and alcohol consumption had a proportion lower than 90.0%. For the QHHNS, blood LDL-cholesterol measurement had the lowest proportion of non-missing data (84.3%). Proportions for eleven variables were between 85.0% and 90.0% (household income, BMI, difference between self-reported and measured weight and height, all blood lipid variables, knowledge that the individual has high blood cholesterol); all other variables had a proportion equal to or greater than 90.0%. While the proportion of respondents with a non-missing answer for income is often reported to be low in general surveys (Liberatos et al. 1988), this proportion was relatively high here (OHS: 85.3%; QHHNS: 88.7%).

For each survey, the proportions of immigrant and non-immigrant participants with non-missing answers were generally similar (Table B3), although the proportions were somewhat smaller for immigrants for some variables. For immigrants, the proportions fell below 80% for dietary intake (79.1%) and physical activity (75.6%) in the OHS, and for the individual's knowledge that he or she has high blood cholesterol (76.1%) in the QHNNS.

4.6.1 Exposure variables

4.6.1.1 Place of birth

Place of birth was the main exposure of interest in this thesis, except for the study of acculturation. For the analyses involving OHS data, places of birth were grouped in four different ways (from general to more specific) to create four exposure variables. The 1991 census Canada geographical classification of places of birth (Statistics Canada 1993a; see Appendix C) was used to create these variables. Geographical groups (as small as possible) were selected if their *effective sample size* (i.e., the sample size adjusted for statistical weights and design effect; see section 4.7.2 for details) was equal to or greater than 25. This arbitrary cut-off point was determined after considering the number of individuals available from each region, sub-region, and country of birth in the OHS database. With this sample size, all European sub-regions (in the 1991 census Canada classification system), all Asian sub-regions but Western Asia, one African sub-region, both Central and South America, and 18 countries could be selected. The same sub-regions and countries could also be used in the analyses of dietary intake on place of birth (these analyses represent the core of the analyses). The smallest *crude* number of individuals in one of the selected sub-groups was 80 (East Africa: *effective* sample size=34). Groups not meeting the pre-requisite sample size were amalgamated according to Census Canada classification guidelines. The variables created were:

1) **IMM**, which dichotomized the respondents into those born in Canada (non-immigrants) and those born outside of Canada (immigrants);

2) **REGION**, which categorized individuals by region of birth (Canada, United States, Europe, Asia, Caribbean, Africa, and Central/South America);

3) **SUB-REGION**, which grouped the subjects by sub-region of birth (Canada, United States, Western Europe, Northern Europe, Scandinavia, Southern Europe, Eastern Europe, East Asia, South East Asia, South Asia, Middle East, Caribbean, East Africa, Other Africa (North/South/Central/West), Central America, and South America; and

4) **COUNTRY**, which categorized the respondents by country of birth (Canada, USA, Germany, Holland, United Kingdom, Italy, Portugal, Yugoslavia, Greece, Poland, Hungary, Other Europe, Hong Kong, China, Philippines, Vietnam, India, Other Asia, Jamaica, Trinidad, Other Caribbean, Africa, Guyana, Other Central/South America).

For each variable, Canada was the reference category. For COUNTRY, the sub-groups Other Europe, Other Asia, Other Caribbean, Africa, and Other Central/South America were kept in the analyses to preserve the number of respondents between analyses. However, significant relationships found for these groups are not described in the results.

Due to missing data, the number of respondents varied by outcome of interest, and thus, the number of respondents in each selected geographical sub-group also varied. When a geographical sub-group became too small (*effective* sample size <25) for a selected outcome, or when there was no event in one sub-group, this sub-group was combined with larger groups in an attempt to keep as many respondents as possible in the analyses and thus keep the number of respondents as similar as possible between analyses. If the sub-group could not be joined to another related group, it was removed from the analyses. This methodological issue is described in Tables D1-D4 of Appendix D.

Because of the small number of QHHNS respondents born outside of Canada, comparisons were restricted to the variables IMM (Canada, Others) and REGION (Canada, Europe, Others). Analyses and conclusions drawn from this survey were consequently more limited.

4.6.1.2 Acculturation variables: OHS only

Three exposure variables were used in the study of the acculturation level of immigrants (research question 3). Non-immigrants were excluded from these analyses.

ACCETHNI was defined using reported ethnicity. Respondents could report up to four different ethnicities in the OHS. Three levels of acculturation were used:

1) *low acculturation*: immigrants who did *not* report a "Canadian" ethnicity but who reported at least one other cultural identity (reference group);

2) *intermediate acculturation*: immigrants who reported a "Canadian" ethnicity *and* at least one other cultural identity;

3) *high acculturation*: immigrants who reported only a "Canadian" ethnicity.

Language spoken at home was used to create a "language acculturation" variable, **ACCLANG**. We assumed that:

1) immigrants who were *not* speaking English or French at home and who were born in a country where English or French was *not* an official language (Encyclopedia Britannica 1993) were *not acculturated* (reference group): we assumed that individuals born in a country where English or French was *not* an official did *not* know these languages before coming to Canada, and consequently that they did not change their language spoken at home after migrating;

2) immigrants who were speaking English or French at home and who were born in a country where English or French was *not* an official language were *acculturated*: we assumed that these individuals changed their language spoken at home after their migration;

3) immigrants born in countries where the official language was English and/or French were classified in a *"not applicable"* category: we assumed that these respondents knew English and/or French before coming to Canada, and, consequently, it was not possible to estimate if they have changed their language use after their immigration.

Finally, we supposed that the longer the time (**TIME**) since migration, the higher the potential acculturation level of the immigrants. Age at migration was indirectly taken into consideration by the inclusion of age and length of time in Canada in the regression models. Age was forced into all regression models involving acculturation.

In the study of acculturation, place of birth was used as a covariate. REGION, SUB-REGION, and COUNTRY (see section 4.6.1.1) were used as individual covariates in three sets of analyses. For each of these variables, the category with the largest number of respondents was selected as the new reference category (to replace Canada as the reference group): Europe was selected for REGION, North Europe for SUB-REGION, and United Kingdom for COUNTRY.

4.6.2 Demographic and socioeconomic variables

Gender, age, marital status, area of residence (rural/urban stratum), education, household income status, stress level (OHS only), and satisfaction with social life (used as a measure of social integration) were treated as potential confounders of the associations studied (see section 4.7.4). These variables have been strongly related to place of birth or ethnicity and to nutritional and health parameters (Ben-Shlomo et al. 1993; Badets and Chui 1994; Frank-Stromborg 1991; Pineo 1977; Hulshof et al. 1991; Bolton-Smith et al. 1991; Cronin et al. 1982; Susser et al. 1985; Molzahn and Northcott 1989; Kasl 1984; Rahman et al. 1994). As suggested by Blishen et al. (1987), independent indicators of socioeconomic status were preferred to a composite socioeconomic index.

For the OHS, highest education in the household, i.e., highest education attained among all members of a household, was selected in an attempt to reduce the problem associated with individuals who were students (*crude* number of students=2,644; i.e., 6.1% of the OHS study group members), and to reduce non-response for this variable.

Household income status was derived by the Ontario Ministry of Health (1992b) using household income, household size, and area of residence (urban/rural). The low income category was defined using poverty lines and low income cut-offs developed by the National Council of Welfare (1989) and Statistics Canada (1990) respectively (Ontario Ministry of Health 1992b). Respondents were classified into three household income groups: 1) low income; 2) income between low income and $50,000; and 3) income equal to or greater than $50,000. A similar classification was applied to QHHNS data.

4.6.3 Ethnicity

In both the OHS and the QHHNS, ethnicity was used as a covariate in the regression analyses, except for the study of acculturation (see section 4.6.1.2). Three categories based on reported ethnicity or ethnicities (it was possible to report up to four different ethnicities in the OHS and two in the QHHNS) were used: 1) Canadian ethnicity *only*; 2) a combination of Canadian ethnicity *and* any other ethnicity; 3) any ethnicity *except* Canadian ethnicity, or a combination of ethnicities *except* Canadian ethnicity. Respondents who reported being Canadian and English or Canadian and French and who were born in Canada were classified as Canadians.

4.6.4 Nutritional variables

Nutritional variables included current dietary intake, anthropometric characteristics, nutritional knowledge, and other nutrition related variables.

4.6.4.1 Current dietary intake

The current dietary intake of the subjects was described in terms of both daily food and nutrient intakes. The selection of the nutrients for this study was based on the availability of data in the OHS (i.e., nutrients studied in the OHS). Limitations associated with the dietary data collection techniques used are discussed in section 8.2.5.1.

In the OHS, current dietary intake was measured using a self-administered food-frequency questionnaire developed and validated by Dr. Elizabeth Bright-See (Ontario Ministry of Health 1992a; Bright-See et al. 1994). Nutrient intakes were derived by the Ontario Ministry of Health (1992a, 1992b) using the CANDAT nutrient analysis system based on the 1988 Canadian Nutrient File modified to include the latest information on the dietary fibre content of foods (Bright-See et al. 1994). The QHHNS used both a 24-hour food recall and a food-frequency questionnaire administered by trained dieticians (Santé Québec 1990b). In the present project, data from the 24-hour food recall were used because derived nutrient intakes from the food-frequency questionnaire were not available. The methods used to collect dietary data were the same as those used in the Nutrition Canada Survey (Santé et Bien-être Social Canada 1975) and the Nova Scotia Heart Health Program (Santé Québec 1990a; 1990b). Dietary intakes were derived by the Bureau of Biostatistics and Computer Applications of the Food Directorate of Health and Welfare Canada (Junkins and Karpinski 1994) using the 1988 Canadian Nutrient File revised to include foods and recipes specific to the Quebec diet (Santé Québec 1990b).

The OHS food-frequency questionnaire did not probe for information on alcohol-containing beverages, but the number of alcoholic drinks consumed during the past seven days was estimated in another section of the self-completed questionnaire. For this reason, energy intake derived from the food-frequency questionnaire excluded energy from these beverages and thus underestimated *total* energy intake. The QHHNS 24-hour recall allowed for the recording of alcohol-containing drinks consumed during the day preceding the interview. However, to make results more comparable between surveys, especially for nutrient intakes reported in relation to dietary energy, energy intake from alcohol in the QHHNS was excluded from total energy intake. Energy from alcohol only and not from alcohol-containing beverages (i.e., energy from alcohol *and* from other energy providing nutrients found in alcoholic drinks) had to be used because information on total energy intake from alcoholic drinks was not derived from the 24-hour recall.

4.6.4.1.1 Canada Food Guide variables: OHS only

For the OHS, information on the number of servings, consumed daily, of eight food groups was available. Intakes for the four food groups of the 1992 Canada Food Guide (Health and Welfare Canada 1992) were examined: "Cereals and Breads"; "Vegetables and Fruits"; "Milk Products"; and "Meat, Poultry, Fish, and Alternates". The other groups consisted of: "Desserts and Sugar"; "Added Fats; "Mixed dishes"; and "Coffee and Tea".

Daily intakes for each group of the Canada Food Guide were compared to the recommendations of the Guide as a way of estimating if the overall daily food consumption provided a nutritionally sensible eating pattern. For each group, a binary variable was created to indicate if the respondents met (reference category) or not at least 75% of the recommended number of servings for this group. The use of 75% of the recommendations and not 100% was selected for two reasons: 1) to allow for the fact that some of the foods consumed were classified under "Mixed dishes" or "Desserts and Sweets" in the OHS without being sub-divided into components that should have been classified under one or more of the four groups of the Guide; and 2) to allow for the possible selection, by some respondents, of foods of high nutrient density (in that case, a respondent could potentially have met his or her own nutritional needs with less servings than suggested). In addition to these four binary variables, the total number of food groups satisfying the recommendations of the Guide was calculated. Individuals were then dichotomized into those meeting *all* four recommendations of the Guide (reference group) and those meeting *less than* four recommendations.

4.6.4.1.2 Nutrient intake

In order to try limit the length of the OHS food-frequency questionnaire, the development of the questionnaire (Ontario Ministry of Health 1992b, Bright-See et al. 1994) was based on three nutrients: fat, fibre, and calcium (however, the questionnaire also incorporated most commonly used food and beverages so that total energy intake could be estimated and nutrients expressed in relation to energy). For this reason, principally, but also because of the importance of these nutrients from a public health perspective (Nestle 1992; Garrow 1991), these nutrients were treated as "priority nutrients" in this study. The daily intake of fat (percent of dietary energy), fibre (g/megajoules (g/MJ)), and calcium (mg/day) was studied. For the OHS, calcium intake included calcium from supplements.

The daily consumption of cholesterol (mg/day), energy (kJ (kilojoules)), carbohydrate (percent of energy), protein (percent of energy), iron (mg/day), vitamin C (mg/day), thiamin (mg/5MJ), riboflavin (mg/5MJ), and niacin (niacin equivalent(NE)/5MJ) was also investigated. For the QHHNS, saturated fat (percent of energy) and polyunsaturated fat (percent of energy) intakes were also studied. Data on vitamin A were accessible for both surveys but they were not explored here since vitamin A intake has been reported to be unreliable in the OHS (Bright-See et al. 1994). Alcohol intake was estimated using the number of alcohol-containing beverages consumed during the week preceding the surveys.

4.6.4.1.3 Comparison to nutritional recommendations

Fat, saturated fat, cholesterol, fibre, and carbohydrate intakes were compared to Canadian nutritional recommendations for these nutrients (see recommended intakes in Appendix E). Subjects were dichotomized into those meeting (reference category) and those not meeting each recommendation. The likelihood of high fat, saturated fat, and cholesterol intakes, and the likelihood of low fibre and carbohydrate intakes were examined. The sum of the reported number of alcoholic drinks consumed during the seven days preceding the surveys was used to dichotomized the subjects according to their level of risk associated with alcohol intake, defined using the Ontario Ministry of Health (1988) recommendations: 1) no risk/low risk (reference group): 0-14 drinks/week; 2) moderate/high risk: more than 14 drinks/week.

Protein, iron, vitamin C, thiamin, riboflavin, niacin, and calcium intakes were compared with nutritional recommendations using the probability approach described by the Subcommittee on Criteria of Dietary Evaluation (1986) and by Beaton (1994a). This approach estimates the probability that an individual has an inadequate intake of a nutrient i.e., an intake below his or her own requirement. This approach assumes that:

1) requirements for a nutrient are normally distributed;
2) the coefficient of variation is approximately 15%;
3) the correlation between intake and requirement is very low;
4) the recommended intake meets the requirements of 97.5% of the population (95% for iron).

This method has been previously tested for protein, iron, vitamin C, thiamin in men, and vitamin A (Subcommittee for Criteria of Dietary Evaluation 1986). In this study, it was used to approximate the adequacy of intakes of these nutrients, *as well as* the adequacy of thiamin (in both men and women), riboflavin, niacin, and calcium intakes (Anderson et al. 1982).

The Canadian Recommended Nutrient Intakes (RNI; see Appendix E) were used as references for the recommended intakes of protein, vitamin C, thiamin, riboflavin, niacin, and calcium. Because the definition of calcium requirements is extremely difficult and incomplete (Health and Welfare Canada 1990a), two references were used to assess the risk of "inadequate" calcium intake: 1) the RNI; and 2) the World Health Organization (WHO; World Health Organization 1962) recommendation. The WHO recommended intake is approximately half the RNI (see Appendix E).

In the case of iron, the probability approach cannot be used for menstruating women without modification: while basal iron losses of women are assumed to be the same as those of men after adjustment for body size, there is a strong positive skew in the distribution of menstrual iron losses (Beaton 1994a). Nevertheless, this distribution is found to approximate a log normal distribution (Beaton 1994b). Consequently, it was possible to estimate the probability of "inadequate" iron intake using log transformed data for menstruating women. In this study, these women were defined as women between 18 and 50 (inclusive) years of age (London and Hammond 1990). Recommendations from a joint FAO/WHO Expert Group (Food and Agriculture Organization 1988) were used for iron, as suggested by Beaton (1994b).

The coefficients of variation published by Health and Welfare Canada (1990a) were used for protein (11.9% for males 16-18 years of age, 12.4% for females 16-18 years, 12.5% for males and females 19 years and over), vitamin C (20%), thiamin (15%), and niacin (15%). The coefficient of variation suggested by the WHO (Food and Agriculture Organization 1988) was used for iron (15%). For riboflavin and calcium, we assumed that the coefficient of variation was 15%.

Knowing the recommended intake for the selected nutrient, the variability in requirements (coefficient of variation), and assuming that the distribution of the requirements follows a normal curve, it was possible to calculate the probability, for an individual, of *not* meeting his or her own need for each of the selected nutrients. Because the distributions of the resulting probabilities were highly negatively skewed, individuals were dichotomized into:

1) those having *low risk of "inadequate" intake* (or an *"adequate" intake)* for this nutrient: individuals with a 50% or less probability of *not* meeting their own requirement (reference group);

2) those having a *high risk of "inadequate" intake* (or an *"inadequate" intake)* for this nutrient: individuals with a greater than 50% probability of *not* meeting their own requirement for a nutrient.

In this study, "inadequacy" only refers to this relative evaluation and *not* to an absolute inadequate or deficient intake or status.

4.6.4.2 Anthropometric characteristics

Health and Welfare Canada (1988a) reported that BMI represents a valid measure of the relationship between weight and health for adults between 20 and 65 years of age (except for pregnant and lactating women); after the age of 65 years, an increase in BMI is not as closely associated with a higher risk of health problems. The BMI of the respondents between 20 and 65 years (exclusive to parallel reports from the Ontario Ministry of Health (1992c)) was used to define overweight (BMI>25 kg/m^2), obesity (BMI>27 kg/m^2), and low BMI (BMI<20 kg/m^2), using Health and Welfare Canada's (1988a) cut-off points.

In the OHS, BMI was based on self-reported weight and height. Reported measurements are known to be of sufficient accuracy in most circumstances (Willett 1990a; Millar 1986). In the OHS, values of BMI less than 7 kg/m^2 or greater than 45 kg/m^2 were excluded from the analyses, as recommended by the Ontario Ministry of Health (1992b). This procedure was suggested to help correct for the fact that some respondents, who may have reported their weight in the wrong units (kilograms instead of pounds or vice versa) because of the layout of the questionnaire, may not have been identified during data editing (Ontario Ministry of Health 1992b). It was estimated, however, that errors were present in less than 1% of the respondents.

In the QHHNS, both reported and measured weights and heights were available and measured data were used to calculate BMI. Differences between measured and reported weights and heights were also examined to estimate under and over-reporting; BMI was used as a covariate for these outcomes. In addition, waist and hip circumferences were measured and used to calculate the waist-to-hip circumference ratio, an indicator of abdominal obesity and of the risk for diseases such as ischemic heart disease and diabetes (Willett 1990a; Health and Welfare Canada 1988a). Respondents were dichotomized into high and low risk for this variable. High risk was defined as a ratio greater or equal to 1.0 for men and 0.8 for women (Health and Welfare Canada 1988a).

4.6.4.3 Nutritional knowledge: QHHNS only

General knowledge of the effect of fat, cholesterol, and salt intakes on health was explored for the QHHNS. Three binary variables were used to assess the lack of knowledge of the respondents:

1) FAT-KNOW: "has heard about any health problems that might be related to how much fat people eat" (reference group) versus "has not heard about it or does not know";

2) CHOLESTEROL-KNOW: "has heard about cholesterol *and* thinks that cholesterol is found in foods *and* thinks that cholesterol in the foods you eat can affect your health" (reference group) versus "has not heard about cholesterol or does not think that cholesterol is found in foods or does not think that cholesterol in the foods can affect health or does not know to any of the previous statements";

3) SALT-KNOW: "thinks that the amount of salt you eat can affect your health" (reference group) versus "does not think so or does not know".

FAT-KNOW and CHOLESTEROL-KNOW were treated as covariates for the regression of fat and cholesterol intakes on place of birth.

4.6.4.4 Nutrition related variables: OHS only

Chewing ability (no chewing problem versus some chewing problem) and thinking that it is possible to improve health by changing eating habits ("thinks that it is possible" versus "does not think that it is possible or does not know") may influence dietary intake

(Carlos and Wolfe 1989; Allard and Mongeon 1982; Sheperd and Stockley 1987). These OHS variables were treated as covariates in the analyses involving nutritional outcomes.

4.6.5 Health related variables

4.6.5.1 Health behaviours

Four health behaviours were treated as covariates in the regression analyses: cigarette smoking, physical activity, alcohol intake, and diet. Smoking, physical activity, and alcohol intake have been related in the past to place of birth, ethnicity, dietary intake, anthropometric traits, and health status (Richards and Baker 1988; Millar 1992; Edwards and MacMililan 1990; Margetts and Jackson 1993; Subar et al. 1990; Mao et al. 1988; Bild et al. 1993; Hultman et al. 1994; Siscovick et al. 1985; Glassner 1981; Feinman and Lieber 1994; Wright 1987). Dietary intake has also been associated with place of birth (Freimer et al. 1983), anthropometric and health parameters (Shils et al. 1994).

Smoking status included three categories: 1) never a smoker (reference category); 2) past smoker; and 3) current smoker. Individuals who reported abstinence from smoking for less than one year were excluded from the analyses (Schwartz 991).

In the OHS, energy expenditure (in kcal/kg/day) from leisure time physical activities was derived by the Ontario Ministry of Health (1992b) using the type of physical activities the respondents participated in during the month preceding the survey, the frequency of these activities, the time per session, and the metabolic energy cost for each activity expressed as a multiple of the r sting metabolic rate. In the QHHNS, physical activity was assessed using the number of times the respondent participated in physical activities for 20 or 30 minutes duration per session during his or her leisure time within the past four months. This variable included six categories: 1) never; 2) less than once a month; 3) about once a month; 4) about 2 to 3 times a month; 5) 1 to 2 times a week; 6) 3 or more times a week.

As mentioned before, the number of drinks consumed during the week preceding the survey was used to estimate alcohol consumption. Dietary covariates included fat (as percent energy), fibre (g/1,000 kcal), and energy (kilocalories) intakes; these nutrients have been associated the most frequently with numerous major health problems (Nestle

1992; U.S. Department of Health and Human Services 1988). For the QHHNS, saturated fat intake was used instead of total fat intake when investigating blood lipids (Kris-Etherton et al. 1988). Energy intake was forced into the regression models if fat or fibre were present in order to produce measures of fat and fibre intake that were independent of total caloric intake (Willett 1990b).

4.6.5.2 Health problems

The overall number of health problems reported by the OHS subjects was calculated and examined in this study. Because of the highly negatively skewed distribution of this variable, a binary variable was created to categorize the respondents into those who reported no health problems (reference group) and those who reported at least one health problem.

This study focused on non-communicable major health problems which have been related to place of birth or ethnicity, and to nutrition (Feldman 1994; Kotchen and Kotchen 1994; Anderson and Geil 1994; Helzlsouer et al. 1994; Shils et al. 1994): 1) cardiovascular diseases, including angina (QHHNS only), infarction (QHHNS), intermittent claudication (QHHNS only), hypertensive diseases (OHS only), and hypertension (QHHNS only); 2) diabetes mellitus; 3) digestive diseases (OHS only), including gastrointestinal ulcers (OHS only); and 4) neoplasms (OHS only).

Self-reported and proxy information were used for all health problems except for hypertension in the QHHNS; limitations associated with these data collection techniques are discussed in section 8.3.5. The identification of proxy respondents was not possible. In the QHHNS, the presence of hypertension was established using both self-reported information and blood pressure measurements (Santé Québec et al. 1994). The prevalence of the selected health problems may have been underestimated if there was underdiagnosis or if the respondents did not want to report their health problems; however, underestimation could not have been estimated. The prevalence may have been overestimated if individuals reported health problems that were only transient or that they did not truly have. For the OHS, it was possible to try to limit overreporting of health problems by selecting only the respondents who reported having seen or talked to a physician during the last year about their particular health problem(s). The proportions of respondents who reported a health problem and who did/did not consult a physician about this health problem are shown in Table 4.4.

Table 4.4 Prevalence of reported health problems with and without taking account of consultation with medical doctor for the health problem (OHS).

Health problem[1]	Method	
	Self-reporting only %	Self-reporting and consultation with a physician[2] %
Circulatory- All	15.3	13.3
Hypertension	10.3	9.5
Other circulatory	7.3	5.8
Diabetes mellitus	2.7	2.5
Digestive- All	8.7	5.1
Gastro-intestinal ulcer	2.8	1.8
Other digestive	6.3	3.5
Cancer	2.1	1.6

[1] Defined using ICD-9 codes (U.S. National Centre for Health Statistics 1978) based on health problems reported at one of ten questions during the interview: 1) hypertensive diseases: 401.0-405.9; 2) other circulatory: 390.0-399.0 and 410.0-459.9; 3) all circulatory: 390.0-459.9; 4) diabetes mellitus: 250.0-250.9; 5) gastro-intestinal ulcer: 530.2 and 531.0-534.9; 6) other digestive: 530.0-530.1, 530.3-530.9, and 535.0-579.9; 7) all digestive: 520.0-579.9; 8) cancer: 140.0-239.0.

[2] Respondents were asked when they had consulted a health professional (including physicians), during the last 12 months, for each of their health problem.

Total overreporting was likely to have been small: the proportion of individuals who reported specific health problems *without* having consulted a physician for them was relatively similar to the proportion of individuals who reported these health problems *and* reported consulting a physician for them during the last year. However, proportions differed somewhat for gastro-intestinal diseases (which may have included temporary illnesses that did not require physician consultation).

Blood total-cholesterol, LDL-cholesterol, HDL-cholesterol, and triglyceride measurements were performed in the QHHNS and were used in this study. Lipid profiles were compared to optimal values, as defined by Santé Québec et al. (1994), to assess the increased risk of cardiovascular disease: 1) high total cholesterol (≥5.2 mmol/L or ≥6.2 mmol/L); 2) high LDL-cholesterol (≥3.4 mmol/L); 3) low HDL-cholesterol (<0.9 mmol/L); 4) high triglycerides (≥ 2.3 mmol/L); and 5) high total cholesterol to HDL-cholesterol ratio (>5.0). The subject's knowledge of whether he or she had hypertension or high blood cholesterol (≥5.2 mmol/L) was also studied using QHHNS data.

In the OHS, cardiovascular diseases, diabetes, digestive diseases, cancer, as well as the presence of any other type of disease, were used as covariates in the analyses involving dietary intake outcomes because these health problems might have affected food and nutrient intakes (Shils et al. 1994). In the QHHNS, information on digestive diseases, cancer and other health problems were not available; thus, only cardiovascular disease and diabetes were used as covariates for the analyses investigating dietary intake. In the QHHNS, family history of cardiovascular disease was used as a covariate for the analyses relating place of birth and cardiovascular disease, hypertension, angina, and blood lipids. Diabetes was a covariate for cardiovascular diseases (OHS, QHHNS) and angina (QHHNS), hypertension was a covariate for angina (QHHNS), and LDL-cholesterol (treated as continuous) was a covariate for cardiovascular diseases (QHHNS) and angina (QHHNS).

4.6.5.3 Other health related variables

The number of consultations with a health professional (OHS: general practitioner, specialist, nurse, dentist, optometrist, pharmacist, physiotherapist, chiropractor, psychologist/social worker, other health professional; QHHNS: general practitioner, specialist, other health professional) and, more precisely, with general practitioners and specialists, during the past twelve months for the OHS and during the past three months for the QHHNS, was investigated. Continuous variables were used in the OHS. For the QHHNS, however, these variables were dichotomized into: 1) no consultation (reference group); and 2) one or more consultation. This dichotomization s due to the strong negative skewness of these variables.

For the OHS, the sum of bed-days (days during which the respondents had to stay in bed all or most of the day because of health problems) and cut-down days (days during which the respondents had to cut down on the things they normally do because of their health), during the 14 days preceding the interview, was investigated (Ontario Ministry of Health 1992b). Because of the highly negatively skewed distribution of this variable, a binary variable -vas derived; the two categories were as follows: 1) no bed-day or cut-down day (reference group); and 2) 1 to 14 bed-days or cut-down days.

Finally, and for the OHS only, self-perceived health was studied as an overall index of health status. To estimate self-perceived health, respondents were asked if, in comparison to other persons of the same age, they would say that their health was: poor; fair; good; very good; or excellent. This variable was kept in its ordinal structure.

The number of consultations with general practitioners and specialists was used as a covariate for the regression of the number of cut-down days/bed-days and self-perceived health on place of birth and acculturation variables. Self-perceived health was treated as a covariate for the regression of dietary intake on place of birth.

4.7 Data management and statistical analysis

In this study, data verification and statistical analyses were performed using the statistical package SAS version 6.09 running under SunOS (Unix).

4.7.1 Non-response

Non-response has been found to be an important problem associated with survey data (Lemke and Drube 1992). In this study, we decided not to impute missing data but to drop missing or incomplete records involved in particular regression analyses, assuming that discarded respondents were not different from those who remained in the analyses (Anderson et al. 1983). This procedure decreased the number of subjects in the analyses.

However, we tried reducing this problem by re-entering the excluded subjects during the backward procedure of the regression analyses when this was possible (see section 4.7.4).

4.7.2 Statistical weights and design effect

To give results representative of the target populations, analytic weights available in the OHS and QHHNS databases were used in all analyses. With regard to the OHS, statistical weights accounted for selection probability, non-response, and for the age-sex population structure of each Public Health Unit (Ontario Ministry of Health 1992a). In the QHHNS, statistical weights accounted for selection probability, non-response, geographic strata, gender, and age (Santé Québec et al. 1994). In each survey, the sum of the weights was equal to the overall provincial population surveyed (OHS: 9,743,720; QHHNS: 5,000,371).

Weights were standardized before being used in the statistical analyses. This meant that they were rescaled by dividing each weight by the overall average weight so that the adjusted sum of weights was equal to the number of cases in the sample (Ontario Ministry of Health 1992b). This standardization was done for all respondents, that is, before excluding any respondent (respondents not eligible or with missing information), with the result that standardized weights were representative of the original weights for the total survey samples. The standardization had the advantage of reducing the risk of artificially high statistical power associated with untransformed statistical weights (Lee et al. 1986). The average standardized weight for the OHS study group was 1.049 (standard deviation=1.270; median=0.623; range: 0.003-28.766) and for the QHHNS study group it was 1.005 (standard deviation=0.645; median=0.7337; range=0.218-3.950).

Finally, to statistically adjust for the complex sampling design of the surveys (Cox and Cohen 1985; Rao and Scott 1992; Lee et al. 1986), average design effects of 4.95 (Ontario Ministry of Health, 1992b) and 2.0 (Junkins and Karpinski 1994) were applied to the OHS and QHHNS respectively. Design effect is defined as the ratio of the true variance of a statistic to the variance derived under simple random sampling assumption (Cox and Cohen 1985). A design effect of 2.00, for example, suggests that the same precision could have been reached with half the observations, had a simple random sampling design been used. Not accounting for design effect in the analyses would give a misleadingly high statistical power to the analyses and increase the risk of type I error. For the OHS, a series of design effects was supplied by the Ontario Ministry of Health (1992b). By using the largest design effect supplied (average for all variables for the province), we assume that we have produced results that are conservative. For the QHHNS, an average design effect of 2.00 was selected based on preliminary results for nutritional data (Junkins and Karpinski 1994).

In the statistical analyses, design effect was adjusted for using two methods. First, for chi-square tests and logistic regression analyses, design effect was incorporated in the analyses through the manipulation of the sample weights to reduce the number of sample elements (Rao and Scott 1992; Lee et al. 1986): standardized weights were divided by the average design effect and then used in the analyses. The resulting ***effective sample sizes*** were equal to the number of individuals (adjusted for statistical weights) divided by the design effect. Secondly, for analyses of variance and linear regression analyses, post-hoc adjustments of the variance had to be performed (Rao and Scott 1992): F-statistics were divided by the design effect.

4.7.3 Descriptive statistics

Weighted proportions, weighted means, standard deviations (unadjusted for design effect for simplicity), and medians were calculated using standard procedures (Rosner 1990; SAS Institute Inc. 1985). Some chi-square tests of association and analyses of variance (Rosner 1990; Daniel 1987; SAS Institute Inc. 1985, 1990) were calculated at this stage (i.e., for Table 4.3). Descriptive statistics were performed only to test for incongruity that could have been present in the data and to get a first overview of the overall characteristics of the study populations. For this reason, description of the data by population sub-groups (e.g., age, gender) were *not* performed, except by non-immigrant/immigrant sub-groups. In addition, because of the lack of information on specific design effect for each variable studied, standard deviation were unadjusted for design effect in the presentation of descriptive results. The research questions were answered using regression analyses (see below).

4.7.4 Regression analyses

Logistic and linear regression analyses (Hosmer and Lemeshow 1989; Kleinbaum et al. 1988) were the main analyses used in this study. As suggested by Kelsey et al. (1986b), the control of confounding variables is possible when analysing cross-sectional data. For this reason, adjustment was made for covariates selected because they were known risk factors for the outcome studied and because they had been associated in the past with the exposure of interest. Such adjustment allowed us to estimate if place of birth (or acculturation) per se, that is, after removing the influence of covariates selected according to our best knowledge *and* according to the limitations associated with the data used, could explain the differences in the nutritional and health characteristics of immigrants and non-immigrants. The adjustment gave a clearer picture of the association of place of birth and acculturation (including unknown factors related to culture, genetics, migration process, conditions in the country of birth, etc.) with dietary intake and health parameters, compared with unadjusted analyses.

A backward chunkwise method (Kleinbaum et al. 1988; Hosmer and Lemeshow 1989) was used for regression analyses, assuming that no interaction was present in the data. The chunkwise procedure had the advantage of reducing the number of statistical tests compared with the selection of single variables for removal from the regression models. The backward stepwise approach was selected because it tends to give more efficient models, i.e., it gives a conservative subset (more variables in a model) of independent variables to predict the outcome of interest (Kennedy and Bancroft 1971).

Regression analyses for each outcome variable included three general steps (Greenberg 1985):

1) the regression of the outcome of interest on the exposure variable only;

2) the regression of the outcome on the exposure variable and all the selected chunks of covariates (full model);

3) the backward stepwise modelling procedure using the chunk selection procedure, starting from the full model and leading to the final model (exposure variable and significant covariates (at $\alpha<0.25$, see below)).

Results from steps 1 and 3 are included in result tables. Exposure variables were *forced in* all regression models. For the study of acculturation, age was also forced in the models to indirectly adjust for age at migration (see section 4.6.1.2). Covariates were grouped into chunks of related variables presented in a conceptual order:

1) *demographic*: gender, age, marital status, stratum;

2) *ethnicity*;

3) *socioeconomic or social*: education, income, stress, satisfaction with social life;

4) *diet related*: chewing capacity, thinks that diet influences health;

5) *health behaviours*: diet (total fat, saturated fat, fibre, and energy intakes), knowledge about fat and cholesterol intake, smoking, alcohol intake, physical activity;

6) *BMI*;

7) *health problems and consultations with general practitioners and specialists*: cardiovascular, hypertensive, and digestive diseases, diabetes, cancer, other health problem, number of health problems, family history of cardiovascular disease, LDL-cholesterol level, and number of consultations with general practitioners and specialists;

8) *self-perceived health*.

We assumed that the first three chunks contained basic variables. Thus, they were included in all full models but were subject to removal during the backward selection procedure, just like other chunks of variables. The inclusion of chunks 4 to 8, as well as the specific variables selected within these chunks, varied according to the outcome of interest (see Appendix F).

Chunk elimination was performed backward, i.e., from chunk 8 to chunk 1. Chunks of covariates were removed entirely if the multiple chi-square or multiple-partial F test for the chunk was non-significant, that is, if it had a *p-value greater than of equal to 0.25*. This conservative level has been suggested by Hosmer and Lemeshow (1989). Mickey and Greenland (1989) also reported that significance tests performed acceptably compared to the change-in-estimate criterion method if the selected significance level was greater or equal to 0.20. In this study, if the p-value for the chunk was smaller than 0.25, a backward procedure within the chunk was done using the same significance level (Kleinbaum et al. 1988). The backward elimination procedure was repeated until all non-significant chunks of variables or variables within chunks were removed from the model. Individuals excluded from the full model because of missing information for one or more variables were re-entered in subsequent analyses if these variables were removed from the model during the backward procedure. This was done to increase the sample size (in the models) and thus make the sub-selected samples more representative of the overall study groups.

Because of the high number of sub-research questions answered in this thesis (see section 3.1), this research is subjected to the problem associated with multiple testing (Tukey 1977; Rothman 1986), which consist of an increased risk of type I error. To try counterbalance this risk, the significance level for the exposure variables was reduced to $\alpha = 0.01$ for the presentation and discussion of the results. The 99% confidence intervals and p-values for each exposure variable were also included in regression result tables to give more information to the reader (Rothman 1986). Regression estimates associated with a p-value smaller than 0.01 are presented in bold in the tables. A few borderline significant relationships ($0.01<p<0.05$) were also found and are described in result chapters.

4.7.5 Data transformation

The distribution of the continuous outcomes was plotted and variables presenting a non-normal distribution were normalized using square-root and log normal transformations (Kleinbaum et al. 1988). Such procedures have the advantage of normalizing the distribution of the continuous outcomes (Kleinbaum et al. 1988), but they make the interpretation of the beta coefficients resulting from multiple regression analyses less intuitive.

For OHS data, square-root transformations were applied to fibre, calcium, protein, iron, vitamin C, and cholesterol intakes, and to the number of consultations with health professionals or with general practitioners and specialists. Log normal transformations were used for energy, thiamin, riboflavin, and niacin intakes. For the QHHNS data, square-root transformations were used for fibre, saturated fat, polyunsaturated, cholesterol, energy, protein, vitamin C, thiamin, riboflavin, and niacin intakes, while the distribution of iron intake and BMI were modified using log-normal transformations.

4.7.6 Multicollinearity

The presence of multicollinearity in regression analyses was appraised using two methods: 1) the observation of high estimated standard errors for the regression estimates; 2) the examination of condition indices and variance proportions (Kleinbaum et al. 1988; Myers 1990). According to Kleinbaum et al. (1988), two or more variance proportions greater than 0.50 associated with a condition index equal to or greater than 30 indicate some collinearity, while two or more variance proportions greater than 0.90 associated with a condition index equal to or greater than 30 indicate moderate to severe collinearity.

Multicollinearity tests are best applicable to linear regression (Kleinbaum et al. 1988). However, as suggested by Kleinbaum (1992), these statistical tests were also applied to dichotomous outcomes. No multicollinearity was found for any of the outcome variables.

4.7.7 Large confidence intervals

In the regression analyses, large confidence intervals due to low prevalence and large standard errors (Hauck and Donner 1977) were identified for some exposure variables and outcomes. Some statistical tests were performed to compare the results of the regression analyses when the variables presenting such large confidence int· vals were included or excluded from the models. The results of these tests indicated no important differences in the regression estimates and no significant difference was observed between the models (using the difference in -2 log likelihood statistics). For this reason, these variables were kept in the analyses. However, the odds ratios associated with large confidence intervals must be interpreted with care.

4.7.8 Outliers

For linear regression analyses, the presence of outliers, i.e., extreme values that can significantly influence the least-squares fitting of a model (Kleinbaum et al. 1988), was investigated using two different statistics, the Cook's D statistic and the DFFITS statistic (Kleinbaum et al. 1988; SAS Institute Inc. 1990; Myers 1990). No values of Cook's D statistics greater than 1.0 were found, which suggests that no influential observations were present for the analyses performed. However, high DFFITS statistics, i.e., values larger than 2.0 or smaller than -2.0 (SAS Institute Inc. 1990), were detected for some variables (for the OHS: 1) research questions 1 and ˆ: high values were detected for 20 out of 72 analyses (total of 32 influential observations); 2) research question 3: high values were detected for 10 out of 24 analyses (total of 13 influential observations); 3) research question 4: no high value was detected; for the QHHNS: one high value was detected for one out of 34 analyses). High values ranged from 2.02 to 4.03 and from -3.68 to -2.03. Regression analyses were run again with the influential observations excluded and the results of these analyses were compared with those obtained when these observations were kept in the analyses. Since the results were essentially the same, the observations with high DFFITS statistics were kept in the analyses. Because of the high number of subjects in the analyses, we are confident that the presence of the few diagnosed c ıtliers did not affect the results of the linear regression analyses.

4.8 Power calculations

Post-hoc power calculations were performed rather than sample size computations because the number of subjects available for this study had already been set by the number of participants in the OHS and QHHNS. Power was consequently dependent on the sample size in the primary data sources, a general limitation associated with secondary data analysis. Formulae described by Kelsey et al. (1986c) and by Lachin (1981) were used for an alpha level of 0.01 (two-sided).

Some controversy exists regarding the use of post-hoc power calculations. While Cohen (1992) stressed the importance of such calculations, Goodman and Berlin (1994) suggested that they are inappropriate and that they should be avoided. According to Goodman and Berlin (1994), post-hoc power calculations are unhelpful for two reasons: 1) they always indicate that there is low power (<50%) with respect to a non-significant result, and, consequently, the affirmation that a study is "underpowered" with regard to an observed non-significant finding is uninformative and tautological; and 2) the reasoning for the use post-hoc power calculations has an "Alice-in-Wonderland feel" and the interpretation such calculations is confusing. These authors suggest that confidence intervals should be presented as an alternative to post-hoc power calculations; confidence intervals allow for a better comparison and interpretation of the findings, both significant and non-significant. As mentioned above (section 4.7.4), confidence intervals around the regression estimates were calculated in this thesis. However, some power calculations were also performed for a subset of nutritional and health variables which are important from a health promotion point of view in Canada (Health and Welfare Canada 1990a; McGinnis and Ballard Brabash 1991; Carroll 1989): 1) the three priority nutrients: dietary fat, fibre, and calcium (as continuous and binary outcomes); 2) the four anthropometric variables: BMI, overweight, obesity, low BMI; 3) health problems: likelihood of having a health problem, cardiovascular diseases, hypertension, diabetes; 4) number of visits to all health professionals and to general practitioners and specialists; and 5) self-perceived health. Results of these calculations are presented for each level of the exposure variables (e.g., for REGION, power is presented for the comparison of Canada with Europe, Asia, Caribbean, Africa, and Others). For reasons of brevity, power calculations stratified by additional variables (e.g., by gender, age categories, etc.) were not performed; it was assumed that further division of data would lead to power results smaller than those reported for pooled data and would not contribute more to the findings. Since the power calculations did not account for the presence of covariates, they are approximate and should be interpreted with caution. Furthermore, sample sizes that were used in calculations were adjusted for average design effects (which were also approximate, but probably conservative especially in the OHS).

Results from the power calculations are presented in Tables G1-G7 of Appendix G. It was reassuring to find that there was sufficient power for various comparisons between non-immigrants and immigrant sub-groups for the analyses involving the three priority nutrients, particularly for fat and calcium intake (Table G1); consequently, we are confident that any important difference are likely to have been detected for these sub-groups. Power values for the anthropometric and health characteristics (Table G2) were, in general, lower than those found for the dietary variables. Nevertheless, a power above 0.80 was observed for different sub-categories, especially for anthropometric traits, for the likelihood of having a health problem, and for self-perceived health. Power was low, however, for differences in the likelihood of specific health problems and in that case, some true differences may not have been detected.

As expected, the power of the analyses involving QHHNS data was lower (Tables G3 and G4) than the power found for OHS data. We assume that this may have been due mainly to the smaller number of participants, and particularly the smaller number of immigrant participants in this survey. This further supports why the OHS was selected as the main focus of this study and emphasizes the importance of large surveys with large sample sizes when comparisons between smaller population sub-groups are made.

For the study of acculturation (Tables G5 and G6), a relatively high power was noted for ACCLANG and TIME for the majority of the selected outcomes, even if the sample size was reduced considerably by excluding all respondents born in Canada. However, for the analyses involving respondents whose dietary pattern had not changed (research question 4; see chapter 5), power was sufficient only for certain sub-groups of respondents and for certain outcomes (in particular for the likelihood of cardiovascular or hypertensive diseases, and for seif-perceived health; Table G7); in that case, the number of respondents was reduced by the exclusion of the individuals whose diet was assumed to have changed over time.

4.9 Ethical considerations

This study was approved by the Ontario Ministry of Health and by Santé Québec (see letters of approval in Appendix H) who provided the datasets. Since this study consisted of secondary data analysis of data already available for limited public use, it did not require to be reviewed by the University of Western Ontario Review Board for Health Sciences Research Involving Human Subjects (see letter in Appendix H).

To ensure confidentiality, data from the OHS and the QHHNS were provided by the Ontario Ministry of Health and by Santé Québec with only code numbers identifying the participants; for the OHS additional information on enumeration areas and family identification were concatenated so that identification was not possible. Results from this study are presented exclusively for groups of respondents, and not for individuals, as an additional measure of confidentiality.

CHAPTER 5. METHODOLOGY: EXPLORATORY RESEARCH QUESTIONS

5.1 Introduction

This chapter describes the specific considerations related to the two exploratory research questions (research questions 4 and 5).

5.2 Association of place of birth with anthropometric and health characteristics for the individuals whose dietary pattern has not changed (research question 4)

This study was based on cross-sectional data. As discussed in section 4.2, this type of design has a major limitation: it provides equivocal evidence of causal relationships (Kelsey et al. 1986b). In an attempt to add a longitudinal perspective to this study, we have investigated, in an exploratory fashion, the association of place of birth with anthropometric and health variables, adjusting for diet and other covariates. The longitudinal perspective was given to dietary intake (which was of primary interest in the thesis) using the following reasoning: if we can select the individuals whose diet has been constant for a sufficient period of time (i.e., current diet estimated to be the same as past diet) to influence their current health status, then, diet becomes a more accurate covariate in the study of the relationship between place of birth and health. Only OHS data were used for this section because of the larger sample size of that survey.

5.2.1 Selection process

We first selected the individuals whose current diet was assumed to be similar to their past diet. The comparison of current and past diet would have been ideal if dietary data had been collected within the framework of a longitudinal study. A more realistic alternative, in the present context, would have been to collect, in the framework of the OHS, information on past diet using remotely recalled dietary consumption (using the same food frequency questionnaire; Willett 1990c). However, this would have increased the length of the self-completed questionnaire considerably and would probably have led to higher non-response rates (the inclusion of the one food frequency questionnaire had been discussed during the pre-testing of the survey questionnaires because of its potential impact on response rates; Ontario Ministry of Health 1992a). Because of the inaccessibility of data on past diet, we made the following two assumptions.

Non-immigrants: We assumed that the diet of the Canadian-born respondents had been constant over the years and that their current dietary pattern was reflective of their "past" diet (Canadian-born individuals remained the reference group in the analyses).

Immigrants: Because immigrants are likely to change their diet after migration (Freimer et al. 1983), tests were performed to try to estimate if the current diet of immigrants (diet in Ontario in 1990, OHS data) was similar to their "past" diet, defined here as diet in the country of origin (before migration). In an hypothetical scenario, the dietary intake of immigrant respondents to the OHS would have been compared with that of individuals (matched by age and sex) living in their countries of birth; the methods used to collect information at all research sites would have been similar to those used in the OHS. However, this approach would have been very costly, long, and difficult considering the number of immigrant respondents in the OHS and the large variety of their countries of origin (n=113). In addition, the comparisons would not have taken into account changes in food habits that may have occurred with time in the country of birth: the current diet of an individual in a country (in 1990) may not have been completely comparable with the diet of another individual from this country before his or her immigration to Canada. For these reasons, past diet was estimated, in this study, using Food and Agriculture Organization (FAO) balance sheets data. FAO data and the methods used to compare current and "past" diets are described in the following sections.

5.2.1.1 FAO data

FAO food disappearance statistics give an overview of the food supply patterns (food available for human consumption) of a number of countries for specific reference periods (Food and Agriculture Organization 1991). These statistics are calculated by adding the quantity of food produced in a given country to the quantity of food imported, and then subtracting the food exported, lost in storage, fed to animals, and used for non-dietary purposes (Hiller and McMichael 1991). The resulting quantity is divided by the total population of the country to approximate per capita food availability.

Although food balance sheet statistics have proven to be useful in preliminary examination of hypotheses and time trends for health and diseases, they are subject to several limitations (Hiller and McMichael 1991; Food and Agriculture Organization 1991): 1) they present only crude average estimates of national consumption; 2) they tend to reflect food disappearance patterns rather than actual intake as they include both home food wastage (during storage, in preparation and cooking, as plate-waste, as quantities fed to domestic animals and pets or thrown away) as well as food consumption; 3) they do not provide any indication of the differences that may be found in the diet consumed by population sub-groups (e.g., different age, gender, socioeconomic, and geographical groups within countries); 4) information does not account for seasonal variability in the total food supply; 5) the quality and completeness of data collected vary from one country to the other; and 6) data are completely unavailable for some countries. For these reasons, food balance sheet statistics cannot give accurate estimates of nutrient intakes (especially at the individual level) and cannot replace food consumption surveys. They also cannot be compared satisfactorily to survey data (e.g., food-frequency questionnaires, 24-hour recall, etc.). However, food balance sheet statistics are considered by the FAO (Food and Agriculture Organization 1991) as appropriate for getting an approximate picture of the overall food situation in the countries that can be used for economic and nutritional studies and for the basis of development plans and related projects.

In this study, we used FAO data because they were the only source of information on estimates of nutrient availability for a large number of countries and years: very few surveys of dietary intake have been done for the general population of countries around the world. Because of the limitations of FAO data, this section of the analyses was exploratory only.

Information on per capita nutrient availability was obtained using the FAO Agrostat software (Food and Agriculture Organization 1992); this software presents the per capita availability of foods, energy, fat, and protein for various countries and for the years 1961 to 1990. An *FAO SAS-Unix dataset*, which included energy, fat, and protein availabilities, as well as energy from alcoholic beverages, by year and by country, was created from an ASCII file developed from the Agrostat software (Food and Agriculture Organization 1992).

For each individual, FAO data were compared to OHS data by country of birth and year of migration (country and year-specific comparisons); however, if an OHS participant had not given his country of birth but only his region of birth, the comparison was made by region of birth (region and year-specific comparisons) for this individual. FAO data were not available for 10 of the 127 countries or regions of birth mentioned by the respondents, namely Afghanistan, Bahrain, Cyprus, United Arab Emirates, Aruba, Puerto Rico, West Indies, Namibia, East Africa, and Central America; 37 respondents were from these regions or countries (0.4% of immigrants respondents in the OHS study group based on *crude* numbers). Data for Spain were used for Gibraltar, data for China were used for Taiwan, and data for the former USSR were utilized for Latvia, Lithuania, and Russia. "Past" diet was assumed to be equivalent to the per capita intakes in the country of origin at the specific time (year) of migration for the individuals who migrated between 1961 and 1990; for the respondents who migrated before 1961, FAO data for 1961 were used.

5.2.1.2 Nutrients used to compare current and "past" diet

To compare current diet (OHS data) to "past" diet (FAO data), fat and protein intakes, both expressed as percent of dietary energy, were first selected; however, only fat was used in the final analyses (see below). The proportions of energy from fat and protein were preferred to crude intakes (in grams per day) to make OHS and FAO data more comparable; FAO data tend to overestimate absolute nutrient availability. Energy from alcohol-containing beverages was excluded from the calculation of total energy intake for two reasons: 1) data on the availability of alcoholic beverages in the FAO dataset were missing for some years or countries; and 2) alcohol consumption was not included in the OHS food-frequency questionnaire. Per capita total fat and protein availability was selected, from FAO data, instead of availability of energy, fat, or protein from different food groups (e.g., energy from cereals, milk, fats) because food groups in the FAO and in the OHS were not exactly comparable: FAO data included mainly non-processed foods (e.g., wheat, rice, milk) while OHS data incorporated both processed and non-processed foods (e.g., rice, pasta, milk, yoghurt).

Because of the limitations associated with both food disappearance statistics (Hiller and McMichael 1991) and food-frequency questionnaires (Willett 1990d; 1990e), differences between FAO and OHS data may have been due to methodological differences rather than to a real discrepancy in consumption. This discrepancy was estimated for Canada. We postulated that the overall consumption assessed using OHS data should be similar to the overall consumption estimated with FAO data for Canada in 1990. The proportional difference between OHS and FAO data was calculated. This difference was estimated to be 23% for protein and 3% for fat (both expressed as percent of dietary energy). Because of the large discrepancy found for protein, and because fat was a priority nutrient in this study, only fat (as percent of energy) was used to compare FAO and OHS data.

5.2.1.3 Methods used to compare current and "past" diet

Two methods were first selected to compare current and "past" diet. First, using FAO data, the regression of fat intake on time (years) was performed for each place of birth. Ninety-five percent confidence intervals for the line (Rosner 1990) were calculated. The current dietary intake of each OHS immigrant was then compared to the specific confidence interval corresponding to his or her country of birth and year of migration. Immigrants whose intake was included within the confidence bands for fat were classified as having, in 1990, a diet similar to their "past" diet. We assumed that dietary patterns had been constant before migration.

The second method used an absolute difference (in percentage points) between current fat intake and per capita availability of fat in the country of birth for the year of migration. An absolute difference of 2% was selected (equivalent to approximately a 5% proportional difference); this low proportion was used as a conservative measure. We assumed that if the absolute difference between current fat intake and FAO data was 2%

or less, then, current dietary patterns were similar to "past" dietary patterns; individuals presenting such a difference were *included* in the analyses.

Because the two methods gave similar results (98.2% of the subjects had the same results), the second method was chosen because of its simplicity. The subjects who were *not* selected using this method, i.e., those whose current diet was assumed to be different from their "past" diet, were classified into two groups:

1) those who migrated at least 20 years before the OHS (i.e., before 1971);

2) those who migrated less than 20 years before the OHS (i.e., between 1971 and 1990).

In the first situation, we presumed that immigrants who migrated before 1971 have used a "Canadianized" diet for many years and that this diet could have affected their present health status. The 20 year time interval was selected because ecological comparisons of coronary heart disease mortality trends and trends in food consumption in the United States between 1909 and 1980 have suggested that dietary changes have preceded coronary heart disease mortality variations by 10-20 years (Slattery and Randall 1988). This time interval could thus have been sufficient to allow for the influence of diet on heart health to be manifest. We assumed, therefore, that the current diet of these immigrants reflected their long term "Canadianized" diet. These individuals were *included* in the analyses.

In the second situation, the immigrants have been in Canada for less than 20 years. We postulated that the length of time on a "Canadianized" diet was too short to have affected their current health status. We assumed that the current intake of these immigrants was different from their "past" diet. These respondents were therefore *excluded* from the analyses associated with this research question. Figure 5.1 summarizes the selection process described above.

5.2.2 Regression analyses

After the selection process, we performed the regression of anthropometric and health outcomes on place of birth according to the methods described in section (4.7.4), for the individuals whose current diet was assumed to reflect long term diet.

5.3 Influence of diet (research question 5)

As described in section 4.7.4, different variables were used as covariates in the regression analyses performed to answer our research questions. Among these, diet (fat, fibre, energy) was used as a covariate in the regression of anthropometric and health outcomes on place of birth and acculturation. Because dietary intake was one of the main topics in this thesis, it was necessary to estimate how the association of place of birth and acculturation with anthropometric and health characteristics would be modified if diet was removed from the regression models, that is, to estimate how much of the variation could have been attributed to diet; however, the explicit study of the etiological role of dietary intake in the development of health problems and in the likelihood of consulting health professionals was *not* an objective of the current research. To answer this research question, we first selected the outcomes for which diet was kept as a significant covariate in the regression analyses (final models). Then, regression analyses, with dietary covariates excluded, were repeated. Differences in regression estimates and in statistical significance were examined.

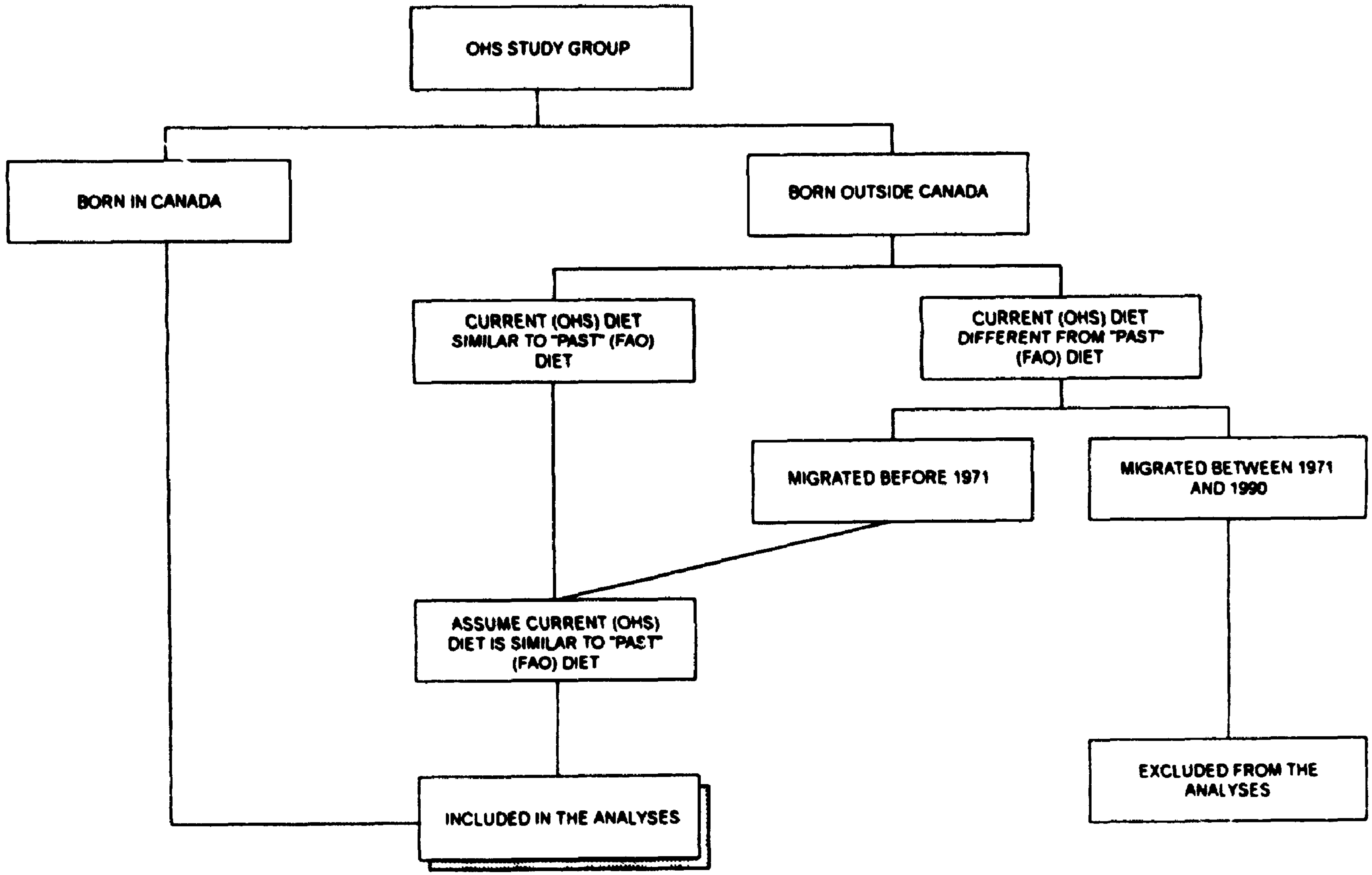


Figure 5.1 Selection of the individuals whose current diet is assumed to be similar to their "past" diet.

CHAPTER 6. RESULTS: PRIMARY AND SECONDARY RESEARCH QUESTIONS

6.1 Introduction

This chapter first provides descriptive information related to exposure variables and covariates. Then, results from descriptive and regression analyses are presented.

In this chapter, two types of tables describe OHS results. First, a series of ***general tables*** (e.g., Table 6.1) displays the overall general results from regression analyses, i.e., the overall level of significance for the relationships between exposure and outcome variables when covariates were adjusted for. Each table contains the results of a few related sub-sections. Secondly, ***summary tables*** (e.g., Table 6.8) outline the significant relationships that were found. No tables are included in this chapter for QHHNS results because too few associations were found to require general or summary tables in the text.

Detailed tables presenting descriptive results (means and proportions) can be found in Appendices J to M. Regression findings (regression estimates with confidence intervals and p-values) for each analysis and for each survey can be found in appendices N to T. These appendices are presented on two diskettes attached to the thesis. The content of each Appendix is included in a separate directory named after the appendix. The names of the files within a directory correspond to the numbers of the tables (e.g., file N1.xls if for Tables N1a to N1d, in Appendix N). The files were created using the software Microsoft Excel, version 4.0 (1985-1992, Soft-Art, Inc.) and are consequently in an Excel format. Direct reference to descriptive and regression result tables is made in the general tables and in the text.

Throughout the text, *odds ratios larger than 1.0* represent higher odds of *"unhealthy"* characteristics (e.g., higher odds of not meeting dietary recommendations, higher odds of reporting one or more health problem, etc.). *Odds ratios smaller than 1.0* represent lower odds of "unhealthy" traits, i.e., a *"protective"* effect.

6.2 Basic description of the data

6.2.1 Exposure variables

6.2.1.1 Place of birth and acculturation variables: OHS

The majority (71.3%) of the OHS study group members were born in Canada (Table 11, Appendix I). Respondents born outside of Canada originated principally from Europe (63.0% of all immigrants) and Asia (17.8%). Groups of subjects born in Northern and Southern Europe were particularly large (19.6 and 21.9% of all immigrants, respectively). Smaller proportions of respondents were from the Caribbean (6.0%), from Central/South America (5.9%), from the United States (4.5%), and from Africa (2.8%). Approximately 27% of the OHS immigrant subjects (Table 12) were acculturated, measured using reported ethnicity and 25.8% presented some acculturation according to language spoken at home (see section 4.5.1.2). The average number of years since migration was 24 (with a large range: 0 to 89 years).

6.2.1.2 Place of birth: QHHNS

In the QHHNS study group (Table 11), only 7.6% of the respondents were born outside of Canada. The majority of the immigrants were from Europe (51.1% of all immigrants) or Asia (19.7%). Other subjects were born in Africa (12.4%), the Caribbean (7.3%), Central/South America (5.1%), and the United States (3.9%).

6.2.2 Covariates

6.2.2.1 OHS

The description of the OHS study group by demographic, socioeconomic, nutritional, and health behaviour covariates is presented in Table 13 of Appendix I. *Only covariates that are not also outcomes of interest in this study are presented in this table.*

The majority of the respondents were females (51.0%), were between 18 and 39 years of age (46.9%), were married (69.1%), lived in an urban area (87.2%), reported a Canadian ethnicity (62.4%), were from a household where the highest education was at least some post-secondary education (56.3%), and had a household income equal to or greater than $50,000 (46.6%). More than half the respondents found their life fairly or very stressful, and 85.0% were somewhat or very satisfied with their social life.

In comparison to Canadian-born individuals, subjects born outside of Canada tended to be more likely to be in older age groups, to be married, to live in an urban area, to be from a household where the highest education is primary school education (or less) or completed post-secondary education, and to have a low income. However, higher proportions of immigrants than non-immigrants found their health not stressful at all or very stressful. Reported ethnicity also varied by place of birth, with 76.4% of Canadian-born subjects but only 27.4% of immigrant subjects reported a Canadian cultural identity.

As for nutritional characteristics, fewer than 10% of the OHS study group members reported some chewing problems. Approximately 64% of Canadian-born subjects and 56% of subjects born outside Canada thought that they could improve their health by changing their eating habits. Relatively large proportions of respondents reported unhealthy behaviours: 33.0% were current [illegible]ers and 71.8% were physically inactive. Immigrants, appeared to be less likely to be current smokers but more likely to be sedentary than did non-immigrants.

6.2.2.2 QHHNS

In the QHHNS as well (Table 14), a majority of respondents were in the youngest age group (51.2% between 18 and 39 years of age), were married (66.2%), were living in an urban area (79.5%), reported a Canadian ethnicity (92.0%), had some post-secondary education (52.0%), and were satisfied with their social life (91.3%). However, in contrast to the OHS, the largest proportion of the respondents to this survey was in the middle income group (49.5%) and not in the high income group. Compared with Canadian-born individuals, immigrant respondents were more likely to be males, older, and married, to live in an urban area, to have completed at least a collegial degree, to have a low or high income, and to be unsatisfied with their social life. Immigrants were also less likely than non-immigrants to report a Canadian ethnicity (31.9% compared with 97.0%).

As many as 37.5% of the QHHNS study group members were current smokers, and 40.3% had been exercising less than once a week during the past four months.

Compared with Canadian-born subjects, immigrants were less likely to be smokers but they were more likely to exercise less than once a week. Finally, 37.3% of all respondents reported a family history of cardiovascular disease (38.8% of Canadian-born respondents and 18.4% of immigrant respondents).

6.2.3 Outcome variables

The description of the nutritional and health characteristics of the OHS and QHHNS subjects are presented in combination with corresponding regression analysis results presented in section 6.3 and 6.4. Tables presenting unadjusted weighted means and proportions by place of birth can be found in Appendices J and K for the OHS, and in Appendices L and M for the QHHNS. These tables are referred to in the following sections.

6.3 Research question 1: nutritional characteristics

6.3.1 Canada Food Guide: OHS only

6.3.1.1 All recommendations

The majority (79.2%; Table J1, Appendix J) of the OHS study group members did *not* meet all four recommendations of the 1992 Canada Food Guide (see Appendix E and section 4.6.4.1.1). The proportion of respondents *not* meeting all four recommendations varied by place of birth: from 67.7% (Poland) to as much as 90.2% (China). On average, the survey participants met between two and three of the four recommendations.

When we considered the relationship between the number of recommendations met by the respondents and place of birth variables, adjusting for covariates (CFG; Table 6.1) and taking Canadian-born subjects as the reference category, significant associations (at α=0.01) were found for SUB-REGION and COUNTRY. Individuals born in South Europe (Table N1c, Appendix N) met a smaller number of the Canada Food Guide recommendations than did Canadian-born subjects, while those born in East Europe (Table N1c) and in Poland (Table N1d) met a higher number of recommendations. The likelihood of *not* meeting all four recommendations of the Canada Food Guide was not related to any of the four exposure variables (CFGALL; Table 6.1).

6.3.1.2 Individual recommendations

Of all the recommendations of the Canada Food Guide, the recommendation for "Cereals and Breads" was met the least often by the respondents: 58.4% of the subjects did *not* meet this recommendation, while 36.3%, 31.2%, and 28.2% of the participants did *not* meet the recommendations for "Vegetables and Fruits", "Milk Products", and "Meats and Alternates" respectively (Table J1). Some variations existed by place of birth. In general, lower proportions of immigrants than non-immigrants did *not* meet the recommendations for "Cereals and Breads" and "Vegetables and Fruits", but higher proportions were consuming *less* serving of "Milk Products" than suggested.

Table 6.1 P values for the relationships (adjusted for covariates) between the outcomes related to the Canada Food Guide and the four exposure variables, for the OHS.

Outcome[1] (Table number in Appendix N)	IMM	REGION	SUB-REGION	COUNTRY
	p-value	p-value	p-value	p-value
CFG (N1a-d)	0.3628	0.1753	**0.0021**	**0.0037**
CFGALL (N2a-d)	0.1507	0.0215	0.0258	0.0446
BREADS (N3a-d)	**<0.0001**	**0.0001**	**0.0004**	**0.0006**
VEG-FRUITS (N4a-d)	0.1152	0.0630	0.0564	0.0755
MILK (N5a-d)	**0.0001**	**<0.0001**	**<0.0001**	**<0.0001**
MEATS (N6a-d)	0.1327	0.4187	**0.0015**	**0.0001**

[1] CFG: number of food groups meeting 75% of the Canada Food Guide recommendations; CFGALL: likelihood of *not* meeting 75% of all four recommendations of the Canada Food Guide; BREADS: likelihood of *not* meeting 75% of the recommendation for "Cereals and Breads"; VEG-FRUITS: likelihood of *not* meeting 75% of the recommendation for "Vegetables and Fruits"; MILK: likelihood of *not* meeting 75% of the recommendation for "Milk Products"; MEATS: likelihood of *not* meeting 75% of the recommendation for "Meats and Alternates".

Regression analysis results tended to parallel descriptive results. They indicated significant relationships between place of birth and the likelihood of *not* meeting the recommendation for "Cereals and Bread" and "Milk Products", particularly, but also between place of birth and the likelihood of *not* meeting the recommendation for "Meats and Alternates" (Table 6.1). However, the likelihood of *not* meeting the advice for "Vegetables and Fruits" was not significantly associated with place of birth variables.

Compared with non-immigrants, immigrants were, overall, less likely (OR=0.73, 99% Confidence Interval (CI)=0.61,0.87) to consume *fewer* servings of "Cereals and Breads" than recommended (Table N3a). Lower odds of *not* meeting this recommendation were also found (Table N3b-d) for immigrants from Europe (OR=0.74, CI=0.60,0.91), East Europe (OR=0.46, CI=0.27,0.77), Poland (OR=0.41, CI=0.19,0.91), Asia (OR=0.56, CI=0.39,0.80), East Asia (OR=0.52, CI=0.29,0.93), South East Asia (OR=0.51, CI=0.28,0.91), and the Philippines (OR=0.36, CI=0.15,0.91).

Some immigrant sub-groups were more likely than Canadian-born respondents to consume *fewer* servings of "Milk Products" than recommended (Tables N5a-d): all immigrants (OR=1.36, CI=1.12,1.66), and immigrants born in Asia (OR=2.84, CI=1.95,4.16), East Asia (OR=5.97, CI=3.15,11.30), South-East Asia (OR=3.19, CI=1.74,5.83), China (OR=9.13, CI=3.00,27.73), Hong Kong (OR=5.81, CI=2.25,14.98), the Philippines (OR=3.55, CI=1.31,9.63), Vietnam (OR=2.79, CI=1.15,6.79), South Europe (OR=2.51, CI=1.79,3.52), and Italy (OR=3.00, CI=1.94,4.64). Nevertheless, respondents born in North Europe (OR=0.67, CI=0.47,0.97), and more specifically in the United Kingdom (OR=0.68, CI=0.47,0.98), had lower odds of *not* meeting the recommendation for this food group than did subjects born in Canada (Tables N5c-d).

Finally, a higher likelihood of *not* meeting the recommendation for "Meats and Alternates" was observed among immigrants born in South Asia (OR=2.23, CI=1.07,4.63) and India (OR=2.65, CI=1.16,6.04), compared with Canadian-born subjects (N6c-d). However, immigrants from East Asia (OR=0.42, CI=0.21,0.82) and Hong Kong (OR=0.29, CI=0.10,0.84) were less likely than non-immigrants to have a low intake of "Meats and Alternates".

6.3.2 Priority nutrients

6.3.2.1 Fat and cholesterol: OHS

The unadjusted average fat intake of the OHS respondents was 37.1% of dietary energy, excluding energy from alcohol-containing beverages (Table J2, Appendix J). This proportion varied from 30.1% (the Philippines) to 38.6% (the Netherlands), depending on place of birth. Overall, immigrants were ingesting less fat than did the subjects born in Canada (34.7% of dietary energy versus 38.0%). On average, fat consumption was higher than the Canadian recommendations (which suggests an intake of 30% or less of dietary energy from fat; see Appendix E). As many as 86.9% of all respondents were *not* meeting the recommended fat intake. A lower proportion of immigrants than non-immigrants had a high fat intake (77.5% versus 90.4%) but large variations by place of birth were found (from 53.8% for Vietnam to 91.3% for the Netherlands)..

As suggested by these descriptive results, regression analyses showed that fat intake was strongly associated with place of birth (FAT; Table 6.2). Overall, immigrants consumed less fat than did non-immigrants (Table N7a). Immigrants from Asia, South East Asia, East Asia, South Asia, the Middle East, Europe, South-Europe, North Europe, Central and South America, Central America, South America, Africa, East Africa, and the Caribbean had a lower fat intake than did their Canadian-born counterparts (Tables N7b-c). In addition, respondents from the United Kingdom and from each of the Asian, South European, Caribbean, and South American countries investigated had a significantly lower fat intake than did non-immigrants.

The likelihood of high fat intake was also associated with place of birth (FAT-HIGH; Table 6.2). Immigrants, overall, were less likely than non-immigrants to report a high fat diet (OR=0.50, CI=0.38,0.64; Table N8a). Immigrants born in Asia (OR=0.21, CI=0.14,0.32), South East Asia (OR=0.16, CI=0.08,0.30), East Asia (OR=0.23, CI=0.13,0.42), South Asia (OR=0.24, CI=0.11,0.52), the Philippines (OR=0.16, CI=0.06,0.45), Vietnam (OR=0.17, CI=0.06,0.45), Hong Kong (OR=0.21, CI=0.10,0.48), and India (OR=0.25, CI=0.11,0.58) had the lowest likelihood of high fat intake compared with non-immigrants (Tables N8b-d). Significantly lower odds of high fat intake were also found among individuals born in Europe (OR=0.66, CI=0.49,0.90), South Europe

(OR=0.34, CI=0.23,0.52), Italy (OR=0.28, CI=0.17,0.46), Portugal (OR=0.36, CI=0.16,0.84), the Caribbean (OR=0.36, CI=0.17,0.75), Jamaica (OR=0.29, CI=0.11,0.80), and Africa (OR=0.31, CI=0.13,0.76), compared with subjects born in Canada (Tables N8b-c).

Table 6.2 P-values for the relationships (adjusted for covariates) between the priority nutrients and cholesterol, and the four exposure variables, for the OHS.

Outcome[1] (Table number in Appendix N)	IMM	REGION	SUB-REGION	COUNTRY
	p-value	p-value	p-value	p-value
FAT (N7a-d)	**<0.0001**	**<0.0001**	**<0.0001**	**<0.0001**
FAT-HIGH (N8a-d)	**<0.0001**	**<0.0001**	**<0.0001**	**<0.0001**
CHOLESTEROL (N9a-d)	0.0955	0.3226	0.7982	0.1658
CHOLEST-HIGH (N10a-d)	0.0384	0.2089	0.6056	0.3904
FIBRE (N11a-d)	0.0609	0.0909	0.0319	**0.0033**
FIBRE-LOW (N12a-d)	0.9103	0.6366	0.1765	0.3310
CALCIUM (N13a-d)	**0.0004**	**<0.0001**	**<0.0001**	**<0.0001**
CALCIUM-INADEQ-RNI (N14a-d)	**<0.0001**	**<0.0001**	**<0.0001**	**<0.0001**
CALCIUM-INADEQ-WHO (N15a-d)	**0.0004**	**<0.0001**	**<0.0001**	**<0.0001**

[1] FAT: fat intake (% energy); FAT-HIGH: likelihood of high fat intake (>30% of dietary energy); CHOLESTEROL: cholesterol intake (mg/day); CHOLEST-HIGH: likelihood of high cholesterol intake (>300 mg/day); FIBRE: fibre intake (g/MJ); FIBRE-LOW: likelihood of low fibre intake (<3.0 g/MJ); CALCIUM: calcium intake (mg/day); CALCIUM-INADEQ-RNI: likelihood of "inadequate" calcium intake, using Canadian recommendations; CALCIUM-INADEQ-WHO: likelihood of "inadequate" calcium intake, using WHO recommendations.

Even if dietary cholesterol was not one of the priority nutrients in this study, results for this variable are reported with those for fat because of the close relationship between these two food components. The unadjusted average cholesterol intake of the OHS group members was 345 mg/day (Table J2), with variations from 281 mg/day (Other Caribbean) to 491 mg/day (Central America). The average intake was higher than Health and Welfare Canada's recommendation (≤300 mg/day) and, overall, approximately half the respondents had a high cholesterol intake (Table J2); variations were from 32.7% (China) to 70.4% (Central America). Neither cholesterol intake nor the likelihood of having a high cholesterol intake were significantly associated with any of the four exposure variables when adjustments were made for significant covariates (CHOLESTEROL, CHOLEST-HIGH; Table 6.2).

6.3.2.2 Fat, saturated fat, polyunsaturated fat, cholesterol: QHHNS

The QHHNS respondents had, on average, a fat intake equal to 34.6% of dietary energy, after excluding energy from alcohol (Table L1; Appendix L). As was the case for the OHS, immigrants were getting a smaller proportion of their dietary energy from fat than did Canadian-born subjects (31.9% versus 34.8%). The proportion of respondents with a high fat intake was also lower among immigrants than non-immigrants (63.7% versus 72.6%). Compared with Canadian-born subjects, immigrants had slightly lower intakes of saturated fat (11.7% of dietary energy versus 12.9%) and polyunsaturated fat (5.3% of dietary energy versus 5.5%), but a higher cholesterol intake (331 mg/day versus 308 mg/day). In addition, a lower proportion of immigrants than non-immigrants had a high saturated fat intake (>10% of dietary energy: 60.4% versus 74.4%), but a higher proportion had a high cholesterol intake (44.4% versus 39.5%).

No significant relationships between place of birth variables (IMM and REGION) and total fat, polyunsaturated fat, and cholesterol intakes were found (Tables P1a-P3b, P5a-P7b). However, immigrants, overall, and immigrants born outside of Europe, had a lower likelihood of high saturated fat intake than did Canadian-born subjects (respectively: OR=0.51, CI=0.27,0.97; and OR=0.31, CI=0.13,0.73; Table P4a-b).

6.3.2.3 Dietary fibre: OHS

Canadian nutritional recommendations (see Appendix E) suggest that fibre intake be increased to approximately 3.0 g/MJ. However, the unadjusted average fibre consumption of the OHS study group members was only 2.1 g/MJ (Table J3). Fibre intake tended to vary by place of birth (from 1.7 g/MJ (Vietnam) to 2.6 g/MJ (Other Caribbean)), but unadjusted average intakes remained lower than the recommendation among all sub-groups of respondents. Over 86% of the total population studied did *not* meet the recommended fibre intake (Table J3) This proportion also varied by place of birth (from 72.4% (Other Caribbean) to 94.5% (Vietnam)).

Regression analyses showed that fibre intake was associated with country of birth (FIBRE; Table 6.2): individuals born in the Philippines had a lower fibre intake than did Canadian-born respondents (Table N11d). No significant relationship was found between place of birth and the likelihood of reporting a low fibre intake (FIBRE-LOW; Table 6.2).

6.3.2.4 Dietary fibre: QHHNS

The unadjusted average fibre intake of the QHHNS respondents, both immigrants and non-immigrants, was only 1.8 g/MJ (Table L2). Overall, 87.6% of the QHHNS subjects had a low fibre consumption, and, contrary to what was found for the OHS, a slightly higher proportion of individuals born outside of Canada (90.0%) than individuals born in Canada (87.4%) had a low intake. However, neither IMM nor REGION were significantly related to fibre intake or to the likelihood of low fibre intake (Tables P8a-P9b).

6.3.2.5 Calcium: OHS

The unadjusted mean dietary calcium intake of the OHS respondents was 1,059 mg/day (Table J3). This relatively high intake may be due to the fact that the OHS food frequency questionnaire tended to overestimate calcium intake (Bright-See et al. 1994; this point is discussed in section 8.2.5.1). Important variations by place of birth were observed: the mean intake was 1,088 mg/day for Canadians and 980 mg/day for respondents born outside of Canada. Among immigrants, calcium intakes ranged from 602 mg/day (China) to 1,126 mg/day (North Europe).

Results from regression analyses corroborated these observations and indicated that significant differences in calcium intake existed between immigrants and non-immigrants (CALCIUM; Table 6.2). Immigrants consumed less calcium, overall, than Canadian-born subjects (Table N13a). Immigrants from Asian sub-regions and countries (Asia, East Asia, South East Asia, Hong Kong, China, the Philippines, Vietnam) had the lowest calcium intake compared with non-immigrants. Respondents born in the Caribbean and in South Europe also had a lower calcium intake than did non-immigrants (Tables N13c-d). In contrast, participants from the United Kingdom had a higher calcium consumption than did subjects born in Canada (Table N13d).

The unadjusted proportion of respondents with an "inadequate" dietary calcium intake (see section 4.6.4.1.3 for the definition of "inadequacy") varied considerably among sub-groups of respondents (Table J3). Overall, 15.7% of all respondents were likely to have an "inadequate" calcium intake when RNI were used as the reference for the recommended calcium intake, while only 2.2% of the respondents presented such a likelihood when the WHO recommendation was used. The lowest proportion of respondents with an "inadequate" calcium intake was for Polish-born subjects (RNI: 10.6%; WHO: 0.3%) and the highest for Chinese-born subjects (RNI: 61.9%; WHO: 25.5%).

Regression analyses showed that the likelihood of "inadequate" calcium intake was highly significantly associated with place of birth (CALCIUM-INADEQ-RNI, CALCIUM-INADEQ-WHO; Table 6.2). When RNI were used, a higher likelihood of "inadequate" calcium intake was found among immigrants, overall (OR=1.47, CI=1.21,1.79), as well as among immigrants born in Asia (OR=3.85, CI=2.65,5.59), East Asia (OR=6.40, CI=3.61,11.36), South East Asia (OR=4.55, CI=2.55,8.12), China (OR=10.21, CI=4.18,24.91), Hong Kong (OR=5.74, CI=2.76,11.94), Vietnam (OR=5.61, CI=2.38,13.19), East Africa (OR=3.52, CI=1.08,11.51), the Caribbean (OR=2.79, 1.30,5.98), Jamaica (OR=2.77, CI=1.09,7.03), South-Europe (OR=1.57, CI=1.06,2.32), Portugal (OR=2.56, CI=1.30,5.05), and Guyana (OR=3.11, CI=1.19,8.09) (Tables N14b-d), compared with non-immigrants.

The use of WHO recommendations gave comparable results (Table 6.2). However, the significantly higher likelihood of "inadequate" calcium intake among respondents born in South Europe, East Africa, Portugal, and Guyana was no longer present (Tables N15b-d), while significantly higher likelihoods were now found among subjects born in Greece and in the Philippines (Table N15d). Large confidence intervals (see section 4.7.7) were observed for some odds ratios for the analyses involving WHO recommendations, and some of these were associated with significant odds ratios (e.g., East Asia, Hong Kong, China, the Philippines, and Vietnam); these have to be interpreted cautiously.

6.3.2.6 Calcium: QHHNS

On average, QHHNS respondents consumed less calcium than did OHS subjects. This may be due to the fact that calcium intake from supplements was not included in calcium intake in the QHHNS. The unadjusted mean daily intake was 818 mg/day and immigrants were ingesting slightly less calcium than did non-immigrants (801 mg/day versus 820 mg/day; Table L2). Overall, 38.3% of the respondents had an "inadequate" calcium intake when RNI were used as the reference for calcium intake, and 11.1% when WHO recommendation was used. Contrary to OHS findings, the proportion of immigrants reporting an "inadequate" intake was only slightly higher than the proportion of non-immigrants reporting such an intake (RNI: 39.8% versus 38.1%; WHO: 12.0% versus 11.1%). Place of birth was not significantly related to calcium intake or to the likelihood of "inadequate" calcium intake in this survey (Table P10a-P12b).

6.3.3 Energy, carbohydrate, protein, and alcohol

6.3.3.1 Energy: OHS

The unadjusted mean daily energy intake of the members of the OHS study group was 9,246 kJ (Table J4). Variations existed between groups from different places of birth (from 7,656 kJ (China) to 10,963 kJ (Poland)). These variations may have been particularly due to differences in gender, age, physical activity, and body composition among the sub-groups, since these factors have a major influence on energy requirements and intake (Schutz and Jéquier 1994). However, after adjusting for these covariates and for other covariates, some differences between immigrants and non-immigrants remained (ENERGY; Table 6.3). Subjects from Asia, East Asia, South East Asia, China, and Vietnam had a lower energy intake than did non-immigrant (Tables N16b-d). In contrast, immigrants from East Europe and Poland consumed more energy than did Canadian-born subjects (Tables N16c-d).

6.3.3.2 Energy: QHHNS

The unadjusted average energy intake of the QHHNS study group subjects was 8,843 kJ (Table L3). While descriptive results indicated that Canadian-born individuals reported a higher unadjusted average energy intake (8,895 kJ) than did subjects born outside of Canada (8,196 kJ), and particularly than did European-born subjects (7,419 kJ), energy consumption was not significantly associated with place of birth (Tables P13a-b).

Table 6.3 P-values for the relationships (adjusted for covariates) between energy, carbohydrate, protein, and alcohol intakes and the four exposure variables, for the OHS.

Outcome[1] (Table number in Appendix N)	IMM	REGION	SUB-REGION	COUNTRY
	p-value	p-value	p-value	p-value
ENERGY (N16a-d)	0.5302	**<0.0001**	**0.0001**	**<0.0001**
CARBOHYDRATE (N17a-d)	**<0.0001**	**<0.0001**	**<0.0001**	**<0.0001**
CARBOHYD-LOW (N18a-d)	**<0.0001**	**<0.0001**	**<0.0001**	**<0.0001**
PROTEIN (N19a-d)	0.5845	0.6734	**0.0049**	**0.0017**
PROTEIN-INADEQ (N20a-d)	0.0140	**<0.0001**	**<0.0001**	**<0.0001**
ALCOHOL-HIGH (N21a-d)	**0.0002**	**<0.0001**	**0.0001**	**<0.0001**

[1] ENERGY: energy intake (kJ); CARBOHYDRATE: carbohydrate intake (% of energy); CARBOHYD-LOW: likelihood of low carbohydrate intake (<50% of energy); PROTEIN: protein intake (% energy); PROTEIN-INADEQ: likelihood of "inadequate" protein intake; ALCOHOL-HIGH: likelihood of high alcohol intake (>14 alcoholic drinks/week).

6.3.3.3 Carbohydrates: OHS

Respondents in the OHS study group ingested an average of 49.2% of their dietary energy from carbohydrates (Table J4). This intake is very close to the recommended 50-55% intake (see Appendix E). Canadian-born individuals had the lowest carbohydrate intake (48.2%), while immigrants were ingesting between 48.6% (the Netherlands) and 56.5% (the Philippines) of their dietary energy from carbohydrates. A smaller proportion of immigrants (43.3%) than non-immigrants (62.7%) had a lower than recommended intake (<50% of dietary energy). Among immigrants, the proportion of individuals with a low carbohydrate intake varied from 18.4% (the Philippines) to 57.3% (the Netherlands). Immigrants consumed a higher proportion of their carbohydrates from "Breads and Cereals" (overall: 26.6%, with variations from 22.9% (India) to 39.3% (Hong Kong)) than did non-immigrants (23.0%), which suggests that they may have reported consuming more complex carbohydrates than did Canadian-born individuals. In addition, a slightly lower proportion of their intake of carbohydrates was from "Desserts and Sweets" (20.3% on average with variations from 15.2% (Vietnam) to 25.0% (Poland)), compared with 21.1% for non-immigrants.

When regression analyses were performed, carbohydrate intake, as well as the likelihood of consuming *less than* 50% of dietary energy from carbohydrates, were strongly associated with place of birth (CARBOHYDRATE; CARBOHYD-LOW; Table 6.3). As suggested by the descriptive results, immigrants had, overall, a higher carbohydrate intake than did non-immigrants (Table N17a). Individuals born in Central America, East Africa, South Asia, South East Asia, the Philippines, India, the Caribbean, Trinidad, and Guyana (Tables N17b-d) reported the highest intakes compared with non-immigrants. Individuals from Africa, Central/South America, Europe, South Europe, Italy, Portugal, Asia, East Asia, Vietnam, and Jamaica also had higher intakes of carbohydrates than did non-immigrants. The likelihood of low carbohydrate intake (Tables N18a-d) was lower among immigrants, overall (OR=0.58, CI=0.48,0.72), and among immigrants from the Caribbean (OR=0.36, CI=0.16,0.80), Asia (OR=0.45, CI=0.30,0.68), South East Asia (OR=0.36, CI=0.19,0.72), South Asia (OR=0.28, CI=0.11,0.70), the Philippines (OR=0.31, CI=0.10,0.94), India (OR=0.30, CI=0.10,0.86), Europe (OR=0.64, CI=0.51,0.81), South Europe (OR=0.45, CI=0.31,0.66), and Italy (OR=0.39, CI=0.24,0.63), than it was among non-immigrants.

6.3.3.4 Carbohydrate: QHHNS

The unadjusted average carbohydrate consumption of the QHHNS study group respondents was 49.7% of dietary energy (Tables L3). As was the case for the OHS, immigrants had a slightly higher carbohydrate intake than did Canadian-born subjects (51.2% versus 49.6%). Approximately half the respondents had a low carbohydrate intake. Both carbohydrate intake and the likelihood of low carbohydrate intake were not significantly associated with IMM or REGION (Tables P14a-P15b).

6.3.3.5 Protein: OHS

The unadjusted average protein intake of the members of the OHS study group was 16.3% of dietary energy (Table J4). Subjects born in India consumed, on average, the smallest proportion of their energy from proteins (14.6%), while those born in Italy and Greece had the largest proportion (17.0%). Canadian-born respondents ingested, on average, 16.4% of their dietary energy from proteins. Overall, 7.0% of the respondents had an "inadequate" protein intake (Table J4). This proportion varied considerably by place of birth: only 2.6% of the respondents born in Hungary, but 30.6% of those born in India, exhibited an "inadequate" intake.

Protein intake (as percent of dietary energy) was significantly associated with sub-regions and countries of birth (PROTEIN; Table 6.3). The diet of the subjects from South Europe and Italy contained more proteins than did the diet of non-immigrants (Table N19c-d), as suggested by unadjusted mean intakes. However, subjects born in South Asia and India had a lower protein consumption than did non-immigrants (Tables N19c-d).

When the logistic regression of the likelihood of "inadequate" protein intake on place of birth was performed (PROTEIN-INADEQ; Table 6.3), immigrants from Asia (OR=3.23, CI=2.13,4.90), South East Asia (OR=3.49, CI=1.81,6.76), South Asia (OR=5.87, CI=2.95,11.68), Vietnam (OR=4.32, CI=1.65,11.30), India (OR=7.20, CI=3.47,14.96), the Caribbean (OR=2.69, CI=1.25,5.79), and Trinidad (OR=3.77, CI=1.09,13.05) had a higher likelihood of "inadequate" intake than did Canadian-born subjects (Tables N20b-d).

6.3.3.6 Protein: QHHNS

QHHNS participants had an unadjusted average intake of protein of 17.0% of dietary energy (17.0% for Canadian-born subjects and 17.9% for subjects born outside of

Canada). Approximately 10% of them had an "inadequate" intake (Table L3). Protein intake was not associated with place of birth (Tables P16a-P17b).

6.3.3.7 Alcohol: OHS

During the week preceding the survey, non-immigrants and immigrants consumed an average of six and four alcoholic drinks, respectively (Table J4). Approximately 12% of the non-immigrants and 7% of the immigrants consumed more than 14 drinks during that week; such an intake represents, according to the Ontario Ministry of Health (1988), a moderate to high health risk. The consumption of more than 14 drinks per week varied among sub-groups of respondents from 0% (Hong Kong, the Philippines) to 13.8% (Hungary).

Regression analyses showed that the likelihood of "high" alcohol intake (>14 drinks/week) was associated with all four place of birth variables (ALCOHOL-HIGH; Table 6.3). As suggested by the descriptive results (Table J4), immigrants were less likely (OR=0.64, CI=0.47,0.87) than non-immigrants to have a high alcohol intake (Table N21a). However, only Asian-born immigrants showed a lower likelihood of high alcohol intake than did non-immigrants (OR=0.19, CI=0.06,0.60; Table N21b)); a borderline significant result was found for South East Asia (OR=0.12, CI=0.01,1.03; p=0.0110).

6.3.3.8 Alcohol: QHHNS

QHHNS respondents consumed, on average, four alcoholic drinks during the week preceding the survey (Table L3); Canadian-born subjects had taken four drinks and non-immigrants five alcoholic drinks during that week. Contrary to OHS results, a higher proportion of immigrants (9.0%) than non-immigrants (6.2%) had a high alcohol intake. Place of birth was not associated with the likelihood of high alcohol intake (P18a-b).

6.3.4 Iron and vitamins

6.3.4.1 Iron: OHS

The unadjusted average iron intake of the OHS subjects was 13 mg/day (Table J5), with some small differences between non-immigrants (13 mg/day) and immigrant sub-groups (variations from 10 mg/day (China, Vietnam) and 17 mg/day (Central America)). Greater variation was observed for the proportion of respondents with "inadequate" iron intake. Overall, 9.9% of the non-immigrant subjects had an "inadequate" iron intake, while between 2.8% (Poland) and 35.0% (Vietnam) of the immigrants had such an intake.

The regression of iron intake on place of birth (IRON; Table 6.4) indicated that OHS participants born in Europe, South Europe, and Italy consumed more iron than did Canadian-born respondents (Tables N22b-d). However, immigrants from Asia, East Asia, South East Asia, China, and Vietnam, had a lower iron intake than did non-immigrants (Tables N22b-d).

Table 6.4 P-values for the relationships (adjusted for covariates) between iron and vitamins, and the four exposure variables, for the OHS.

Outcome[1] (Table number in Appendix N)	IMM	REGION	SUB-REGION	COUNTRY
	p-value	p-value	p-value	p-value
IRON (N22a-d)	0.3971	**<0.0001**	**<0.0001**	**<0.0001**
IRON-INADEQ (N23a-d)	**0.0034**	**<0.0001**	**<0.0001**	**<0.0001**
VITAMINC (N24a-d)	**0.0005**	**0.0001**	**0.0002**	**0.0003**
VITAMINC-INADEQ (N25a-d)	0.7977	0.1789	0.5977	0.9378
THIAMIN (N26a-d)	0.3361	0.3613	**0.0068**	0.0395
THIAMIN-INADEQ (N27a-d)	**0.0011**	**<0.0001**	**0.0001**	**0.0005**
RIBOFLAVIN (N28a-d)	0.7555	**<0.0001**	**<0.0001**	**<0.0001**
RIBOFL-INADEQ (N29a-d)	**0.0092**	**<0.0001**	**<0.0001**	**<0.0001**
NIACIN (N30a-d)	0.1951	0.8202	**<0.0001**	**<0.0001**
NIACIN-INADEQ (N31a-d)	**0.0085**	**0.0084**	0.0112	0.0906

[1] IRON: iron intake (mg/day); IRON-INADEQ: likelihood of "inadequate" iron intake; VITAMINC: vitamin C intake (mg/day); VITAMINC-INADEQ: likelihood of "inadequate" vitamin C intake; THIAMIN: thiamin intake (mg/5 megajoules (MJ)); THIAMIN-INADEQ: likelihood of "inadequate" thiamin intake; RIBOFLAVIN: riboflavin intake (mg/5MJ); RIBOFL-INADEQ: likelihood of "inadequate" riboflavin intake; NIACIN: niacin intake (mg/5MJ); NIACIN-INADEQ: likelihood of "inadequate" niacin intake.

The likelihood of "inadequate" iron intake (IRON-INADEQ; Table 6.4) was higher among immigrants (OR=1.42, CI=1.04,1.92) than among non-immigrant (Table N23a). Respondents born in Asia (OR=4.07, CI=2.62,6.32), and more particularly in East Asia (OR=3.62, CI=1.87,7.02), South East Asia (OR=5.54, CI=2.80,10.94), South Asia (OR=4.17, CI=1.82,9.52), Hong Kong (OR=3.04, CI=1.21,7.64), China (OR=5.52, CI=1.87,16.28), Vietnam (OR=8.34, CI=3.07,22.67), and India (OR=5.37, CI=2.20,13.10) were more likely to have an "inadequate" intake than were Canadian-born subjects (Tables N23b-d).

6.3.4.2 Iron: QHHNS

QHHNS subjects had an unadjusted average iron intake equal to 14 mg/day (Table L4), which is very close to the average intake found in the OHS. Overall, 13.3% of the subjects reported an "inadequate" intake (13.2% of Canadian-born individuals and 14.6% of immigrants), which is slightly higher than what was observed for the OHS. Iron intake and the likelihood of "inadequate" intake were not significantly associated with IMM and REGION (Tables P19a-P20b).

6.3.4.3 Vitamin C: OHS

The unadjusted mean vitamin C intake of the members of the OHS study group was 141 mg/day (Table J5), which is approximately twice the recommended intakes (see Appendix E). The average consumption of all respondent sub-groups was higher than the recommendations. This high intake may have been due to the fact that the OHS food-frequency questionnaire tended to overestimate vitamin C intake (see section 8.2.5.1). The average intake for this vitamin was slightly higher among immigrants (149 mg/day) than among non-immigrants (138 mg/day). The smallest average intake was for immigrants from China (113 mg/day) while the highest was for those from Central America (235 mg/day). The unadjusted proportion of individuals with an "inadequate" vitamin C intake was 3.6% with variations from 0.6% (Other Africa) to 10.8% (China).

Vitamin C consumption was associated with place of birth (VITAMINC; Table 6.4): immigrants, overall, and immigrants from Europe, South Europe, Italy, and Central and South America, consumed more vitamin C than did Canadian-born individuals (Tables N24a-d). However, no significant relationship was found between place of birth and the likelihood of "inadequate" vitamin C intake (VITAMINC-INADEQ; Table 6.4).

6.3.4.4 Vitamin C: QHHNS

The unadjusted mean vitamin C intake of the QHHNS study group was 100 mg/day (Table L4), i.e., less than the OHS respondents' average intake. However, the average intake was higher than the recommended intake for this nutrient. Immigrants and non-immigrants had similar unadjusted mean intakes of vitamin C, but a slightly lower proportion of immigrants than non-immigrants had an "inadequate" intake of this vitamin (14.1% versus 17.7%). Results from the regression analyses indicated that vitamin C intake and the likelihood of "inadequate" intake were not significantly associated with place of birth (Tables P21a-P22b).

6.3.4.5 Thiamin: OHS

Among the OHS respondents, thiamin consumption averaged 0.82 mg/5MJ (Table J6), an intake higher than the Canadian recommendation (see Appendix E). Respondents born in the Philippines had the lowest average consumption (0.71 mg/5MJ) while those from Yugoslavia had the highest intake (0.86 mg/5MJ). Overall, 4.8% of the subjects had an "inadequate" thiamin intake. Important variations by place of birth were observed: "inadequate" intakes were found among 4.3% of all non-immigrants and among 1.8% (Other Central/South America) to 15.3% (Trinidad) of immigrants.

Regression analyses for thiamin intake (THIAMIN; Table 6.4) showed that respondents from western Europe ingested less thiamin than did Canadian-born subjects (Table N26c). The likelihood of "inadequate" thiamin intake also varied by place of birth (THIAMIN-INADEQ; Table 6.4), and immigrants, overall (OR=1.46, CI=1.08,1.97; Table N27a), as well as immigrants from Asia (OR=2.91, CI=1.83,4.63), East Asia (OR=2.77, CI=1.28,5.99), South East Asia (OR=3.18, CI=1.50,6.72), South Asia (OR=2.73, CI=1.06,7.05), China (OR=3.85, CI=1.22,12.16), India (OR=3.04, CI=1.10,8.38), the

Caribbean (OR=2.53, CI=1.09,5.88), and Trinidad (OR=4.08, CI=1.16,14.36) were more likely to have an "inadequate" intake than were non-immigrants.

6.3.4.6 Thiamin: QHHNS

The unadjusted mean thiamin intake of the QHHNS subjects was 0.87 mg/5MJ (Table L5), which is similar to the OHS respondents' intake. However, compared with OHS results, a relatively high proportion of respondents had an "inadequate" thiamin consumption: 10.4% of Canadian-born subjects and 16.7% of immigrant participants. Nevertheless, regression analysis results showed that thiamin intake did not vary significantly by place of birth (Tables P23a-P24b).

6.3.4.7 Riboflavin: OHS

The unadjusted average riboflavin intake (1.2 mg/5MJ; Table J6) of the members of the OHS study group was twice as high as the current recommendation (see Appendix E). Small differences were found among sub-groups of respondents; immigrants from Yugoslavia reported the highest average intake (1.4 mg/5MJ) and those from Hong Kong the lowest intake (1.0 mg/5MJ). Only 2.4% of the subjects (Table J6) had an "inadequate" riboflavin intake, with variations from 0.2% (Poland and Hungary) to as much as 18.3% (Vietnam).

Results from multiple linear and logistic regression analyses indicated that both riboflavin intake and the likelihood of "inadequate" riboflavin intake were associated with place of birth (RIBOFLAVIN, RIBOFL-INADEQ; Table 6.4). Immigrants from Asia, East Asia, South East Asia, Hong Kong, the Philippines, and Vietnam consumed less riboflavin than did non-immigrants (Table N28a-d). However, individuals from Europe, North Europe, and the United Kingdom had a higher riboflavin intake than did Canadian-born respondents (Tables N28b-d). A higher likelihood of "inadequate" consumption was found among immigrants, overall (OR=1.52, CI=1.00,2.31), and among subjects born in Asia (OR=4.50, CI=2.59,7.82), East Asia (OR=3.80, CI=1.55,9.33), South East Asia (OR=7.75, CI=3.65,16.42), China (OR=5.04, CI=1.27,19.93), the Philippines (OR=4.89, CI=1.36,17.58), and Vietnam (OR=10.40, CI=3.56,30.37), compared with participants born in Canada (Tables N29a-d). Some significant odds ratios were associated with large confidence intervals (e.g., Vietnam; see section 4.7.7) and have to be interpreted carefully.

6.3.4.8 Riboflavin: QHHNS

The members of the QHHNS study groups were, on average, consuming 1.1 mg/5MJ of riboflavin daily (Table L5); this intake is similar to the average riboflavin consumption of the OHS respondents. As was the case for thiamin, a higher proportion of the QHHNS respondents (9.2%) than OHS respondents had an "inadequate" riboflavin intake and a higher proportion of non-immigrants than immigrants reported an "inadequate" intake (9.3% versus 7.1%). Riboflavin consumption and the likelihood of "inadequate" intake were not associated with IMM or REGION (Tables P25a-P26b).

6.3.4.9 Niacin: OHS

The unadjusted mean niacin intake of the OHS study group respondents was much higher than the Canadian recommended intake (see Appendix E): it reached 20.1 NE/5MJ and varied from 17.4 NE/5MG (India) to 21.7 NE/5MJ (China) among sub-groups of respondents (Table J6). Only 1.0% of the respondents had an "inadequate" intake of niacin. None of the subjects from Greece, Hungary, Jamaica, and Other Africa (North/South/West Africa) had an "inadequate" intake, while 8.7% of Indian-born participants reported such an intake.

Niacin consumption was significantly associated with sub-regions and countries of birth (NIACIN; Table 6.4). Participants from West Europe, Germany, East Europe, South Asia, and India (Table N30c-d) had a lower niacin intake than did Canadian-born subjects (Tables N30c-d). However, those born in South Europe reported consuming more niacin than did non-immigrants (Table N31c).

The likelihood of "inadequate" niacin intake was significantly associated with IMM and REGION (NIACIN-INADEQ; Table 6.4): immigrants, overall, and immigrants from Asia were more likely to have an "inadequate" intake of niacin than did Canadian-born subjects (all immigrants: OR=2.18, CI=1.02,4.69; Asia: OR=6.50, CI=2.16,19.58; Tables N31a-b). The relationship between the likelihood of niacin "inadequacy" and

SUB-REGION was borderline significant (Table 6.4). Respondents from South East Asia (OR=4.80, CI=1.03,22.23) and South Asia (OR=13.35, CI=3.91,45.59) had a higher likelihood of "inadequate" intake than did non-immigrants. Some large confidence intervals for the odds ratios were found.

6.3.4.10 Niacin: QHHNS

The unadjusted mean niacin intake of the QHHNS participants was 22.5 NE/5MJ (Table L5), i.e., two and a half times the recommended intake, and slightly more than the average intake of the OHS subjects. Only 2.2 percent of the QHHNS respondents (2.3% of non-immigrants, 1.4% of all immigrants, and no immigrant born outside of Europe) had an "inadequate" niacin intake. No significant association was found between place of birth and niacin intake (P27a-P28b).

6.3.5 Anthropometric characteristics

6.3.5.1 OHS

The unadjusted average BMI of the OHS study group members between the age of 20 and 65 years was 24.9 kg/m^2 (Table J7). This value is at the upper limit of the Health and Welfare Canada's (1988a) definition of healthy weights (20-25 kg/m^2). Mean BMI varied substantially by place of birth: it was 25.0 kg/m^2 among Canadian-born respondents, and between 21.4 kg/m^2 (Hong Kong) and 26.8 kg/m^2 (Hungary) among immigrant sub-groups. The unadjusted prevalences of overweight and obesity were high and also varied by place of birth (Table J7). Of the total group, 43.5% were overweight and 26.7% were obese. Respondents from Hong Kong had the lowest unadjusted prevalences of overweight (14.2%) and obesity (7.4%) and Italian-born subjects had the highest prevalences (overweight: 66.7%; obesity: 43.2%).

The observed variations in the unadjusted average BMI by place of birth were confirmed by regression analysis results (BMI; Table 6.5): BMI was strongly associated with all four exposure variables. Immigrants, overall, and immigrants born in Asia, East Asia, South East Asia, Hong Kong, China, Vietnam, North Europe, and the United Kingdom, had a lower BMI than did non-immigrants (Tables N32a-d).

Table 6.5 P-values for the relationships (adjusted for covariates) between anthropometric outcomes and the four exposure variables, for the OHS.

Outcome[1] (Table number in Appendix N)	IMM	REGION	SUB-REGION	COUNTRY
	p-value	p-value	p-value	p-value
BMI (N32a-d)	**<0.0001**	**<0.0001**	**<0.0001**	**<0.0001**
OVERWT (N33a-d)	**0.0001**	**<0.0001**	**<0.0001**	**<0.0001**
OBESITY (N34a-d)	0.1284	**0.0066**	**<0.0001**	**<0.0001**
LOW-BMI (N35a-d)	**0.0003**	**<0.0001**	**<0.0001**	**<0.0001**

[1] BMI: BMI (kg/m^2); OVERWT: likelihood of overweight (BMI>25 kg/m^2); OBESITY: likelihood of obesity (BMI>27 kg/m^2); LOW-BMI: likelihood of low BMI (BMI<20 kg/m^2).

Regression analyses also indicated that while immigrants were in general less likely to be overweight than non-immigrants (OR=0.75, CI=0.63,0.90; Table N33a), lower likelihoods of both overweight and obesity (OVERWT, OBESITY; Tables 6.5, N33b-d, N34b-d) were found among individuals born in Asia (overweight: OR=0.40, CI=0.27,0.59; obesity: OR=0.56, CI=0.34,0.91), East Asia (overweight: OR=0.22, CI=0.10,0.45; obesity: OR=0.30, CI=0.11,0.79), North Europe (overweight: OR=0.65, CI=0.47,0.91; obesity: OR=0.63, CI=0.42,0.96), and the United Kingdom (overweight: OR=0.66, CI=0.47,0.92; obesity: OR=0.64, CI=0.42,0.98), compared with non-immigrants. In addition, subjects from South East Asia (OR=0.39, CI=0.20,0.78), Hong Kong (OR=0.25, CI=0.09,0.70), and China (OR=0.18, CI=0.05,0.66) had a lower likelihood of overweight than did their Canadian-born counterparts (Table N33d). However, as suggested by the descriptive results, Italian-born subjects were more likely to be overweight (OR=1.85, CI=1.17,2.93; Table N33d) than were non-immigrants.

The unadjusted overall prevalence of low BMI (Table J7) was 9.1% with variations from 3.5% (Italy) to 43.8% (Vietnam). Low BMI was associated with place of birth variables (LOW-BMI; Table 6.5). Immigrants, overall, (OR=1.51, CI=1.13,2.02), and immigrants from Asia (OR=3.40, CI=2.11,5.50), East Asia (OR=5.83, CI=2.86,11.87), South-East Asia (OR=3.63, CI=1.69,7.78), Hong Kong (OR=7.54, CI=3.06,18.58), China (OR=4.11, CI=1.11,15.17), and Vietnam (OR=10.59, CI=3.80,29.50), had a higher likelihood of low BMI than did non-immigrants (Tables N35a-d). The odds ratio for Vietnam had a somewhat large confidence interval, however (Table N35d).

6.3.5.2 QHHNS

The unadjusted mean BMI (24.9 kg/m^2; Table L6) and the overall proportions of QHHNS respondents presenting overweight (42.7%), obesity (28.3%), and low BMI (10.8%) were similar to those found in the OHS. However, contrary to OHS results, overweight and obesity were more frequently found among immigrants than among non-immigrants: 1) 42.5% of non-immigrants and 45.3% of immigrants (48.6% or European-born immigrants) were overweight; and 2) 27.7% of Canadian-born subjects and 35.4% of immigrants (44.6% of European-born subjects) were obese. Overall, 10.8% of the participants (10.9% of non-immigrants and 9.2% of all immigrants, but only 3.0% of European-born subjects) had a low BMI. The waist-to-hip circumference ratio was found to be high among 20.7% of QHHNS participants, overall. It was high among 20.7% of Canadian-born subjects, 20.5% of all immigrants, and 30.3% of European-born subjects. On average, the QHHNS subjects tended to underreport their weight by 0.6 kg and to overestimate their height by 0.7 centimetre. European-born subjects underreported their weight by 1.4 kg in average. None of the anthropometric characteristics studied were associated with the exposure variables (Tables P28a-P34b).

6.3.6 Nutritional knowledge: QHHNS only

Only 2.3% of the QHHNS subjects had *not* heard about the relationship between fat intake and health problems (Table L7). However, 25% of the respondents (approximately 25% of non-immigrants and 21% of immigrants) did not know that dietary cholesterol or salt intake could affect health. None of the nutritional knowledge variables were significantly associated with place of birth (Tables P35a-P37b).

6.4 Research question 2: health characteristics

6.4.1 Health problems: OHS

The OHS subjects reported, on average, two health problems (Table K1; Appendix K), and 70.0% of the subjects reported at least one health problem. The proportion of respondents with one or more health problem was the lowest among individuals born in Vietnam (47.2%) and the highest among those born in the United States (79.3%). The overall unadjusted prevalence of specific health problems was 13.3% for cardiovascular disease, 9.5% for hypertensive disease, 2.5% for diabetes, 5.1% for digestive disease, 1.8% for gastro-intestinal ulcer, and 1.6% for cancer (Table K1). Prevalence tended to vary by place of birth. The largest variations were observed for cardiovascular disease (from 6.5% (Other Asia) to 27.3% (Other Caribbean)) and hypertensive disease (from 4.2% (India) to 24.0% (Other Caribbean)). A higher proportion of immigrants than non-immigrants reported these two health problems (cardiovascular disease: 14.8% versus 12.7%; hypertensive disease: 10.9% versus 8.9%).

Regression analysis results indicated that the likelihood of having one or more health problems (NUMBPRB>1; Table 6.6) was associated with all four exposure variables. This likelihood was lower among immigrants, overall (OR=0.74, CI=0.62,0.88), and among subjects born in Europe (OR=0.79, CI=0.64,0.97), South Europe (OR=0.66, CI=0.47,0.92), Greece (OR=0.40, CI=0.16,0.98), Asia (OR=0.52, CI=0.37,0.72), East Asia (OR=0.55, CI=0.32,0.95), South East Asia (OR=0.46, CI=0.27,0.80), South Asia (OR=0.47, CI=0.24,0.93), China (OR=0.38, CI=0.16,0.89), Vietnam (OR=0.28, CI=0.11,0.72), Central/South America (OR=0.53, CI=0.28,1.00), and South America (OR=0.47, CI=23,0.95) than among non-immigrants (Tables O1a-d).

However, the likelihood of reporting one of these selected health problems was not significantly related to place of birth variables when adjustment was made for covariates (CVD, HYPERTENS-DIS, DB, DIGESTIVE, ULCER, CANCER; Table 6.6). Despite this lack of significance, one borderline significant ($0.01<p<0.05$) relationships is worth mentioning: for the relationship between the likelihood of having a hypertensive disease and REGION (Table 6.6), subjects born in the Caribbean had a significantly higher likelihood of reporting hypertensive disease (OR=2.55, CI=1.17,5.58; Table O3b) than did non-immigrants. Large confidence intervals were found for some odds ratios for the likelihood of having diabetes, gastro-intestinal ulcer, cancer, and digestive diseases.

Table 6.6 P-values for the relationship (adjusted for covariates) between health problems and the four exposure variables, for the OHS.

Outcome[1] (Table number in Appendix O)	IMM	REGION	SUB-REGION	COUNTRY
	p-value	p-value	p-value	p-value
NUMBPRB≥1 (O1a-d)	**<0.0001**	**<0.0001**	**0.0001**	**<0.0001**
CVD (O2a-d)	0.0562	0.1285	0.7342	0.5537
HYPERTENS-DIS (O3a-d)	0.2418	0.0333	0.1727	0.4717
DB (O4a-d)	0.4559	0.6730	0.8813	0.6113
DIGESTIVE (O5a-d)	0.5164	0.2580	0.7790	0.4415
ULCER (O6a-d)	0.1840	0.0540	0.0235	0.4122
CANCER (O7a-d)	0.3710	0.8115	--	--

[1] NUMBPRB≥1: likelihood of having at least one health problem; CVD: likelihood of having a cardiovascular disease; HYPERTENS-DIS: likelihood of having a hypertensive disease; DB: likelihood of having diabetes mellitus; DIGESTIVE: likelihood of having a digestive disease; ULCER: likelihood of having a gastro-intestinal ulcer; CANCER: likelihood of having cancer.

6.4.2 Health problems: QHHNS

Compared with OHS results, a lower proportion of QHHNS participants (Table M1, Appendix M) reported having a cardiovascular disease (9.6%) but a higher proportion reported hypertension (14.0%). The higher prevalence of hypertension may have been due to the fact that hypertension was only self-reported in the OHS, while it was assessed using both blood pressure measurements and self-reporting in the QHHNS. Only 4.4% of all subjects did not know that they had hypertension, however. Higher unadjusted proportions of immigrants than non-immigrants had cardiovascular disease (12.3% versus 9.4%), hypertension (21.1% versus 13.4%), angina (11.8% versus 8.1%), intermittent claudication (0.6% versus 0.4%), and diabetes (10.5% versus 4.5%) (Tables M1 and M3). However, while 1.6% of non-immigrant subjects had experienced an infarction, no immigrant reported this health event.

A higher proportion of immigrants than non-immigrants had high levels of total blood cholesterol (Table M2; total cholesterol≥5.2mmol/L: 50.8% versus 48.5%; total cholesterol≥6.2mmol/L: 42.6% versus 35.5%) and triglycerides (21.0% versus 16.7%), or low levels of HDL-cholesterol (11.1% versus 7.6%). However, high LDL-cholesterol levels and total-cholesterol-to-HDL-cholesterol ratio were found more frequently among Canadian-born subjects than immigrants (high LDL-cholesterol: 39.8% versus 36.2%; high ratio: 27.9% versus 24.0%). Finally, proportionally more immigrants than non-immigrants (42.6% versus 35.5%) did not know if their total blood cholesterol level was high (≥5.2 mmol/L). Despite these descriptive differences reported above, no significant relationships were found between the likelihood of health problems or high/low blood lipids and place of birth (Tables Q1a-Q12b). Because of the very low prevalence of intermittent claudication and infarction among immigrant sub-groups, only descriptive statistics were performed for these health characteristics.

6.4.3 Consultations with health professionals: OHS

On average, the members of the OHS study group had seen or talked to a health professional eleven times during the twelve months preceding the survey interview (Table K2). Approximately half (five) of these consultations were with general practitioners and specialists. Between sub-groups of respondents, the average number of consultations with *all* health professionals ranged from 7 (Hong Kong and Trinidad) to 15 (South Asia) and the number of consultations with general practitioners and specialists varied from 4 (Caribbean, Africa, West Europe, Middle East, East Africa, Other Africa, the Netherlands, Hong Kong, the Philippines, Trinidad, Guyana) to 11 (South Asia).

Regression analyses showed that the number of consultations with *all* health professionals was not significantly associated with any of the four exposure variables (CONSULT-HPROF; Table 6.7). However, there was a significant relationship between the number of consultations with general practitioners and specialists (CONSULT-GPSP) and sub-region of birth: immigrants from South Europe reported a higher number of consultations with these health professionals than did non-immigrants (Table O9c). A borderline significant relationship was also noted between the number of consultations with general practitioners and specialists and COUNTRY (Table 6.7): Italian-born subjects had consulted significantly more frequently these health professionals during the past 12 months than did Canadian-born subjects.

Table 6.7 P-values for the relationships (adjusted for covariates) between other health outcomes and the four exposure variables, for the OHS.

Outcome[1] (Table number in Appendix O)	IMM	REGION	SUB-REGION	COUNTRY
	p-value	p-value	p-value	p-value
CONSULT-HPROF (O8a-d)	0.8024	0.7580	0.6163	0.5611
CONSULT-GPSP (O9a-d)	0.0244	0.1107	**0.0062**	0.0188
CUT-DOWN-BED-DAYS (O10a-d)	0.6213	0.2353	0.7123	0.8537
SELF-HEALTH (O11a-d)	**<0.0001**	**<0.0001**	**<0.0001**	**<0.0001**

[1] CONSULT-HPROF: number of consultations with all health professionals during the past twelve months; CONSULT-GPSP: number of consultations with general practitioners or specialists during the past twelve months; CUT-DOWN-BED-DAYS: likelihood of having had at least one cut-down day or bed-day during the last two weeks; SELF-HEALTH: self-perceived health.

6.4.4 Consultations with health professionals: QHHNS

During the three months preceding the survey, the QHHNS subjects had consulted a health professional two times, on average, and a general practitioner or specialist one time (Table M3), i.e., less often, on a yearly basis, than did OHS respondents. A slightly higher proportion of immigrants than non-immigrants had consulted a health professional (60.9% versus 59.4%) or a general practitioner or specialist (54.8% versus 52.2%), at least once. The likelihood of having consulted a health professional at least once was not associated with IMM and REGION (Tables Q13a-Q14b).

6.4.5 Cut-down days and bed-days: OHS only

During the fourteen days preceding the interview, 13.1% of the subjects in the OHS study group had to stay in bed all or most of the day because of health problems, or had to cut down on the things they normally do because of their health, and this for at least one day (Table K2); the average number of cut-down or bed-days was one. The unadjusted proportion of individuals who reported one or more cut-down or bed-days varied slightly by place of birth: 13.6% among Canadian-born subjects versus 11.8% among immigrants. The lowest unadjusted proportion was found among respondents from Vietnam (3.2%) and the highest among subjects from Guyana (25.8%). However, the likelihood of having had at least one bed-day or cut-down day was not associated with place of birth (CUT-DOWN-BED-DAYS; Table 6.7).

6.4.6 Self-perceived health: OHS only

On average, the members of the OHS study group reported that their health was between good and very good (score=3.7), compared with people of the same age (Table K2). The score varied between 3.2 (Portugal, Hungary) and 4.1 (Trinidad) among respondent sub-groups. Self-perceived health was strongly associated with all four exposure variables describing place of birth (SELF-HEALTH; Table 6.7). Immigrants had, in general, a slightly lower self-health score than did non-immigrants (Table O11a). Immigrants from Asia, East Asia, South East Asia, South Asia, South Europe, East Europe, as well as those from China, Vietnam, India, and Italy reported a lower self-perceived health than did their Canadian-born counterparts (Table O11b-d).

6.5 Summary of the findings for research questions 1 and 2

6.5.1 OHS

Tables 6.8 to 6.10 summarize the OHS findings described for the two primary research questions. Results are illustrated *only for the outcomes significantly associated with at least one exposure variable* (after adjusting for covariates; see Tables 6.1 to 6.7), and then *only for the immigrant sub-groups presenting significant differences from Canadian-born subjects*. Significant odds ratios are presented in the tables (numbers= odds ratios). In addition, significant linear relationships are displayed: positive signs (+) indicate positive relationships and negative signs (-) negative relationships.

Table 6.8 SUMMARY TABLE: significant relationships[1] between immigrant status (IMM) or regions of birth (REGION) and nutritional and health outcomes, for the OHS.

Outcome[2]	IMM	REGION				
		Europe	Asia	Caribbean	Africa	CS America
NUTRITIONAL						
BREADS	0.73	0.74	0.56			
MILK	1.36		2.84			
FAT	-	-	-	-	-	-
FAT-HIGH	0.50	0.66	0.21	0.36	0.31	
CALCIUM	-		-	-		
CALCIUM-INADEQ-RNI	1.47		3.85	2.79		
CALCIUM-INADEQ-WHO	2.23		9.88	5.41		
ENERGY		-				
CARBOHYDRATE	+	+	+	+	+	+
CARBOHYD-LOW	0.58	0.64	0.45	0.36		
PROTEIN-INADEQ			3.23	2.69		
ALCOHOL-HIGH	0.64		0.19			
IRON		+	-			
IRON-INADEQ	1.42		4.07			
VITAMINC	+	+				+
THIAMIN-INADEQ	1.46		2.91	2.53		
RIBOFLAVIN		+	-			
RIBOFL-INADEQ	1.52		4.50			

/continued...

(continued) Table 6.8 SUMMARY TABLE: significant relationships[1] between immigrant status (IMM) or regions of birth (REGION) and nutritional and health outcomes, for the OHS.

Outcome[2]	IMM	REGION				
		Europe	Asia	Caribbean	Africa	CS America
NIACIN-INADEQ	2.18		6.50			
BMI	-		-			
OVERWT	0.75		0.40			
OBESITY			0.56			
LOW-BMI	1.51		3.40			
HEALTH						
NUMBPRB≥1	0.74	0.79	0.52			0.53
SELF-HEALTH	-		-			

[1] Significant odds ratios (odds of *not* meeting the nutritional recommendations, of having overweight, obesity, or low BMI, or of reporting at least one health problem) are presented in the table (as numbers), as well as significant linear relationships (plus signs (+) indicate positive relationships and minus signs (-) negative relationships).

[2] BREADS: likelihood of *not* meeting the recommendation for "CEREALS AND BREADS"; MILK: likelihood of *not* meeting the recommendation for "MILK PRODUCTS"; FAT: fat intake (% energy); FAT-HIGH: likelihood of high fat intake; CALCIUM: calcium intake (mg/day); CALCIUM-INADEQ-RNI: likelihood of "inadequate" calcium intake, using Canadian recommendations; CALCIUM-INADEQ-WHO: likelihood of "inadequate" calcium intake, using WHO recommendations; ENERGY: energy intake (kJ); CARBOHYDRATE: carbohydrate intake (% of energy); CARBOHYD-LOW: likelihood of low carbohydrate intake; PROTEIN-INADEQ: likelihood of "inadequate" protein intake; ALCOHOL-HIGH: likelihood of high alcohol intake; IRON: iron intake (mg/day); IRON-INADEQ: likelihood of "inadequate" iron intake; VITAMINC: vitamin C intake (mg/day); THIAMIN-INADEQ: likelihood of "inadequate" thiamin intake; RIBOFLAVIN: riboflavin intake (mg/5MJ); RIBOFL-INADEQ: likelihood of "inadequate" riboflavin intake; NIACIN: niacin intake (mg/5MJ); NIACIN-INADEQ: likelihood of "inadequate" niacin intake; BMI: BMI (kg/m^2); OVERWT: likelihood of overweight; OBESITY: likelihood of obesity; LOW-BMI: likelihood of low BMI; NUMBPRB≥1. likelihood of having at least one health problem; SELF-HEALTH: self-perceived health.

Table 6.9 SUMMARY TABLE: significant relationships[1] between sub-regions of birth (SUB-REGION) and nutritional and health outcomes, for the OHS.

Outcome[2]	SUB-REGION										
	West Europe	North Europe	South Europe	East Europe	East Asia	SE Asia	South Asia	Middle East	East Africa	Central America	South America
NUTRITIONAL											
CFG			-	+							
BREADS				0.46	0.52	0.51					
MILK		0.67	2.51		5.97	3.19					
MEATS					0.42		2.23				
FAT		-	-		-	-	-	-	-	-	-
FAT-HIGH			0.34		0.23	0.16	0.24				
CALCIUM			-		-	-					
CALCIUM-INADEQ-RNI			1.57		6.40	4.55			3.52		
CALCIUM-INADEQ-WHO					13.50	14.39					
ENERGY				+	-	-					
CARBOHYDRATE			+		+	+	+		+	+	
CARBOHYD-LOW			0.45			0.36	0.28				
PROTEIN			+				-				
PROTEIN-INADEQ						3.49	5.87				
IRON			+		-	-					
IRON-INADEQ					3.62	5.54	4.17				
VITAMINC			+								
THIAMIN	-										
THIAMIN-INADEQ					2.77	3.18	2.73				

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(continued) Table 6.9 SUMMARY TABLE: significant relationships[1] between sub-regions of birth (SUB-REGION) and nutritional and health outcomes, for the OHS.

Outcome[2]	SUB-REGION										
	West Europe	North Europe	South Europe	East Europe	East Asia	SE Asia	South Asia	Middle East	East Africa	Central America	South America
RIBOFLAVIN		+			-	-					
RIBOFL-INADEQ					3.80	7.75					
NIACIN	-		+	-			-				
BMI		-			-	-					
OVERWT		0.65			0.22	0.39					
OBESITY		0.63			0.30						
LOW-BMI					5.83	3.63					
HEALTH											
NUMBPRB≥1			0.66		0.55	0.46	0.47				0.47
CONSULT-GPSP			+								
SELF-HEALTH			-	-	-	-	-				

[1] Significant odds ratios (odds of *not* meeting the nutritional recommendations, of having overweight, obesity, or low BMI, or of reporting at least one health problem) are presented in the table (as numbers), as well as significant linear relationships (plus signs (+) indicate positive relationships and minus signs (-) negative relationships).

[2] CFG: number of food groups meeting 75% of the Canada Food Guide recommendations; BREADS: likelihood of *not* meeting the recommendation for "CEREALS AND BREADS"; MILK: likelihood of *not* meeting the recommendation for "MILK PRODUCTS"; FAT: fat intake (% energy); FAT-HIGH: likelihood of high fat intake; CALCIUM: calcium intake (mg/day); CALCIUM-INADEQ-RNI: likelihood of "inadequate" calcium intake, using Canadian recommendations; CALCIUM-INADEQ-WHO: likelihood of "inadequate" calcium intake, using WHO recommendations; ENERGY: energy intake (kJ); CARBOHYDRATE: carbohydrate intake (% of energy); CARBOHYD-LOW: likelihood of low carbohydrate intake; PROTEIN: protein intake (% of energy); PROTEIN-INADEQ: likelihood of "inadequate" protein intake; IRON: iron intake (mg/day); IRON-INADEQ: likelihood of "inadequate" intake; VITAMINC: vitamin C intake (mg/day); THIAMIN: thiamin intake (g/5MJ); THIAMIN-INADEQ: likelihood of "inadequate" thiam... .ntake; RIBOFLAVIN: riboflavin intake (mg/5MJ); RIBOFL-INADEQ: likelihood of "inadequate" riboflavin intake; NIACIN: niacin intake (mg/5MJ); BMI: BMI (kg/m^2); OVERWT: likelihood of overweight; OBESITY: likelihood of obesity; LOW-BMI: likelihood of low BMI; NUMBPRB≥1: likelihood of having at least one health problem; CONSULT-GPSP: number of consultations with general practitioners or specialists during the past twelve months; SELF-HEALTH: self-perceived health.

Table 6.10 SUMMARY TABLE: significant relationships[1] between countries birth (COUNTRY) and nutritional and health outcomes, for the OHS.

Outcome[2]	COUNTRY														
	Ger-many	UK	Italy	Por-tugal	Yugo-slavia	Greece	Poland	Hong Kong	China	Philip-pines	Viet-nam	India	Jama-ica	Trini-dad	Guy-ana
NUTRITIONAL															
CFG							+								
BREADS							0.41			0.36					
MILK		0.68	3.00					5.81	9.13	3.55	2.79				
MEATS								0.29				2.65			
FAT		–	–	–	–	–		–	–	–	–	–	–	–	–
FAT-HIGH			0.28	0.36				0.21		0.16	0.17	0.25	0.29		
FIBRE										–					
CALCIUM		+						–	–	–	–				
CALCIUM-INADEQ-RNI				2.56				5.74	10.21		5.61		2.77		3.11
CALCIUM-INADEQ-WHO						5.56		11.85	19.51	8.99	18.01		4.78		
ENERGY							+		–		–				
CARBOHYDRATE			+	+						+	+	+	+	+	+
CARBOHYD-LOW			0.39							0.31		0.30			
PROTEIN			+									–			
PROTEIN-INADEQ											4.32	7.20		3.77	
IRON			+						–		–				
IRON-INADEQ								3.04	5.52		8.34	5.37			
VITAMINC			+												
THIAMIN															
THIAMIN-INADEQ									3.85			3.04		4.08	

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(continued) Table 6.10 SUMMARY TABLE: significant relationships[1] between countries birth (COUNTRY) and nutritional and health outcomes, for the OHS.

Outcome[2]	COUNTRY														
	Germany	UK	Italy	Portugal	Yugoslavia	Greece	Poland	Hong Kong	China	Philippines	Vietnam	India	Jamaica	Trinidad	Guyana
RIBOFLAVIN		+						-		-	-				
RIBOFL-INADEQ									5.04	4.89	10.40				
NIACIN	-											-			
BMI		-						-	-		-				
OVERWT		0.66	1.85					0.25	0.18						
OBESITY		0.64													
LOW-BMI								7.54	4.11		10.59				
HEALTH															
NUMBPRB≥1						0.40			0.38		0.28				
SELF-HEALTH			-						-		-	-			

[1] Significant odds ratios (odds of *not* meeting the nutritional recommendations, of having overweight, obesity, or low BMI, or of reporting at least one health problem) are presented in the table (as numbers), as well as significant linear relationships (plus signs (+) indicate positive relationships and minus signs (-) negative relationships).

[2] CFG: number of food groups meeting 75% of the Canada Food Guide recommendations; BREADS: likelihood of *not* meeting the recommendation for "CEREALS AND BREADS"; MILK: likelihood of *not* meeting the recommendation for "MILK PRODUCTS"; FAT: fat intake (% energy); FAT-HIGH: likelihood of high fat intake; CALCIUM: calcium intake (mg/day); CALCIUM-INADEQ-RNI: likelihood of "inadequate" calcium intake, using Canadian recommendations; CALCIUM-INADEQ-WHO: likelihood of "inadequate" calcium intake, using WHO recommendations; ENERGY: energy intake (kJ); CARBOHYDRATE: carbohydrate intake (% of energy); CARBOHYD-LOW: likelihood of low carbohydrate intake; PROTEIN: protein intake (% of energy); PROTEIN-INADEQ: likelihood of "inadequate" protein intake; IRON: iron intake (mg/day); IRON-INADEQ: likelihood of "inadequate" iron intake; VITAMINC: vitamin C intake (mg/day); THIAMIN: thiamin intake (g/5MJ); THIAMIN-INADEQ: likelihood of "inadequate" thiamin intake; RIBOFLAVIN: riboflavin intake (mg/5MJ); RIBOFL-INADEQ: likelihood of "inadequate" riboflavin intake; NIACIN: niacin intake (mg/5MJ); BMI: BMI (kg/m^2); OVERWT: likelihood of overweight; OBESITY: likelihood of obesity; LOW-BMI: likelihood of low BMI; NUMBPRB≥1: likelihood of having at least one health problem; SELF-HEALTH: self-perceived health.

6.5.2 QHHNS

For the QHHNS, the relationships observed between place of birth and the nutritional and health characteristics were rarely significant. The only difference observed was for saturated fat intake: immigrants, overall, and immigrants born outside of Europe, were less likely than non-immigrants to have a high saturated fat intake.

6.6 Study of acculturation: OHS only

6.6.1 Nutritional characteristics

Regression analysis results showed that neither ACCETHNI nor TIME were associated with any of the selected nutritional characteristics when adjustment was made for covariates (Table 6.11). However, ACCLANG was associated with calcium intake (CALCIUM) when REGION was the covariate for place of birth (Table R5b; Appendix R). Respondents who were classified as "not applicable" for ACCLANG (i.e., immigrants from countries where English or French was an official language) had a higher intake than those who were not acculturated (i.e., immigrants *not* speaking English or French at home and who were born in a country where English or French was *not* an official language). The likelihoods of overweight and obesity were also related to ACCLANG (Table R9b and R10b). Individuals in the "not applicable" category for ACCLANG were less likely to be overweight (OR=0.62, CI=0.43,0.90) or obese (OR=0.50, CI=0.33,0.75) than did those who were not acculturated.

6.6.2 Health characteristics

No significant relationships between ACCETHNI or TIME and any of the selected health characteristics were found when adjustments were made for covariates (Table 6.12). However, ACCLANG was significantly associated with the number of consultations with general practitioners and specialists and with self-perceived health. First, subjects in the "not applicable" category reported a lower number of consultations with general practitioners and specialists than did not acculturated participants (Table

Table 6.11 P-values for the relationships (adjusted for covariates) between nutritional outcomes and acculturation variables, for the OHS.

Outcome[1] (Table number in Appendix R)	REGION			SUB-REGION			COUNTRY		
	ACCETHNI	ACCLANG	TIME	ACCETHNI	ACCLANG	TIME	ACCETHNI	ACCLANG	TIME
FAT (R1a-d)	0.1566	0.1116	0.1072	0.2762	0.1190	0.2190	0.2595	0.5433	0.1042
FAT-HIGH (R2a-d)	0.3032	0.1840	0.4024	0.4626	0.8224	0.5037	0.5213	0.3848	0.5744
FIBRE (R3a-d)	0.8072	0.9800	0.4386	0.8577	0.8967	0.4504	0.5938	0.1779	0.1662
FIBRE-LOW (R4a-d)	0.4795	0.2864	0.4057	0.5054	0.2006	0.5037	0.4167	0.1672	0.5454
CALCIUM (R5a-d)	0.9980	**0.0008**	0.7817	0.9860	0.4931	0.9123	0.9880	0.7180	0.7150
CALCIUM-INADEQ-RNI (R6a-d)	0.8936	0.1341	0.3198	0.8500	0.9489	0.4966	0.8151	0.7615	0.4101
CALCIUM-INADEQ-WHO (R7a-d)	0.3266	0.6894	0.4658	0.7371	0.5444	0.5824	0.6760	0.6952	0.6740
BMI (R8a-d)	0.9662	0.0506	0.0633	0.9880	0.4030	0.0318	0.9920	0.2696	0.1223
OVERWT (R9a-d)	0.9930	**0.0027**	0.0811	0.9817	0.5148	0.0550	0.9802	0.5099	0.1747
OBESITY (R10a-d)	0.6676	**<0.0001**	0.1319	0.6157	0.3556	0.0750	0.6077	0.4776	0.1465
LOW-BMI (R11a-d)	0.9254	0.8568	0.0275	0.9871	0.6554	0.0281	0.9841	0.7015	0.0269

[1] FAT: fat intake (% energy); FAT-HIGH: likelihood of high fat intake (>30% of dietary energy); FIBRE: fibre intake (g/MJ); FIBRE-LOW: likelihood of low fibre intake (<3.0 g/MJ); CALCIUM: calcium intake (mg/day); BMI: BMI (kg/m^2); OVERWT: likelihood of overweight (>25 kg/m^2); OBESITY: likelihood of obesity (>27 kg/m^2); LOW-BMI: likelihood of low BMI (<20 kg/m^2).

Table 6.12 P-values for the relationships (adjusted for covariates) between health outcomes and acculturation variables, for the OHS.

Outcome[1] (Table number in Appendix R)	REGION			SUB-REGION			COUNTRY		
	ACCETHNI	ACCLANG	TIME	ACCETHNI	ACCLANG	TIME	ACCETHNI	ACCLANG	TIME
NUMBPRB≥1 (R12a-d)	0.6247	0.0271	0.2455	0.5951	0.3205	0.3003	0.6427	0.5741	0.3547
CVD (R13a-d)	0.2221	0.6002	0.4541	0.2515	0.9375	0.4002	0.2659	0.5276	0.4382
HYPERTENS-DIS (R14a-d)	0.5650	0.6132	0.4190	0.4846	0.8278	0.2422	0.6977	0.5605	0.3328
CONSULT-HPROF (R15a-d)	0.0442	0.0514	0.2231	0.0576	0.0990	0.3082	0.0455	0.8805	0.3409
CONSULT-GPSP (R16a-d)	0.5890	**0.0041**	0.6681	0.5796	0.1684	0.8870	0.5250	0.3162	0.8187
CUT-DOWN-BED-DAYS (R17a-d)	0.0222	0.2973	0.9681	0.0277	0.2448	0.9051	0.0398	0.6206	0.9082
SELF-HEALTH (R18a-d)	0.6758	**0.0010**	0.8927	0.6530	0.0427	0.9053	0.7008	0.0830	1.0000

[1] NUMBPRB≥1: likelihood of having at least one health problem; CVD: likelihood of having cardiovascular disease; HYPERTENS-DIS: likelihood of having hypertensive disease; CONSULT-HPROF: number of consultations with all health professionals during the past twelve months; CONSULT-GPSP: number of consultations with general practitioners or specialists during the past twelve months; CUT-DOWN-BED-DAYS: likelihood of having had at least one cut-down day or bed-day during the last two weeks; SELF-HEALTH: self-perceived health.

R16b). Secondly, subjects classified as acculturated or as "not applicable" had a better self-perceived health score than did not acculturated subjects (Table R18b).

The borderline significant relationship found for the relationship between ACCLANG and the likelihood of having one or more health problems is worth mentioning (Tables 6.12 and R12b). Subjects in the "not applicable" category were more likely to have a health problem (OR=1.45, CI=1.01,2.08) than were not acculturated individuals.

6.6.3 Summary of the findings for research question 3

Table 6.13 summarizes the findings for the analyses involving acculturation using the criteria described in section 6.5.1.

Table 6.13 SUMMARY TABLE: Significant relationships[1] found between acculturation variables and the selected nutritional and health outcomes, for the OHS.

Outcome[2]	ACCLANG[3,4]	
	Acculturated versus not acculturated	Not applicable versus not acculturated
NUTRITIONAL		
CALCIUM		+
OVERWT		0.62
OBESITY		0.50
HEALTH		
CONSULT-GPSP		–
SELF-HEALTH	+	+

[1] Significant odds ratios (odds of being overweight or obese) are presented in the table (as numbers), as well as significant linear relationships (plus signs (+) indicate positive relationships and minus signs (-) negative relationships).

[2] CALCIUM: calcium intake (mg/day); OVERWT: likelihood of overweight (BMI>25 kg/m^2); OBESITY: likelihood of obesity (BMI>27 kg/m^2); CONSULT-GPSP: number of consultations with general practitioners or specialists during the past twelve months; SELF-HEALTH: self-perceived health.

[3] ACCLANG: acculturation for language spoken at home.

[4] No significant relationship for ACCETHNI (acculturation for ethnicity) and for TIME.

CHAPTER 7: RESULTS: EXPLORATORY RESEARCH QUESTIONS

7.1 Introduction

This chapter presents the results associated with the two exploratory research questions, i.e., with research questions 4 and 5.

7.2 Research question 4: analyses taking account of "past" diet

In this section, results related to the association of place of birth with anthropometric and health characteristics among OHS respondents whose current diet was assumed to be similar to their "past" diet are described (see section 5.2 for methodological questions). Sections 7.2.1 and 7.2.2 include a description of the general findings, while section 7.2.3 presents a comparison of these findings with those reported in Chapter 6.

7.2.1 Anthropometric characteristics

Regression analysis results showed that BMI (Table 6.14) and the likelihood of both overweight and obesity (BMI, OVERWT, OBESITY) were associated with some place of birth variables. Respondents born in East Asia, North Europe, and in the United Kingdom had a lower BMI than did their Canadian-born counterparts (Table S1c-d, Appendix S). The likelihood of being overweight (Table S2b-d) was also lower among subjects from these regions or countries of birth (East Asia: OR=0.33, CI=0.11,0.97; North Europe: OR=0.66, CI=0.45,0.96; United Kingdom: OR=0.66, CI=0.45,0.96), as well as among respondents born in Asia (OR=0.41, CI=0.19,0.86), compared with non-immigrants. However, subjects born in South Europe (OR=1.56, CI=1.07,2.27) and Italy (OR=2.01, CI=1.24,3.23) were more likely than non-immigrants to be overweight (Tables S2c-d). The likelihood of obesity was related to SUB-REGION but none of the selected immigrant sub-groups were significantly different from Canadian-born subjects, although borderline significance was found for North Europe (p=0.0199; OR=0.65, CI=0.40,1.05) and South Europe (p=0.0187; OR=1.46, CI=0.96,2.22) (Table S3c); these borderline results agree with the findings for overweight. In addition, the relationship between the likelihood of obesity and COUNTRY (Table S3d) was borderline significant (Table 6.14);

Italian-born subjects had a higher likelihood of obesity (OR=1.68, CI=1.02,2.78) than did non-immigrants; this observation is consistent with the results for overweight. Finally, low BMI was not associated with place of birth (Table 6.14).

Table 6.14 P-values for the relationships (adjusted for covariates) between anthropometric outcomes and the four exposure variables, for the OHS, and for individuals whose current dietary pattern has not changed.

Outcome[1] (Table number in Appendix S)	IMM	REGION	SUB-REGION	COUNTRY
	p-value	p-value	p-value	p-value
BMI (S1a-d)	0.0124	0.0146	**0.0017**	**0.0045**
OVERWT (S2a-d)	0.0310	**0.0019**	**<0.0001**	**<0.0001**
OBESITY (S3a-d)	0.3535	0.2111	**0.0098**	0.0178
LOW-BMI (S4a-d)	0.6179	0.2669	0.3785	0.3794

[1] BMI: BMI (kg/m^2); OVERWT: likelihood of overweight (>25 kg/m^2); OBESITY: likelihood of obesity (>27 kg/m^2); LOW-BMI: likelihood of low BMI (<20 kg/m^2).

7.2.2 Health characteristics

Overall, the likelihood of having at least one health problem and the likelihood of reporting one of the selected health problem were not associated with any of the four exposure variables (Table 6.15). However, significance was almost achieved for the relationship between the likelihood of having at least one health problem and both IMM and SUB-REGION; immigrants, overall (OR=0.81, CI=0.64,1.01), and immigrants from South Europe (OR=0.67, CI=0.45,1.00) and East Asia (OR=0.38, CI=0.15,0.94) were less likely than non-immigrants to report a health problem.

While place of birth was not associated with the number of consultations with *all* health professionals (CONSULT-HPROF; Table 6.15), the number of consultations with general practitioners and specialists was significantly associated with sub-regions of birth (CONSULT-GPSP; Table 6.15). Compared with non-immigrants, respondents from South-Europe had consulted these health professionals more frequently during the past twelve months (Table S13c). The association of country of birth with the number of consultations with general practitioners and specialists was also borderline significant (Table 6.15); Italian-born respondents reported a higher number of consultations than did non-immigrants (Table S13d).

Table 6.15 P-values for the relationships (adjusted for covariates) between health outcomes and the four exposure variables, for the OHS, and for individuals whose current dietary pattern has not changed.

Outcome[1] (Table number in Appendix S)	IMM	REGION	SUB-REGION	COUNTRY
	p-value	p-value	p-value	p-value
NUMBPRB≥1 (S5a-d)	0.0155	0.0612	0.0265	0.1671
CVD (S6a-d)	0.1527	0.4151	0.7284	0.8241
HYPERTENS-DIS (S7a-d)	0.6958	0.0985	0.1310	0.4894
DB (S8a-d)	0.5879	0.8140	0.6686	0.7707
DIGESTIVE (S9a-d)	0.4710	0.6818	0.8714	0.9404
ULCER (S10a-d)	0.2787	0.2194	0.3586	0.4695
CANCER (S11a-d)	0.7326	0.9762	--	--
CONSULT-HPROF (S12a-d)	0.1434	0.3358	0.3360	0.4582
CONSULT-GPSP (S13a-d)	0.0452	0.5011	**0.0043**	0.0154
CUT-DOWN-BED-DAYS (S14a-d)	0.9508	0.7983	0.9512	0.9688
SELF-HEALTH (S15a-d)	**0.0046**	**0.0036**	**<0.0001**	**<0.0001**

[1] NUMBPRB≥1: likelihood of having at least one health problem; CVD: likelihood of having cardiovascular disease; HYPERTENS-DIS: likelihood of having hypertensive disease; DB: likelihood of having diabetes mellitus; DIGESTIVE: likelihood of having a digestive disease; ULCER: likelihood of having gastro-intestinal ulcer; CANCER: likelihood of having cancer; CONSULT-HPROF: number of consultations with all health professionals during the past twelve months; CONSULT-GPSP: number of consultations with general practitioners or specialists during the past twelve months; CUT-DOWN-BED-DAYS: likelihood of having had at least one cut-down day or bed-day during the last two weeks; SELF-HEALTH: self-perceived health.

The likelihood of having had at least one bed-day or cut-down day during the last fourteen days was not associated with place of birth (Table 6.15). However, immigrants, overall, and immigrants from Asia, East Asia, South Europe, East Europe, and Italy reported a lower self-perceived health score than did non-immigrants (Tables S15a-d).

7.2.3 Summary of the findings

Table 6.16 summarizes the findings for the analyses performed on the OHS respondents whose dietary pattern was assumed to have not changed over time. The layout of this table is slightly different from the one used for Tables 6.8-6.10 and 6.13. However, the criteria used to include results in the table remain the same as those described earlier (section 6.5.1).

Table 6.16 compares two types of results: 1) the results found when *all* respondent were considered (*option A* in the table; research questions 1 and 2); and 2) the results found when *only* the respondents whose current diet was assumed to be similar to "past" diet were considered (*option B* in the table; research question 4). This layout allows for the comparison between the two sets of analyses and consequently the evaluation of the impact of the exploratory adjustment for long-term diet. The criteria used to include results in the table remain the same as those described earlier (section 6.5.1).

It was possible to see that when adjustment was made for long-term diet, none of the differences previously found for obesity, low BMI, and the likelihood of reporting at least one health problem remained significant. However, all the differences between non-immigrants and immigrant sub-groups, observed for the number of consultations with general practitioners and specialists and for self-perceived health, remained. Half the differences previously noted for BMI were still present (for North Europe, East Europe, United Kingdom), and five out of six differences for overweight remained significant (for Asia, North Europe, East Asia, United Kingdom, and Italy). Two new differences were found: 1) South European-born subjects were more likely than non-immigrants to be overweight; 2) Italian-born participants were less likely than Canadian-born subjects to report one or more health problem.

7.3 Research question 5: Influence of diet

This section describes the results of the analyses performed to find if the association of place of birth and acculturation with anthropometric and health characteristics was modified when significant dietary covariates were removed from the regression models.

Table 6.16 SUMMARY TABLE: Significant relationships[1] between immigrant status (IMM), regions of birth (REGION), sub-regions of birth (SUB-REGION), countries of birth (COUNTRY), and anthropometric and health outcomes, for *all* respondents (A) and for the respondents whose dietary pattern has not changed (B), for the OHS.

Outcome[2]	IMM		REGION				SUB-REGION								COUNTRY					
			Europe		Asia		North Europe		South Europe		East Europe		East Asia		UK		Italy		Greece	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
ANTHROPOMETRIC																				
BMI	-				-		-	-					-	-	-	-				
OVERWT	0.75				0.40	0.41	0.65	0.66		1.56			0.22	0.33	0.66	0.66	1.85	2.01		
OBESITY					0.56		0.63						0.30		0.64			1.68		
LOW-BMI	1.51				3.40								5.83							
HEALTH																				
NUMBPRB≥1	0.74		0.79		0.52				0.66				0.55						0.40	
CONSULT-GPSP									+	+										
SELF-HEALTH	-	-			-	-			-	-	-	-	-	-			-	-		

[1] Significant odds ratios (odds of being overweight or obese, of having a low BMI, or of reporting at least one health problem) are presented in the table (as numbers), as well as significant linear relationships (plus signs (+) indicate positive relationships and minus signs (-) negative relationships).

[2] BMI: BMI (kg/m^2); OVERWT: likelihood of overweight ($BMI>25$ kg/m^2); OBESITY: likelihood of obesity ($BMI>27$ kg/m^2); LOW-BMI: likelihood of low BMI ($BMI<20$ kg/m^2); NUMBPRB≥1: likelihood of having at least one health problem; CONSULT-GPSP: number of consultations with general practitioners or specialists during the past twelve months; SELF-HEALTH: self-perceived health.

The list of the outcomes for which diet was a significant covariate is presented in Table 6.17 while Tables T1a-T22d (Appendix T) display, for each of these selected outcome, the final regression models with and without dietary covariates. Some differences in regression estimates and in p-values associated with these estimates, were observed between the two sets of models. However, although differences of more than 10% (Mickey and Greenland 1989) were observed, the changes in estimates were not always consistent; both increases and decreases in odds ratios and beta estimates were observed depending on the outcome selected.

Overall p-values for the exposure variables became significant in five of the models studied. Two were associated with analyses performed to answer research question 1 and 2 (for the OHS), and three with the analyses performed to answer research question 4. In the first case, IMM and COUNTRY became significantly associated with the number of visits to general practitioners and specialists: immigrants, overall, and Italian-born immigrants reported more consultations than did Canadian-born subjects (Tables T7a and T7d). Beta estimates changed from 0.099 (CI=-0.014;0.213) to 0.126 (CI=0.013;0.239) for all immigrants, and from 0.447 (CI=0.190; 0.704) to 0.489 (CI=0.233;0.744) for subjects born in Italy, compared with non-immigrants.

In the second case (research question 4), IMM and REGION were now associated with BMI (Tables T15a-b). Immigrants, overall, and immigrants from Asia had a lower BMI than did non-immigrants. Beta estimates changed from -0.460 (CI=-0.933;0.014) to -0.527 (CI=-0.996;-0.058) for all immigrants, and from -1.925 (CI=-3.522;-0.328) to -2.028 (CI=-3.620;-0.437) for Asia. COUNTRY became significantly associated with the number of visits to general practitioners and specialists. Italian-born participants consulted these health professionals more frequently than did non-immigrants; beta estimates changed from 0.461 (CI=0.200;0.721) to 0.494 (CI=0.234;0.753).

Table 6.17 Outcomes and exposure variables for the final regression models in which fat, fibre, and/or energy intakes were significant covariates (final models), by research question.

Outcome[1]	Research questions 1-2 OHS	Research question 1-2 QHHNS	Research question 3 OHS	Research question 4 OHS
BMI	IMM REGION SUB-REGION COUNTRY	IMM REGION	Models with: REGION SUB-REGION COUNTRY	IMM[2] REGION[2] SUB-REGION COUNTRY
OVERWT	IMM REGION SUB-REGION COUNTRY			SUB-REGION COUNTRY
OBESITY	IMM REGION SUB-REGION COUNTRY	IMM REGION		IMM REGION SUB-REGION COUNTRY
CVD	IMM REGION SUB-REGION COUNTRY			IMM REGION SUB-REGION COUNTRY
HYPERTENSION		IMM REGION		
DB	IMM REGION SUB-REGION COUNTRY			IMM REGION SUB-REGION COUNTRY
TRIGLYCERIDES		IMM REGION		
CONSULT-HPROF	IMM REGION SUB-REGION COUNTRY			IMM REGION SUB-REGION COUNTRY
CONSULT-GPSP	IMM[2] REGION SUB-REGION[2] COUNTRY		Model with: REGION	IMM REGION SUB-REGION COUNTRY[2]
SELF-HEALTH	IMM REGION SUB-REGION COUNTRY			IMM REGION SUB-REGION COUNTRY

[1] BMI: BMI (kg/m^2); OVERWT: likelihood of overweight (BMI>25 kg/m^2); OBESITY: likelihood of obesity (BMI>27 kg/m^2); CONSULT-HPROF: number of consultations with all health professionals during the past twelve months; CONSULT-GPSP: number of consultations with general practitioners or specialists; SELF-HEALTH: self-perceived health.

[2] Exposure variables which became significant when diet was removed from the final models.

CHAPTER 8. DISCUSSION: PRIMARY AND SECONDARY RESEARCH QUESTIONS

8.1 Introduction

This chapter presents a discussion of the results described in Chapter 6 (mainly for OHS results because of the lack of association between place of birth and the selected outcomes for the QHHNS). Comparisons are made with existing literature in this area of research, and limitations associated with the present study and their influence on the findings are outlined.

8.2 Research question 1: nutritional characteristics

8.2.1 Canada Food Guide: OHS only

8.2.1.1 All recommendations

In 1992, a new food guide was introduced in Canada to promote healthy eating habits in Canadians (Health and Welfare Canada 1992). The guide recommends eating a variety of foods from four food groups: "Cereals and Breads", "Vegetables and Fruits", "Milk Products", and "Meats and Alternates" (see Appendix E). Although nutritional campaigns have occurred frequently in Canada during the last decade (Chevalier 1994; Langlois and Charbonneau 1995), most of the OHS participants both immigrants and non-immigrants, were *not* meeting all four recommendations of the guide. Only about one in five participants was daily consuming at least 75% of the recommended number of servings of all four food groups. This result may have occurred because the 1992 Guide recommendations were used for the comparison between current and recommended intakes, whereas the survey was conducted in 1990. The new Guide recommends a higher intake of breads and cereals (≥5 servings instead of ≥3) and vegetables and fruits (≥5 servings instead of ≥4) than did the 1982 version of the Canada Food Guide (Health and Welfare Canada 1982). However, when the OHS food-frequency questionnaire was designed, serving sizes used for the questionnaire were made as similar as possible to those that were going to be used in the 1992 version of the Guide (Bright-See 1994).

Compared with Canadian-born individuals, Polish-born respondents were slightly more likely to meet all four guidelines of the Guide. As this group of immigrants also had a higher average energy intake than did non-immigrants, this difference could have partly been explained by a higher overall food consumption.

8.2.1.2 Individual recommendations

Differences between immigrants and Canadian-born respondents for the likelihood of meeting each recommendation of the Guide were consistent with variability in traditional dietary patterns in countries of birth. This suggests that some immigrants have maintained, at least partially, some of their cultural dietary habits.

The most striking results were for "Milk Products". Respondents born in Asia, East Asia, South East Asia, and in some countries within these areas had a particularly higher likelihood of *not* meeting the recommendation for this food group than did respondents born in Canada. This result agrees with the low per capita availability of milk in various Asian regions compared with Canada (using data from food balance sheet statistics; Food and Agriculture Organization 1992). In China, data from the 1982 Chinese National Nutrition Survey also indicated that milk was not consumed at all by the respondents living in 58 out of the 65 counties surveyed (Brun et al. 1990).

Like Asian-born respondents in the OHS, Italian-born Ontarians were *less* likely then Canadian-born Ontarians to meet the recommendation for "Milk Products". Traditionally, Mediterranean and Italian diets have been richer in cereals, fruits, and vegetables but poorer in milk and dairy products, meats, and sugar than the northern European diet (Ferro-Luzzi and Sette 1989), although more recent data have indicated an increase in milk consumption in Italy (Buzina et al. 1991). OHS immigrant respondents from the United Kingdom, however, were *more* likely than non-immigrants to meet the recommendation for "Milk Products". Data on per capita food availability (Food and Agriculture Organization 1992) also indicated that the population of the United Kingdom consumed, in 1990, slightly more milk (as percent of dietary energy) than did the population of Canada. Nonetheless, in the United Kingdom, milk consumption has declined since the late 1970s (Buss 1991; Roberts 1988). As a result of dietary changes in Italy and in the United Kingdom, differences between Canadian-born individuals and *recent* or future immigrants from these countries may be smaller than those reported here for all immigrants.

Individuals born in Asia, East Asia, and South East Asia were *more* likely than non-immigrants to meet the suggested number of servings of "Cereals and Breads", while East Asians were *less* likely to meet the recommendation for "Meats and Alternates". This finding agrees with the typical Asian diet known to be rich in cereals and complex carbohydrates and relatively poor in meat (Posner et al. 1994a; Food and Agriculture Organization 1992). Results from the 1982 Chinese National Nutritional Survey (Brun et al. 1990) suggested that meat intake among Chinese individuals between 35 and 64 years of age was very low (median 20 g/day); meat was consumed less than once a week by participants born in 35 out of 65 counties surveyed. However, our finding that South Asian-born immigrants had a higher likelihood of meeting the recommended number of servings for "Meats and Alternates" than did Canadian-born individuals was unexpected. This result does not agree with the traditionally low average meat intake of South Asians (Food and Agriculture Organization 1992). It suggests that the immigrants surveyed may have been influenced by the dietary transition (associated with an increased meat intake; Popkin 1994) found in some low income countries, including some South Asian countries, or that they have adopted a more Western diet after moving to Canada. These immigrants may also simply have reported a higher intake of meat alternates such as legumes, seeds, and nuts.

The recommendation for "Cereals and Breads" was more likely to have been met by Polish-born immigrants than by Canadians. Food balance statistics from the FAO (Food and Agriculture Organization 1992) also indicated that, in 1990, the per capita availability of cereals, in Poland, was on average approximately 50% higher (as percent of energy) than it was in Canada.

Contrary to what was expected, neither immigrants from southern Europe (Ferro-Luzzi and Sette 1989; Buzina et al. 1991), nor immigrants from any other region or country, were more likely than Canadian-born individuals to meet the recommendation for "Vegetables and Fruits". Overall, only 36.3% of the OHS study group members were meeting at least three-fourths of the recommended number of servings for this food group. This observation is worrisome given that vegetables and fruits are good sources of dietary fibres, vitamins, and minerals that have been related to the prevention of various health problems (Helzlouer et al. 1994; Gey et al. 1987; Block 1992). In the United States, where the results from the Second NHANES (performed between 1976 and 1980) showed that 45% of the population was not consuming any fruits or fruit juices and that 22% of the population was not consuming any vegetables daily (Patterson et al. 1990), a large campaign to promote vegetable and fruit consumption was introduced a few years ago in the major media (Havas et al. 1994). This large "Five-a-day" campaign has not had any significant Canadian media repercussion yet.

8.2.2 Priority nutrients

The role of dietary fat, fibre, and calcium in the development or in the prevention of chronic diseases such as cardiovascular disease, diabetes, and cancer, has been investigated extensively during the past two decades (Levenson and Bockman 1994; Bright-See 1987; Smith Vanderkooy 1988; Trowell 1976). A consensus that dietary fat intake should be limited, and fibre and calcium consumption increased, has been reached by many countries around the world (Posner et al. 1994b; World Health Organization 1990).

8.2.2.1 Fat and cholesterol

8.2.2.1.1 General comments

In the present research, large proportions of OHS and QHHNS participants had fat, saturated fat, and cholesterol intakes that were exceeding current recommendations. A high fat intake has been related to various health problems that are particularly frequent in Canada, including obesity, cardiovascular disease, and cancer (U.S. Department of Health and Human Services 1988). In addition, results from the American 1987 NHIS indicated that individuals with a high fat intake were less likely to meet other dietary guidelines than were individuals with a lower fat intake (Subar et al. 1994). Respondents in the highest quartile for fat intake (as percent of dietary energy) had higher cholesterol, saturated fat, sodium, protein, and energy intakes than did those in the lowest quartile. They also had lower intakes of vitamin C, carbohydrate, carotene, folate, and dietary fibre -- nutrients considered necessary to maintain good health and that may also help prevent certain health problems (Shils et al. 1994).

Although the observed unadjusted average fat consumption of the surveys' participants was high (37% in the OHS and 35% in the QHHNS), it appeared lower than the average intake reported by Canadians twenty years ago: in 1972, the Canada Nutrition Survey showed that Canadians were on average ingesting 40% of their dietary energy as fat (excluding energy from alcohol; Health and Welfare Canada 1990b). Our findings (see below) suggest that the potential decrease in the average fat intake in Canada may partly have been influenced by the increasing ethnic diversity of Canadian immigrants and more generally of the Canadian population (as described by Canadian censuses; Statistics Canada 1973; 1989; 1993b; Badets and Chui 1994).

8.2.2.1.2 Differences between immigrants and non-immigrants

Total fat: In the OHS, immigrants had a lower average fat intake than did Canadian-born subjects and they were also more likely to meet the recommended fat intake than did their non-immigrants counterparts, an encouraging finding. More precisely, differences in the fat intake of immigrant and non-immigrant OHS respondents tended to reflect differences in traditional food patterns by place of origin. For example, the lower fat intake found among immigrants from Asia (more specifically from East Asia (Hong Kong, China), South East Asia (the Philippines, Vietnam), South Asia (India), and the Middle East) was in accordance with the traditionally low fat intake in these regions (Popkin 1994; Campbell and Junshi 1994; Food and Agriculture Organization 1992). Investigations conducted in the United States and the United Kingdom also showed that fat intake was lower among immigrants from South Asia, Vietnam, and China than among non-immigrants (Carlson et al. 1982; Sevak et al. 1994; Choi et al. 1990; Kim et al. 1993). Some Asian countries, however, have recently experienced economic and demographic transformations that have caused an increase in the consumption of fats (Popkin et al. 1993; World Health Organization 1990; Popkin 1994); these changes may narrow future differences in fat consumption between newcomers from these countries and Canadian-born individuals.

The traditional Mediterranean diet has often been proposed as a model to help reduce cardiovascular disease and some cancers (Buzina et al. 1991; Menotti 1991; James et al. 1989; Berrino and Muti 1989). Ferro-Luzzi and Sette (1989) have reported that its fat content is generally low, although some variations exist between Mediterranean countries, with a high mono-unsaturated to saturated fat ratio (>2) and a moderate polyunsaturated to saturated fat ratio (approximately 0.4 to 0.5). Our finding that OHS respondents born in South Europe (including Italy, Portugal, Yugoslavia, and Greece) consumed less fat than did participants born in Canada is consistent with this observation. An investigation of elderly Italians (Freudenheim et al. 1993) also indicated that they ingested less total fat, saturated fat, and cholesterol (all nutrient expressed in relation to dietary energy) than did elderly Americans; that study, however, compared Americans with Italians living in Italy and not with Italian-born Americans. Recent trends have indicated an increase in meat, animal fat products, and total fat intake in South European countries (Serra-Majem et al. 1993). Consequently, recent immigrants or future immigrants from South Europe to Canada may no longer have the typically low fat intake that was once found in this region (Helsing 1993).

The observation that fat consumption was lower among OHS participants born in the Caribbean, East Africa, Central America, and South America than among Canadian-born individuals also agrees with the usually low fat content of the diet in these regions of the world (Posner et al. 1994a; Food and Agriculture Organization 1992). However, the lower fat intake of immigrants from North Europe and the United Kingdom compared with Canadian-born subjects was unexpected; using FAO data on per capita food availability (Food and Agriculture Organization 1992), fat intake (as percent of dietary energy) was very similar in Canada and in the United Kingdom.

Cholesterol: The lack of difference between non-immigrant and immigrant sub-groups for cholesterol intake or for the likelihood of high cholesterol intake was surprising. We had expected that the results for cholesterol would parallel those for fat since recent surveys of dietary intake in the United States (Subar et al. 1994; Ursin et al. 1993) and Australia (Baghurst et al. 1994) have indicated that cholesterol intake was positively correlated with fat intake. Differences in food selection by the respondents to the surveys could have partly explained this result. For example, fish usually has a low fat content but is relatively rich in cholesterol, and the cholesterol content of some shellfish such as shrimps, lobster, and crab is high (Health and Welfare Canada 1988b).

Saturated fat: Immigrant respondents to the QHHNS had a lower mean saturated fat intake than did Canadian-born individuals. This result is in agreement with a report from Shatenstein and Gagnon (1992). These authors observed, in a group of adults living in the Montreal area, that saturated fat intake was associated with language spoken at home: respondents speaking a language other than French or English, i.e., the multicultural population of Montreal, consumed less saturated fat than did other subjects.

8.2.2.2 Dietary fibre

8.2.2.2.1 General comments

Overall, 86.3% of the OHS respondents and 87.6% of the QHHNS participants consumed less dietary fibre than recommended in Canada. Although optimal fibre requirements (amount and type of fibres) are still being debated, there is a consensus on the need to increase the fibre content of the diet in several countries (Health and Welfare Canada 1985; Schneeman and Tietyen 1994; World Health Organization 1990), including Canada. Some concerns remain, however, that excessive intake of dietary fibre may reduce the absorption of several nutrients, including calcium, zinc, manganese, selenium, copper, and iron, particularly in vegetarian diets (Freeland-Graves 1988; Dwyer 1991).

The generally low fibre intake found in this study (2.1 g/MJ) is important considering the health risks associated with low intake (U.S. Department of Health and Human Services 1988; Trowell 1976). However, fibre intake seems to have increased slightly since the early 1970s. Results of the Nutrition Canada Survey (Health and Welfare Canada 1985) indicated that between 1970 and 1972, the average fibre intake of Canadians was 1.5 g/MJ; among adults aged 20 years and over, fibre intake varied between 1.3 g/MJ and 1.9 g/MJ depending on gender and age group. This increase may have been due in part to the Canadian promotion campaigns advocating a higher fibre consumption (e.g., campaigns by the Canadian Cancer Society, the Canadian Diabetic Association, and the Canadian Dietetic Association).

8.2.2.2.2 Differences between immigrants and non-immigrants

In this investigation, fibre intake was rarely associated with place of birth. This observation was unexpected and we had presumed, based on previous literature, that some immigrant sub-groups would have had a higher fibre intake compared with non-immigrants. For example, Sevak et al. (1994) reported that a group of South Asian males between 40 and 69 years of age and living in London (United Kingdom) ingested more dietary fibre than did their European-born counterparts. In addition, Campbell and Junshi (1994) observed that the average fibre consumption of Chinese (in China) was three times as high as the average intake of Americans (in the United States). The absence of association between place of birth and fibre intake, here, may have been due to the acculturation of the diet of immigrants towards a more Western-like diet poorer in dietary fibres. However, we observed that fibre intake was not associated with the acculturation level among immigrants in this study.

Our findings for fibres are in accordance with the lack of association found between place of birth and "Vegetables and Fruits" in the OHS (see 8.2.1.2). The most important sources of dietary fibres in the Canadian diet are vegetables and fruits: in 1986, 53% of the fibre content of the foods bought by Canadians was coming from vegetables and fruits, whereas 38% was coming from cereals and baking goods, and only 9% from other sources (Health and Welfare Canada 1990b).

While no difference in fibre intake was noted by place of birth, differences in resistant starch intake may have been present. Resistant starch has been defined as the fraction of starch in food that escapes digestion in the small intestine and then becomes available for fermentation by anaerobic bacteria in the colon (Muir and O'Dea 1992). By promoting bacterial fermentation, some authors have suggested that resistant starch shares the beneficial effects of insoluble fibre (Ranganathan et al. 1994; Cummings and Bingham

1987; Anderson 1991) and consequently could help prevent some diseases. The proportion of resistant starch in different foods or diets has been known to vary considerably (Muir and O'Dea 1992; Livesey 1990). For example, Levitt et al. (1987) demonstrated that approximately 19% of the carbohydrates from baked beans, 7 to 10% of that from wheat, oats, corn, and potatoes, but only 0.9% of that from rice escaped small bowel absorption and reached the colon. Consequently, differences in the main sources of complex carbohydrates between countries (e.g., rice for China versus wheat for Canada; Food and Agriculture Organization 1992) and more specifically between Canadian-born individuals and immigrant sub-groups may influence the amount of resistant starch ingested. More research has to be done before recommendations can be formulated for resistant starch.

8.2.2.3 Calcium

8.2.2.3.1 General comments

OHS results indicated that some respondents were likely to have had an "inadequate" calcium intake. This observation has major implications, particularly since the OHS food-frequency questionnaire tended to overestimate calcium intake (Bright-See et al. 1994), and since calcium from supplements was included in the calculation of total calcium intake. The population of Canada is aging and various diseases that have been related to inadequate calcium intake, for example colon cancer and hypertension, have been found to be frequent among the elderly (Heaney 1993; Garland et al. 1991; McCarron et al. 1991). Osteoporosis with associated fractures is a major contributor to morbidity and to health care costs, particularly among postmenopausal women (Heaney 1991; Heaney 1993; Osteoporosis Society of Canada 1994).

8.2.2.3.2 Differences between immigrants and non-immigrants

Various sub-groups of respondents were ingesting less calcium or had a higher likelihood of "inadequate" calcium intake than did Canadian-born individuals. The observation that OHS respondents born in Asia, East Asia (Hong Kong, China), and South East Asia (the Philippines, Vietnam) had a lower calcium consumption and a higher likelihood of "inadequate" calcium intake than did Canadian-born subjects, and the finding that OHS immigrants born in the United Kingdom had a lower likelihood of "inadequate" intake of calcium than did non-immigrants, parallel the results found for "Milk Products". This finding was expected; in the average Canadian diet, the most important source of calcium is milk and milk products (approximately 60% of the calcium ingested, estimated using information on household food expenditures in 1986 in Canada; Health and Welfare Canada 1990b).

Data from food balance sheet statistics (Food and Agriculture Organization 1980) and from past surveys also agree with our results. The amount of calcium available for consumption in 1977 was lower in Hong Kong, China, the Philippines, and Vietnam than in Canada; some changes may have occurred, however, between 1977 and 1990 (more recent FAO data on mineral and vitamin availability were not available). Hu et al. (1993) also noticed that elderly women living in various regions of China had a relatively low calcium intake (from 230 to 724 mg/day depending on the county surveyed). However, Kim et al. (1993) reported that elderly Chinese individuals (over 60 years of age) living in Chicago were not consuming less calcium than did elderly Americans overall. Haines and co-workers (1994) also found that calcium intake from foods in a group of postmenopausal Chinese women living in Hong Kong was at the lowest end of the recommended range of intakes for adult females in Asia (recommendations: 400 to 500 mg daily); 44% of the dietary calcium ingested was from fruits and vegetables and only 31.8% from milk products -- a pattern different from the one found in Canada. Approximately 27% of the women interviewed in that study had taken calcium supplements and had a *total* calcium intake averaging approximately 1,250 mg/day, which was considerably higher than the mean intake from foods.

The higher likelihood of "inadequate" calcium intake among OHS respondents born in South Europe (including Portugal and Greece) is consistent with the traditional food consumption pattern in this region of the world (Ferro-Luzzi and Sette 1989; see section 8.2.1.2). The FAO (Food and Agriculture Organization 1980) also reported that in 1977, the amount of calcium available for consumption was lower in Portugal, Jamaica, Guyana, and East African countries, and higher in Poland than in Canada; this corroborates our findings. However, the availability of calcium was similar between Greece and Canada.

8.2.3 Energy, carbohydrate, protein, and alcohol

8.2.3.1 Energy

8.2.3.1.1 General comments

While numerous developing countries are still facing energy malnutrition (usually associated with protein malnutrition), industrialized countries have to deal predominantly with health problems associated with dietary excesses (Nestle 1992); excessive energy intake has been associated with cardiovascular diseases, cancer, and digestive diseases. Energy requirements vary considerably from one individual to the other, depending on gender, age, energy expenditure, height, weight, etc. (Schutz and Jéquier 1994). Consequently, these factors have to be taken into consideration when comparing energy intake between individuals and groups of individuals. Finally, various studies have explored the accuracy of self-reported dietary energy intake. While different researchers have noted that obese individuals tend to underreport their energy consumption (Lichtman et al. 1992), Schoeller (1990) and Mertz et al. (1991) have suggested that energy intake is more generally underreported. However, the OHS food-frequency questionnaire tended to slightly overestimate energy intake compared with a four-day food record (Bright-See et al. 1994). It is not known if this overestimation was differentially associated with place of birth.

8.2.3.1.2 Differences between immigrants and non-immigrants

OHS results indicated that energy consumption was associated with place of birth even when important determinants of energy intake were adjusted for. Immigrants from Asia, East Asia (China), South East Asia (Vietnam) consumed less energy than did Canadian-born subjects, and those from East Europe (Poland) ingested more energy than did non-immigrants. These findings are consistent with 1990 food balance sheet statistics for China, Vietnam, Poland, and Canada (Food and Agriculture Organization 1992).

8.2.3.2 Carbohydrates

8.2.3.2.1 General comments

A high carbohydrate intake, particularly one made of complex carbohydrates, has been advocated for the reduction of risks for various diseases (World Health Organization 1990). Canadian recommendations (Health and Welfare Canada 1990a) suggest that carbohydrates provide between 50 and 60% of dietary energy, while the WHO (World Health Organization 1990) suggests a carbohydrate intake equal to 55 to 75% of energy. Even if the selected cut-off point used to define low and high carbohydrate intake in this study was somewhat low (50% of energy) in comparison to the recommendations, more than half the OHS and QHI'NS respondents were not above this point.

8.2.3.2.2 Differences between immigrants and non-immigrants

Overall, immigrant participants in the OHS and immigrants from each region of interest had a higher carbohydrate intake than did Canadian-born respondents. Immigrants from Europe, Asia, and from the Caribbean were also less likely to have a low carbohydrate intake than did Canadian-born individuals. However, data on the type of carbohydrate ingested (complex, simple, etc.) were unfortunately not available from the OHS. Descriptive statistics, however, not only suggested that immigrants had a higher carbohydrate consumption than did non-immig:ants, but also that a slightly higher prooortion of the carbohydrate intake of immigrants, compared with non-immigrants, tenc'ed to come from "Cereals and Breads" (suggesting a higher proportion of complex carbohydrates).

OHS results for carbohydrates are in accordance with food consumption patterns and food availability in Europe, Asia, the Caribbean, Africa, and Central and South America (Food and Agriculture Organization 1992; Campbell and Junshi 1994). They suggest that immigrants from these regions have kept some of the cultural dietary patterns found in their countries of origin. Some investigators have also reported that groups of migrants from South Asia (Sevak et al. 1994), China (Kim et al. 1993; Choi et al. 1990), and Vietnam (Carlson et al. 1982), to the United Kingdom or the United States, had a higher carbohydrate intake than did their host-country counterparts.

The higher carbohydrate intake and the lower likelihood of low carbohydrate intake among OHS subjects born in South Europe reflect, once again, Mediterranean food habits (Ferro-Luzzi and Sette 1989). Our findings are also analogous to the results of the study from Freudenheim and co-workers (1993) which indicated that elderly Italians living in Italy were ingesting more carbohydrates than did elderly Americans.

8.2.3.3 Proteins

8.2.3.3.1 General comments

Although protein-energy malnutrition is still a major public health problem found in all regions of the developing world (World Health Organization 1990), including South East Asia (World Health Organization 1986), it is not a frequent problem in developed countries. In Canada, results from the Nutrition Canada Survey (Santé et Bien-être Social Canada 1975) indicated that the average protein intake was well above the recommended intakes for all age groups except for individuals 65 years and over; however, some elderly individuals, especially elderly women, may have been at an increased risk of insufficient protein intake.

In the present study as well, the average protein intake (15% to 17% of dietary energy) suggests that protein consumption is generally sufficient (if not high in some cases) among Ontarians and Quebecers. However, 7% of all OHS respondents and almost 10% of the QHHNS respondents were likely to have had an "inadequate" protein intake. We cannot assume, however, that these respondents were at risk of protein deficiency. Other measures, including biochemical (e.g., albumin or prealbumin levels) and anthropometric measurements, would have to be performed to detect such a deficiency. Nevertheless, our results suggest that protein intake should be studied more closely among Canadians (particularly among sub-groups at high risk), and both very low and very high intakes should be monitored.

8.2.3.3.2 Differences between immigrants and non-immigrants

OHS respondents born in South Asia and India consumed less protein than did non-immigrants, and those born in South East Asia (Vietnam), South Asia (India), and

Trinidad had a higher likelihood of "inadequate" protein intake than did Canadian-born individuals. Sevak et al. (1994) also reported that a group of South Asian men, between 40 and 65 years of age and living in London, England, ingested less protein (as percent of energy) than did their European-born counterparts. However, Carlson et al. (1982) indicated that the average protein content of the diet of Vietnamese migrants to Britain (as percent of energy) was similar and even higher than the average protein content of the diet in the United Kingdom or in the United States. The per capita availability of protein (as percent of energy) for consumption in different countries in 1990 (Food and Agriculture Organization 1992) also parallels our findings: protein availability was lower in Vietnam, India, and Trinidad than in Canada.

8.2.3.4 Alcohol

8.2.3.4.1 General comments

In this study, approximately 10% of the OHS respondents and 6% of the QHHNS respondents had consumed more than 14 drinks during the week preceding the survey and thus had a moderate to high risk of developing alcohol problems, according to the classification system used by the Ontario Ministry of Health (1988). For the OHS, the proportion was slightly more than the proportion reported for all Canadians in the 1990 Health Promotion Survey (6%; Adalf 1993). This survey, however, included younger individuals (15 years and older) than did the present study.

8.2.3.4.2 Differences between immigrants and non-immigrants

Descriptive statistics suggest that OHS respondents born outside Canada, and particularly those born in Asia and Africa, tended to consume fewer servings of alcohol-containing beverages per week, in average, than did non-immigrants. The proportion of respondents who consumed more than 14 drinks per week was the lowest among respondents from the Asian countries studied and the highest among individuals born in Hungary and Yugoslavia (Table J4). This result is consistent with statistics on per capita alcohol availability (Food and Agriculture Organization 1992): 1990 food balance sheet data suggest that the proportion of dietary energy from alcohol-containing beverages is lower in Asian countries and higher in Hungary than in Canada (data were not available for Yugoslavia). In addition, various studies have reported that alcohol intake is associated with ethnicity and place of birth (McKeigue and Karmi 1993; Small 1984/1985; Glassner 1981; Muhlin 1985). Some studies performed in the United States, for example, suggested that Asians consume less alcohol than Caucasians (Schall et al. 1992; Akutsu et al. 1989). This observation is consistent with our findings. However, most of these studies were based on descriptive data only and did not adjust for potential confounding variables.

When we adjusted for significant covariates, alcohol intake was associated with place of birth, but few significant differences were found between non-immigrants and immigrant sub-groups. This finding was unexpected and may have been influenced by the acculturation of the immigrants surveyed (Small 1984/1985), particularly immigrants coming from countries where alcohol consumption is usually low. Acculturated immigrants may more likely follow the average alcohol intake of the general population of Canada. This hypothesis has been corroborated by Caetano (1987) who reported that alcohol consumption increased with acculturation among American Hispanics, particularly among women. Clarke and colleagues (1990) also indicated that the alcohol intake of a group of Asian immigrants tended to increase with the amount of time spent in England. Alcohol may also be perceived as more accessible in Canada than in the country of origin (Legge and Sherlock 1990/1991), favouring alcohol intake in some immigrants, thereby reducing the gap in alcohol intake between immigrants and non-immigrants.

8.2.4 Iron and vitamins

8.2.4.1 General comments

Overall, the average intake of iron, vitamin C, thiamin, riboflavin, and niacin of the OHS and QHHNS respondents appears sufficient, and the likelihood of "inadequate" intake of these nutrients was relatively low, although some variations by place of birth existed. The likelihood of excessive intakes was not estimated here. In addition, if we assume that immigrants consumed less supplements than did Canadian-born individuals based on the fact that it was reported that non-Hispanic White Americans use nutrient supplements more frequently than Hispanic and Black Americans (Subar and Block 1990; Block et al. 1988; see section 8.2.5.5), differences between immigrants and non-immigrants for nutrient intakes and for the likelihood of "inadequate" intakes could have been even greater than those observed here.

Among the respondents investigated in the OHS, those born in Asia, and particularly in East Asia, South East Asia, as well as South Asia, were the most likely to have "inadequate" intakes of iron, thiamin, and niacin. Iron and vitamin deficiencies are also more generally found in developing than in developed countries (World Health Organization 1987, 1990; Pan American Health Organization 1990).

8.2.4.2 Iron: differences between immigrants and non-immigrants

OHS respondents born in some Asian sub-regions and countries (East Asia, South East Asia, China, Vietnam, India) reported a lower iron intake or a higher likelihood of "inadequate" iron intake than did Canadian-born subjects. This is in accordance with FAO food balance sheet statistics for 1977 (Food and Agriculture Organization 1980): the amount of iron available for consumption was on average lower in China, Vietnam, and India than in Canada. The availability of iron for consumption in Hong Kong (FAO data), however, was not lower than it was in Canada. Changes in food availability in some countries may have taken place between 1977 and 1990, however.

In the context of the present study, it was somewhat surprising to see that East Asian-born immigrants had a lower iron consumption and a higher likelihood of "inadequate" iron intake than did non-immigrants because immigrants from this Asian sub-region were also found to be more likely than Canadian-born individuals to meet the recommendations for "Meat and Alternates" and "Cereals and Breads" (see section 8.2.1.2) -- two food groups which provide respectively approximately 43% and 23% of the iron consumed by Canadians (assessed using household food expenditure in Canada in 1986; Health and Welfare Canada 1990b). The most important food sources of iron in the diet of East Asian immigrants, however, may have differed from those found in the general Canadian population. In addition, the foods selected by East Asian-born immigrants may not have had a high iron density (e.g. rice does not contain much iron compared with bread made with enriched flour).

OHS respondents born in South Europe, overall, and those born in Italy had a higher intake of iron than did Canadian-born respondents. This may have been associated with differences in the intake of cereal products between Italian and Canadian-born individuals, as suggested by results for "Cereals and Breads" (see section 8.2.1.2).

Finally, our findings can be compared with studies that investigated iron deficiency, although we did *not* estimate the prevalence of iron deficiency but only the likelihood of "inadequate" iron intake. For example, Bindra and Gibson (1986) reported, in a group of East Indians living in Canada, a high prevalence of iron deficiency due to low intake of available iron (predominantly due to their lacto-ovo vegetarian diet) and high consumption of dietary fibre, phytate, and tannins. It was also reported that Indians living in Natal (South Africa) commonly have iron-deficiency anaemia, potentially because of high dietary phytate and low calcium intake (Mayet et al. 1972). In the present study, Indian-born subjects had a higher likelihood of "inadequate" iron intake than did non-immigrants but not a higher fibre intake. Because iron deficiency has been found to be highly prevalent in some developing countries, the investigation of iron deficiency among immigrant sub-groups at high risk in Canada would be valuable.

8.2.4.3 Vitamin C: differences between immigrants and non-immigrants

Beaton and Bengoa reported in 1976 that scurvy was a rare deficiency in nearly every population studied throughout the world, because of generally sufficient (at least marginally) intakes of vitamin C. In this study, the results also suggest that the consumption of vitamin C in Ontario and Quebec is, on average, adequate.

The higher vitamin C intake of the OHS respondents born in South Europe or Italy is consistent with the usually high consumption of fruits and vegetables in Mediterranean countries and in Italy (Buzina et al. 1991; Ferro-Luzzi and Sette 1989), as well as with the reported per capita availability of vitamin C in Italy (Food and Agriculture Organization 1980). In 1986, 84% of the vitamin C consumed by Canadians came from fruits and vegetables (estimated using household food expenditures; Health and Welfare

Canada 1990b). Nevertheless, in this study, unadjusted descriptive statistics indicated that Italian-born immigrants tended to consume *less* servings of "Fruits and Vegetables" than did non-immigrants (3.7 versus 4.2 servings/day). The vitamin C content of fruits and vegetables varies, however (Health and Welfare Canada 1988b).

The results found for Italy contrast with the findings of a study conducted by Krogh and co-workers (1993). This investigation showed that elderly Italian and American males (60 years and older) consumed similar amounts of vitamin C, and that elderly Italian females tended to ingest less vitamin C than did their American counterparts. However, this study was limited to elderly individuals, it compared data collected using different dietary data collection techniques, and it was performed in two different countries.

8.2.4.4 Thiamin: differences between immigrants and non-immigrants

It has been reported that thiamin deficiency is still found in some developing countries, although its prevalence has decreased over time. In the 1960s, the World Health Organization (1967) was reporting that beriberi was a significant health problem in countries where rice (especially polished rice) was the main staple food, and particularly in South East Asia (Philippines, Vietnam, Thailand, and Burma). A decade later, however, it was reported (Beaton and Bengoa 1976) that its prevalence had decreased considerably, although it remained endemic in a moderate or mild form in certain countries.

In this study, respondents from East Asia (China), South East Asia, South Asia (India), and the Caribbean (Trinidad) had a higher likelihood of "inadequate" thiamin consumption than did non-immigrants. Indian-born subjects also had a lower thiamin intake than did their Canadian-born counterparts. This finding parallels FAO food balance sheet data for 1977 (Food and Agriculture Organization 1980) which reported that the per capita availability of thiamin was lower in China, the Philippines, Vietnam, India, and Trinidad than in Canada.

8.2.4.5 Riboflavin: differences between immigrants and non-immigrants

Various OHS immigrant sub-groups, particularly Asian, South Asian, and South East Asian sub-groups, reported a lower riboflavin intake or a higher likelihood of "inadequate" riboflavin intake than did non-immigrants. Once again, this agrees with the differences observed in the per capita riboflavin availability reported in 1977 (Food and Agriculture Organization 1980): availability was lower in China, the Philippines, and Vietnam than in Canada.

In the 1960s, riboflavin deficiency was reported to occur in South and East Asian countries, as well as in Africa and Latin America (World Health Organization 1967). More recently, low riboflavin intake and riboflavin deficiency have been reported in some Asian countries. For example, the 1982 Chinese National Nutrition Survey (Brun et al. 1990) showed, among individuals between 35 and 64 years of age and living in 24 provinces of China, that the average riboflavin was about 75% of the Chinese recommended dietary allowances and that more than 70% of the population surveyed was at risk of riboflavin deficiency; deficiency was assessed using erythrocyte glutathione reductase activity coefficients. In the Linxian province in China, riboflavin deficiency (evaluated using the same biochemical technique) was reported to affect almost 90% of the adults 40 to 50 years of age (Yang et al. 1982). In the Philippines, a study performed on a small group of pregnant and non-pregnant women between 20 and 29 years of age to assess riboflavin requirements (Kuizon et al. 1992), indicated that among non-pregnant women, riboflavin intake was low (approximately 47% of the recommended intake), while among pregnant women, both thiamin and riboflavin intakes were low (39% and 47% of the recommended intakes respectively).

8.2.4.6 Niacin: differences between immigrants and non-immigrants

Pellagra was once frequently encountered in countries characterized by a predominantly maize-based diet (e.g., Near East, East Africa, South Europe, United Arab Emirates, Lesotho, South Africa, Uganda), as well as in India, Cuba, and Brazil (World Health Organization 1967). However, it was subsequently suggested (Beaton and Bengoa 1976) that pellagra had disappeared from South Europe and decreased in the Middle East.

In this study, few differences between immigrants and non-immigrants were found for niacin intake. East African and Middle Eastern immigrants did not have a lower niacin intake or a higher likelihood of "inadequate" niacin intake than did non-immigrants. In addition, South European-born individuals had a higher niacin intake than did Canadian-born individuals. In contrast, only Asians had a generally higher likelihood of "inadequate" niacin intake than did non-immigrants, and individuals born in India and Germany reported a lower niacin consumption than did Canadian-born subjects.

8.2.5 Limitations of dietary information

8.2.5.1 Data collection techniques

Dietary data were collected using a food-frequency questionnaire (OHS) and 24-hour recall (QHHNS) techniques. The food-frequency questionnaire technique has recently become the primary method for measuring dietary intake in epidemiological studies because several of its advantages often outweigh its limitations: food-frequency questionnaires estimate the usual diet of individuals, they are relatively easy to complete, and they are relatively inexpensive, especially if the questionnaire is self-administered and scanned directly into an electronic database (Willett 1990d; Barrett-Connor 1991). In a study as large as the OHS, the use of multiple dietary records would not have been feasible because of the time and high costs associated with this method. The preparation and use of food-frequency questionnaires present some difficulties such as the choice of foods to include in the questionnaire, the order of appearance of foods in the questionnaire, the serving sizes selected for each food, the reference period for intake, and the need for literacy if the questionnaire is self-administered (Willett 1990d; Barrett-Connor 1991; Briefel et al. 1992). Long food-frequency questionnaires can also exhaust the respondents, leading to poorer quality of information toward the end of the questionnaire. However, the validity of the OHS food frequency questionnaire (Willett 1990e) was examined by Bright-See and co-workers (1994). The results of this validation study indicated that when the food-frequency questionnaire was compared with a four-day weighted food record, results for fat and fibre intakes (expressed as percent of dietary energy) were very similar between the two methods. Energy, calcium, and vitamin C intakes tended to be overestimated in the food-frequency questionnaire. Carbohydrate, iron, cholesterol, thiamin, riboflavin, and niacin intakes and the number of serving of "Milk Products" were also slightly higher when the food-frequency questionnaire was used compared with the food record. Protein intake and the number of servings of "Cereals and Breads", "Vegetables and Fruits", and "Meats and Alternates" consumed were slightly underestimated. Overreporting and underreporting by place of birth was not investigated by Bright-See et al. (1994).

The OHS food-frequency questionnaire was not specifically designed for immigrants since the survey pertained to the general population of Ontario. Therefore, we could hypothesize that it may not have covered completely all the ethnic foods consumed by some immigrant sub-groups (e.g., tofu, tortillas, dry fish or shellfish, bones, etc.), and that it may not have been adapted to the comprehension of some immigrants (Barrett-Connor 1991; Buzzard and Sievert 1994; Hankin and Wilkens 1994). For example, some immigrants may not have recognized some of the foods listed in the questionnaire and consequently may have underreported their intake. However, most of the foods and/or food groups included in the food questionnaire were basic (e.g., rice, legumes, mixed vegetables, pasta dishes, etc.; Ontario Ministry of Health 1992a), and allowed for various methods of preparation. Consequently, we are confident that foods included in the questionnaire were easily understandable and that they covered the basic diet of all respondents.

Compared with food frequency questionnaires, the 24-hour recall procedure used for the QHHNS is more flexible and facilitates the inclusion of ethnic foods and recipes. Data collection by this method is also relatively fast and inexpensive (Witschi 1990) but data entry is not. The validity of this technique may be affected by the memory, cooperation, and communication ability of the subjects, as well as by the skills of the interviewer (Witschi 1990). To help increase the accuracy of the data in the QHHNS, 24-hour food recalls were administered only by dieticians who were trained specifically for this survey. Interviewers also used food models to illustrate portion sizes during the interview (Santé Québec 1990b).

The OHS was conducted between January and November (Ontario Ministry of Health 1992a). Therefore, potential seasonal effects were minimized (Willett 1990f). However, the QHHNS was conducted only in the fall of 1990 and food consumption may thus have been affected by seasonal food choices. However, some researchers (Hunt et al. 1983; Kim et al. 1984b; Donald et al. 1992) have indicated that seasonal variation of nutrient intake is small. We have assumed, therefore, that the estimated average dietary intake of the QHHNS participants was representative of their average annual intake.

Our results for dietary intake were also subject to the general limitations associated with the use of nutrient databases (in this case, the Canadian Nutrient Data Base (Ontario Ministry of Health 1992b; Junkins and Karpinski 1994) to derive the nutrient composition of an individual's diet (West and van Staveren 1991). However, the Canadian Nutrient Data Base is the most complete one adapted for Canadian foods (Verdier 1984, 1987).

Finally, the accuracy of alcohol consumption measurement is known to be affected by various factors including denial, deliberate deception in reports, memory lapses or forgetting, and the method used to collect information (Midanik and Harford 1994). In our study, the consumption of alcohol-containing drinks during the week preceding the survey was based on self-report. Embree and Whitehead (1993), in a study performed on a military base, have suggested that this method does not provide estimates of alcohol consumption that are as valid as questions on the quantities of wine, beer, and spirits consumed during the past 30 days. However, Wyllie et al. (1994) showed that the last-seven-day recall method gave similar results to four other measures of consumption (typical occasion measure, typical within-locations measure, and recent drinking occasions over a specified time period) when comparisons were made across population sub-groups. For this reason, and because the last-seven-day data collection technique has been used in other Canadian surveys (Health and Welfare Canada et al. 1993; Health and Welfare Canada et al. 1992), we assumed that OHS and QHHNS data on alcohol intake during the past seven days gave a reasonable estimate of general alcohol intake. Cultural or ethnic differences in the acceptability of alcohol use and of the consequences of alcohol use (Legge and Sherlock 1990/1991; Akutsu et al. 1989; Fernandez-Pol et al. 1986) may, however, have affected the reporting of alcohol intake among some immigrant groups.

8.2.5.2 Calculation of energy intake

In our analyses, fat, saturated fat, polyunsaturated fat, fibre, carbohydrate, protein, thiamin, riboflavin, and niacin intakes were expressed in relation to energy intake. For the OHS, total energy consumption did not include energy from *alcohol-containing beverages*, and for the QHHNS, it excluded energy from *alcohol* (see section 4.6.4.1).

If had wanted to estimate energy from alcoholic drinks in the OHS, we could have used information from the OHS food-frequency questionnaire (see previous section). The average number of alcohol-containing drinks consumed during the week preceding the survey was six, which represents an intake of approximately 440 kJ per day, based on the average energy content of alcoholic drinks (Pennington 1989; Addiction Research Foundation 1991), and assuming that the proportion of beer, wine, and spirits consumed by the OHS respondents was representative of the general consumption in Ontario (Adrian and Williams 1989). If we had included this energy intake in the calculation of total energy intake (dietary energy and energy from alcoholic drinks), then nutrient intakes expressed in relation to energy intake would have been affected. For example, the average fat intake would have been approximately 35% of dietary energy instead of 37%. Consequently, excluding intake from alcoholic drinks from the calculation of energy intake slightly altered the reported intakes of some nutrients. Nevertheless, we preferred not to use energy from alcoholic drinks for three reasons. First, it would have meant merging data collected using two methods based on two time frames. Secondly, excluding alcoholic drinks made the comparison between immigrants and non-immigrants more appropriate since the literature suggested that alcohol intake tended to vary by place of birth or ethnicity (McKeigue and Karmi 1993; Akutsu et al. 1989). Thirdly, intakes of other nutrients found in alcoholic beverages would also have had to be approximated.

For the QHHNS, energy from alcohol (250 kJ/day on average) was excluded from the calculation of total energy intake to make the results of the QHHNS more comparable with those of the OHS. Energy from alcohol is smaller than energy from alcoholic drinks because these drinks may contain sources of energy other than alcohol, particularly carbohydrates. For this reason, the effect of the exclusion of alcohol on nutrient intakes expressed relative to energy was assumed to be smaller for the QHHNS than for the OHS.

8.2.5.3 Probability approach

The probability approach (see section 4.6.4.1.3), used to estimate the probability that the usual nutrient intake of an individual was inadequate, raised some concerns because it required information on the distribution of nutritional requirements (Beaton 1994a). Currently, such information is available only for a few nutrients and age-sex groups. Thus, we had to use assumptions about the requirement distributions, which is a major limitation of the application to the particular individual. Conversely, evidence suggests that the probability approach is reasonable at the population level (Beaton 1994a; Anderson et al. 1982). Because, in this study, this approach was employed only for subgroups of subjects, this requirement was satisfied.

The choice of the nutritional recommendations was also an important issue when estimating the probability of "inadequate" intake. In this study, we chose the RNI as the nutritional reference (except for iron), because these recommendations have been designed for Canadians (Health and Welfare Canada 1990a). However, some important variations exist around the world for recommended intakes (Committee 1/5 of the International Union of Nutritional Sciences 1983) and in the methods used to define these recommendations (Harper 1994), and it has been reported that North American recommendations tend to be higher than those of the World Health Organization. Although it can be hypothesized that the nutritional needs of some immigrants may be different from those of healthy Canadians (Campbell et al. 1990), we judged that the RNI were the most appropriate recommendations that could have been used for this study because they are widely accepted as reflecting the most recent investigations of nutritional needs (Health and Welfare 1990a; 1985). Criteria for the evaluation of nutritional status among minority or immigrant groups have not yet been explored extensively in Canada. For iron, WHO recommendations were used, as recommended in the calculation technique described by Beaton (1994b). For calcium, there is currently no consensus on calcium requirements and recommended intake for humans, primarily because of the high adaptability of the human body to various calcium intakes (Health and Welfare Canada 1990a; Osteoporosis Society of Canada 1994). In addition, calcium absorption is known to be influenced by the presence of other nutrients or ds in the same meal and by the body's calcium status (Dairy Bureau of Canada 1994; Allen and Wood 1994). For these reasons, we decided to use two sources of recommendations for calcium intake (see section 4.6.4.1.3). Because these recommendations differ considerably, the overall proportion of individuals with an "inadequate" calcium intake varied depending on the reference used. However, the similarity between the results found for the association between place of birth and the likelihood of "inadequate" intake, using either recommendation, confirmed differences in the odds of "inadequate" intake between non-immigrants and some immigrant sub-groups.

Because the distributions of individual probabilities of inadequate intakes of nutrients were highly skewed, we created a binary measure by dividing the respondents into those who had a probability of "inadequacy" greater than 50% and those who had a probability of 50% or less. As mentioned before, we cannot assume that the individuals with a high risk of "inadequacy" were *not* meeting their nutritional requirements: first, additional data such as biochemical measurements would have been necessary; and second, the absorption of some nutrients is known to be affected by other nutrients or foods consumed simultaneously and by nutritional status (Health and Welfare Canada 1990a; Dairy Bureau of Canada 1994). We can state, however, that "inadequate" intakes were *more likely to be problematic*. From a public health point of view, the use of the probability approach appears more useful than the comparison of crude intakes between groups; crude intakes between two groups may differ statistically while being in the same range of intakes (e.g., high intakes, low intakes).

8.2.5.4 Intakes from vitamin and mineral supplements

The benefit of vitamin and mineral supplements is still controversial (Reynolds 1994). However, the use of supplements has been reported to be relatively high in the United States (Subar and Block 1990). Data from the 1987 NHIS indicated that 51.1% of the adults between 18 and 99 years of age had consumed a vitamin or mineral supplement during the previous year and that 23.1% had consumed some daily (Subar and Block 1990). Supplement use was shown to vary between ethnic sub-groups in the American population, with non-hispanic Whites using supplements more frequently than

Hispanic and Black Americans (Subar and Block 1990; Block et al. 1988). In the OHS, calcium intake from supplements was taken into account but it was only approximate because: 1) calcium intake from multi-vitamin and mineral supplements may not have been reported by the OHS respondents (although the amount of calcium in these supplements is usually very low); and 2) the estimation of calcium intake from supplements was calculated from ranges of intakes only (50-300 mg/day; 301-900 mg/day; >900 mg/day). Contrary to calcium, information on iron and vitamin supplement consumption was not available for either survey. Our results may have thus underestimated total iron and vitamin intakes and overestimated the likelihood of "inadequate" intakes.

8.2.6 Anthropometric characteristics

8.2.6.1 General comments

The overall proportion of overweight and obese individuals observed in both surveys was quite large: approximately 43% of the OHS and QHHNS respondents were somewhat overweight, and more than one in four participants was obese. This is worrisome considering the health consequences of obesity (Negri et al. 1988; Pi-Sunyer 1991). In addition, the prevalence of obesity appears to be increasing in Canada (Health and Welfare Canada 1988a; 1993; Østbye et al. 1995), despite current provincial, national, and international health goals to reduce the number of overweight people (Ontario Ministry of Health 1990; U.S. Department of Health and Human Services 1991; World Health Organization 1990).

8.2.6.2 Differences between immigrants and non-immigrants

It was encouraging to see that OHS respondents born in Europe and Asia were, overall, less likely than Canadian-born individuals to be overweight. However, the likelihood of being overweight may presently be increasing in these sub-groups of Canadians.

The observation that Asian-born respondents, and particularly those born in East Asia, Hong Kong, China, and South East Asia, were less likely than non-immigrants to be overweight was expected (Norgan 1990). Choi et al. (1990) observed that elderly Chinese Americans living in Boston tended to have a lower BMI than did elderly White Americans. In addition, recent reports from two Chinese health surveys showed that Chinese individuals had a relatively low BMI and low likelihood of overweight (in comparison to Canadians; Health and Welfare Canada 1988a). One survey found that Chinese adults between 35 and 64 years of age and living in 65 counties in rural China (Campbell and Junshi 1994) had an average BMI of 20 to 21 kg/m^2. The second survey, the 1991 China Health and Nutrition Survey, demonstrated a low prevalence of overweight (BMI>25 kg/m^2) among Chinese adults: variations were from 6.6% to 13.6% depending on household income tercile (Popkin 1994). However, it has been reported that the average BMI has increased in China during the 1980s (Ge et al. 1994).

The lower likelihood of overweight and obesity among respondents born in North Europe and in the United Kingdom compared with non-immigrants agrees with the observation that the prevalence of overweight tends to be higher in Canada than in the United Kingdom (Gray 1989). Laurier et al. (1992) also reported that the average BMI of the population of the United Kingdom (assessed in 1988: males 23.8 kg/m^2; females: 23.2 kg/m^2) was lower than the BMI found for OHS Canadian-born subjects (25.0 kg/m^2). However, their sample included only individuals between 16 and 50 years of age. Knowing that BMI tends to increase with age (Kuskowska-Wolk and Bergström 1993), the samples are not completely comparable, and we can presume that the lower BMI found in that survey may reflect, at least partly, the younger age of the population surveyed.

The higher prevalence of overweight among OHS respondents born in Italy, compared with Canadian-born individuals, disagrees somewhat with the results of an Italian survey performed between 1983 and 1984 (Research Group ATS-RF2-OB43 of the Italian National Research Council 1987): the average BMI observed was 25.4 kg/m^2 for males and 24.6 kg/m^2 for females, which is very close to the average BMI found for Canadian-born OHS subjects. But again, the Italian population surveyed tended to include younger individuals (20 to 59 years) than did the OHS. Consequently, the average BMI of the overall adult Italian population may have been underestimated, and thus potentially the prevalence of overweight compared with the OHS Canadian-born individuals.

Some investigators have suggested that body weight may be associated with the proportion of dietary energy ingested from fat (Rolls and Shide 1992; World Health Organization 1990). Consequently, the lower BMI observed among Asian sub-groups and North-Europeans, compared with non-immigrants, may have been associated with their lower fat intake. This hypothesis does not, however, apply to Italian-born immigrants who reported a lower fat intake but who had a higher likelihood of being overweight than did their Canadian-born counterparts. Genetic factors and other environmental factors unadjusted for may have influenced the observed differences in BMIs between Canadian-born subjects and immigrants from different regions (World Health Organization 1990).

While a low prevalence of overweight is desirable, low BMI cannot be generally recommended from a health point of view (Health and Welfare Canada 1988a). In this study, OHS respondents born in Asia (East Asia, Hong Kong, China, South East Asia) had a higher likelihood of low BMI than did Canadians. Although the cut-off point of 20 kg/m^2 may have been set too high for different immigrant groups (Naidu and Rao 1994), particularly for those coming from developing countries, it was not used here to assess nutritional status but to assess an increased risk of low weight for height between sub-groups of respondents. Differences in lean body mass or in body stature between Canadian-born and Asian-born participants may have influenced our findings (Norgan 1994; Forbes 1994).

8.2.6.3 Limitations of anthropometric information

Although the correlations between BMI and total body fat are relatively strong (0.5 to 0.8; Heymsfield et al. 1994), misclassification of individuals into underweight or overweight categories may have happened. For example, individuals with a high skeletal muscle mass (e.g., athletes) and individuals with short legs for their height may have a high BMI relative to their height. In addition, Netland and Brownstein (1985) and Wang et al. (1994) have suggested that BMI may not be the best method to assess obesity in Asians, and that skinfold thickness would be more appropriate.

For the OHS, self-reported weight and height, rather than actual measurements, were used to calculate BMI. It has been reported that in most situations, self-reported measurements are sufficiently accurate and that errors associated with reported measurements have only minimal effects on epidemiological measures of association (Willett 1990a; Millar 1986). However, some studies have indicated that self-reported weight and height can be unreliable in some population sub-groups. Results from the Second NHANES, for adults 20 to 74 years of age, showed that height was somewhat overestimated by men age 55 to 74 years, by women age 35 to 74 years, and particularly by obese men and women; weight was particularly underestimated by obese individuals (Rowland 1990). Using QHHNS data, we also observed that respondents slightly underestimated their weight and overestimated their height, in average, but these errors were not associated with immigrant status. If we assume that OHS respondents underestimated their weight and overestimated their height in a manner similar to that of the QHHNS respondents (in average), the mean BMI of the OHS respondents between 20 and 65 years of age would increase slightly (from 24.9 kg/m^2 to 25.5 kg/m^2), suggesting that our estimate of BMI may have been low and that the proportion of overweight or obese individuals could be even higher than what was found. Adjustments to self-reported BMI have been suggested (Kuskowska-Wolk et al. 1989). However, these adjustments appear arbitrary and are based on non-Canadian populations.

8.2.7 Nutritional knowledge: QHHNS only

Overall, only 2.3% of the QHHNS respondents did *not* know that some health problems might be related to how much fat people eat. This result is surprising considering the high proportion of individuals with a high fat consumption in the QHHNS study group. However, this finding is consistent with a report from Shepherd and Stockley (1987) which found that a high knowledge about fat was not associated with a lower consumption of fat or with more negative attitudes toward high-fat foods. A survey performed in the United Kingdom (Mela 1993) also indicated that although the respondents had a reasonable knowledge of the relative ordering of the fat content of common foods, they tended to overestimate the fat content of foods low in fat and to underestimate the fat content of foods rich in fat.

General knowledge about dietary salt or dietary cholesterol was lower than that for fat but approximately three-quarters of the respondents knew that these nutrients could affect health status. Considering that Beggs et al. (1993) reported that 48% of Canadian adults were partially or completely unfamiliar with the term dietary cholesterol, the level of the estimated knowledge about cholesterol in the QHHNS subjects was relatively good.

Dietary knowledge variables were not associated with place of birth. However, descriptive statistics suggested that knowledge for salt and cholesterol was slightly better among immigrants than among non-immigrants. This could have been related to the higher proportion of immigrant than non-immigrant participants with a high education.

8.3 Research question 2: health characteristics

8.3.1 Health problems

8.3.1.1 Number of health problems: OHS only

A majority (70%) of OHS respondents reported suffering from at least one health problem, and immigrants, overall, and immigrants from Asia (East Asia, South East Asia, South Asia, Vietnam, China), Central America, and Europe (Germany) were less likely to report a health problem than did Canadian-born individuals. This apparent health advantage of the immigrants tends to agree with the findings of the 1985 Canada General Social Survey (Parakulam et al. 1992) which suggested that the health status of Canadian immigrants was better, overall, than the health status of non-immigrants (based on the presence of a chronic illness, the use of health care facilities or consultation with health professionals for health problems during the previous year, and the degree of activity limitation or disability); however, in that survey, elderly immigrants had poorer health than did non-immigrants. Because the number of health problems reported did not account for the type and severity of the health problems reported, it was a fairly crude index of health status that was also influenced by various factors affecting the reporting of health problems. It should consequently be interpreted with care.

8.3.1.2 Selected health problems

8.3.1.2.1 General comments

A relatively high proportion of OHS and QHHNS respondents had cardiovascular disease. This was expected considering the importance of these health problems in Canada (Brancker and Lim 1992; Tomiak and Gentleman 1993). The prevalence of hypertension in the OHS and QHHNS was somewhat lower than the prevalence reported in other Canadian surveys. For example, while the prevalence found in this study was 10% for the OHS and 14% for the QHHNS, the Canadian Blood Pressure Survey (Health and Welfare Canada 1989) observed that 18% of the Canadians aged 18 years and over had hypertension, the Canadian Heart Health Surveys (which include the QHHNS; Joffres et al. 1992) reported an average prevalence of hypertension of 15 to 20% (for Canada) depending on the method of diagnosis, and the 1990 Health Promotion Survey noted that 16% of Canadian males and 13% of Canadian females 15 years and older reported having hypertension (Lauzon 1993). It was encouraging to note that a low proportion (4.4% of all respondents) of the QHHNS respondents were not aware that they had high blood pressure, giving more credit to self-reporting of hypertension.

The prevalence of elevated total blood cholesterol, a risk factor for cardiovascular disease, was high among the QHHNS respondents: 49% of the respondents had a cholesterolemia (total cholesterol) of 5.2 mmol/L or more and 19% a cholesterolemia of 6.2 mmol/L or more. These proportions, based on biochemical measurements, were much higher than the self-reported prevalence (11%) of high blood cholesterol among respondents, age 15 years and older, in the 1990 Health Promotion Survey (Lauzon 1993). This result is consistent with QHHNS results which indicated that only one-third of the respondents were aware that their blood cholesterol was high (≥5.2 mmol/L). Self-reporting of hypercholesterolemia consequently seemed to underreport the prevalence of this health problem. High LDL-cholesterol, total cholesterol to HDL-cholesterol ratio, and triglyceridaemia were also found in important proportions in the QHHNS respondents.

8.3.1.2.2 Differences between immigrants and non-immigrants

The lack of association between place of birth and any of the selected health problems was unexpected because the prevalence of various health problems had been reported to be influenced by place of birth and ethnicity (as described in section 2.2). Among others, migrants from South Asia (Balarajan 1991) have been reported to have a high risk of dying from cardiovascular disease while migrants from some East Asian (Frerichs et al. 1984) and South European countries (Menotti 1991) were reported to have a low risk. In addition, it has been shown that the prevalence of hypertension is high in Black Africans, Black Americans, individuals from the Caribbean (Cornoni-Huntley et al. 1989; Fabre et al. 1983; Sorel et al. 1991), and Filipinos (Stavig et al. 1984), but low among Hispanic Americans (compared with White Americans; Sorel et al. 1991). South Asian migrants, Hispanic Americans, and some Arab, Caribbean, and Chinese populations were also found to have a high risk of diabetes or glucose intolerance compared with other populations of the world (Ramaiya et al. 1990; Dowse et al. 1990; Morrisson et al. 1986; King et al. 1993; Marshall et al. 1993; Perez-Stable et al. 1989). The prevalence of digestive diseases has also been reported to vary by ethnicity (Jayanthi et al. 1992; Feehaly et al. 1993), and cancer mortality and morbidity have been reported to be influenced considerably by place of birth in different migrant groups (Frank-Stromborg 1991; Grulich et al. 1992; McMichael and Giles 1988; Terracini et al. 1990; Wang et al. 1989; Whittemore 1989; Nasca et al. 1981; Newman and Spengler 1984). The investigations mentioned above, however, were often based on descriptive statistics only and did not adjust for confounding variables. In addition, they investigated populations that may differ from the Canadian population (both in terms of immigrant and non-immigrant populations). This emphasizes the importance of using Canadian data to draw recommendations for the Canadian health care system.

In our study, even if the likelihood of hypertension was not significantly associated with any of the place of birth variables, Caribbean-born OHS respondents had a higher likelihood of hypertension than did Canadian-born individuals, when considered independently. This result parallels the results of other researchers (Adelstein et al. 1984).

8.3.2 Consultations with health professionals

The number of consultations with health professionals or the number of consultations with general practitioners and specialists gives a general indication of the use of health care services by the population. The general lack of relationship between place of birth and these two indices was expected considering the results found for the prevalence of health problems. Nevertheless, this finding is not consistent with the work of Gillam et al. (1989) and Balarajan et al. (1989). These authors have reported higher rates of physician consultations among some ethnic groups compared with the general population of their host countries. However, differences in the health status of immigrant/ethnic groups and reference populations in these studies may have been more important than those observed here. Moreover, the results described by these authors were only adjusted for gender, age, and socioeconomic status, while we controlled for other covariates as well. Difference in the acculturation level of immigrants between studies may also have influenced the comparison of the results between studies. For example, the HHANES (Estrada et al. 1990) showed that approximately one-third of Mexican American adults had experienced barriers when seeking care during their most recent medical encounter, and that Spanish-speaking, foreign-born, and less acculturated individuals were the most likely to be deprived of the health care they sought. Other factors (e.g., culture, communication difficulties, etc.) may also have influenced the consultation pattern of immigrants. Finally, care must be taken when comparing health service use between countries because barriers to health care may vary from one country to the other. For example, the universality of access to health care in Canada does not exist in the United States (Starfield 1990).

Contrary to other immigrant sub-groups investigated in this study, OHS South-European-born respondents had consulted a general practitioner or a specialist more frequently during the past twelve months than did Canadian-born individuals. We could postulate that this is related to the higher *unadjusted* prevalence of cardiovascular disease, hypertensive disease, digestive disease, or gastro-intestinal ulcers among these respondents than among Canadian-born individuals (see Table N1). When covariates were taken into consideration, however, no difference was found between Italian-born individuals and non-immigrants for the likelihood of having one of these health problems. Consequently, other factors may have influenced this result (e.g., acculturation, culture, low statistical power, etc.).

8.3.3 Cut-down days and bed-days: OHS only

During the week preceding the survey, almost one in eight persons had to stay in bed all or most of the day because of health problems, or had to cut down on the things they normally do because of their health, and this for at least one day. The likelihood of having had at least one cut-down or bed-day during the last two weeks was not associated with place of birth. This suggests that recent health status (last two weeks) did not tend to differ between immigrants and non-immigrants. This result is once again consistent with the general findings for specific health problems, as well as with findings for the number of consultations with health professionals.

8.3.4 Self-perceived health: OHS only

In this study, self-perceived health was used as a general estimate of health status. Some authors have reported that self-perceived health is associated with mortality, poor perceived health being associated with an increased mortality risk (Kaplan and Camacho 1983; Mossey and Shapiro 1982; Idler and Angel 1990).

Immigrants judged their health slightly less positively than did Canadian-born individuals. This result was surprising considering that compared with non-immigrants: 1) immigrants, in general, and some immigrant sub-groups were *less* likely to report one or more health problems; 2) immigrants were not more likely than non-immigrants to report cardiovascular disease, hypertension, diabetes, digestive disease, and cancer; 3) except for immigrants from South Europe, immigrants had *not* consulted a general practitioner or specialist more frequently during the past twelve months; and 4) immigrants were *not* more likely to have had one or more cut-down day or bed-day during the two weeks preceding the survey. This result may have thus reflected cultural factors between sub-groups. Different authors (Hill et al. 1990; Molzahn and Northcott 1989) have noted that health and illness perception (Hill et al. 1990) as well as pain perception and the readiness to complain about pain, are influenced by culture (Hartog and Hartog 1983); we can thus presume that self-perception of health also is culturally influenced. The lower perceived health of non-immigrants compared with Canadian-born individuals could also have been due to the fact that the immigrants reporting at least one health problem may have been suffering from more serious or detrimental health problems than did non-immigrants, leading to a lower self-perceived health. Finally, the words *poor, fair, good, very good*, and *excellent*, for the appraisal of personal health, may have been understood and used differently by immigrants than by non-immigrants (through different semantic interpretations or connotation attached to them).

8.3.5 Limitations of health information

8.3.5.1 Use of self and proxy reported information

Except for hypertension and hyperlipidaemia in the QHHNS, health data were based on self-reporting (OHS and QHHNS; Ontario Ministry of Health 1992a, 1992b; Santé Québec et al. 1994) and proxy reporting (OHS only). The limitations and the validity of such data have been addressed by different authors during the last decades. In 1957, Krueger criticized the use of household interviews to measure the prevalence of chronic disease because these data are influenced by several factors such as: 1) the knowledge of the condition; 2) the use of proxy respondents; 3) memory loss; 4) the deliberate withholding of information; 5) differences in what constitutes certain health problems or symptoms; 6) the limitations of the questionnaire; and 7) low intellectual capabilities.

Harlow and Linet (1989) reviewed epidemiological studies appraising the agreement between self-reported information from questionnaires and medical records data. Overall, they observed that agreement between self-reported data on chronic illness and information derived from medical records varied substantially by health problem, with both underreporting and overreporting occurring. However, results from four large American studies (Krueger 1965; Commission on Chronic Illness 1957; National Center for Health Statistics 1965; Madow 1973) indicated that self-reporting of diabetes mellitus and heart disease were generally accurate. However, malignant neoplasms and thyroid diseases tended to be underreported by the respondents and that hay fever, asthma, sinusitis, and chronic bronchitis tended to be overreported. While age, sex, race, and education did not tend to influence self-reporting, the likelihood of recent physician consultation for a health problem increased self-reporting. Moderate to excellent agreement between self-reported information and medical records was also found for hypertension, diabetes mellitus, gallbladder disease, hysterectomy, oophorectomy, and benign breast disease in a group of women between 50 and 74 years of age (predominantly White women) and living in two retirement communities in the Los Angeles area (Paganini-Hill and Ross 1982). Results from the Nurses' Health Study (Colditz et al. 1986), a large prospective cohort study of 121,700 American female registered nurses between the age of 30 and 55 years, also indicated that medical records confirmed a high proportion of self-reported cancers (between 67 and 99%) but lower proportions of myocardial infarction (68%) and cerebrovascular accident (66%). A Norwegian investigation, however, suggested that self-reported data on myocardial infarction was more likely to be confirmed by medical records than information on stroke and diabetes mellitus.

The results described above suggest that self-reported information on health problems can be reliable, especially for health problems which have clear diagnostic criteria and that are easily communicated to the patient (Colditz et al. 1986). However, more research is needed to develop strategies to improve the quality of self-reported data (Horwitz and Yu 1985) and to evaluate the validity of information collected using survey questionnaire. In addition, it is important to recognize that medical records, which are often considered as gold standards in epidemiological research, are also subject to errors and are consequently not always more accurate than survey information (Hewson and Bennett 1987; Horwitz and Yu 1984).

Proxy respondents are used frequently in epidemiologic studies to provide information on an individual who is not available for questioning or who is unable to supply the information needed. The use of surrogate respondents has commonly taken place (Nelson et al. 1990; Mosely and Wolinsky 1986) in case-control studies of rapidly fatal conditions, in studies of de..enting diseases, and in health surveys collecting information at the household level (as for the OHS).

The agreement between proxy and self-reporting or between proxy reporting and medical records has been investigated by different researchers who indicated that agreement is reasonably good (Kolonel et al. 1977; Mosely and Wolinsky 1986; Halabi et al. 1992; Herrmann 1985; Farrow and Samet 1990). For example, to evaluate the quality of health data obtained through health surveys in Lebanon, Halabi et al. (1992) recently compared proxy information on heart disease, hypertension, and back pain to self-reported information and to the results of physical examinations; proxy informants were family members of the index subjects. The results showed that the level of agreement between self and proxy reporting was the highest for heart disease (kappa statistic between 0.79 and 1.00), but was somewhat lower for hypertension (kappa statistic between 0.50 and 0.65) and back pain (kappa statistic between 0.49 and 0.50). The level of agreement between self and proxy responses and the results of physical examinations was also relatively good; it was the highest for heart disease and the lowest for back pain. Farrow and Samet (1990) also reported that the agreement between proxy responses and self-reported information from elderly subjects was at least moderately good for a selection of health and functional status variables. Among others, the level of agreement was between good and very good for hypertension, heart problem, and diabetes (the individual was asked if the subject had seen a physician for these medical conditions during the year before their diagnosis of cancer).

Factors such as the type of surrogate respondent (siblings, spouses, and offsprings; Pickle et al. 1983), the characteristics of the respondents, the method of administration of the questionnaire (Herrmann 1985), the nature of the information required (e.g., disease type), and the amount of detail requested (Rogot and Reid 1975; Pickle et al. 1983; Halabi et al. 1992) have been reported to influence the level of agreement between self and proxy answers. Conflicting results were found for proxy characteristics. Kolonel et al. (1977) reported that the sex, age, race, and education of the respondent, and family income does not influence the degree of agreement between self and proxy information.

However, Pickle et al. (1983) suggested that the race, sex, and age of the surrogate informants affect their ability to provide the information solicited.

Farrow and Samet (1990) reported that proxy respondents did not systematically under or overreport exposures in a study of elderly cancer patients. However, some researchers indicated that the use of proxies generally leads to the underreporting of health problems and complaints (Clarridge and Massagli 1989) and health service utilization (Mosely and Wolinsky 1986). Further research is still needed to better understand the factors of influence on proxy information, and the validity and reliability of surrogate responding (Nelson et al. 1990). In the OHS, as the proxy respondent could not be identified, it was not possible to account for proxy responding in the statistical analysis of the data.

In the OHS, we have tried limiting the overreporting of health problems by considering the prevalence of a health problem only among individuals who consulted a physician for that health problem during the past twelve months (see section 4.6.5.2). This approach, however, may have led to the overcontrol of the self-reporting of health problems. Underreporting because the respondent did not want to report a health problem, forgot about the health problem, or had not been diagnosed, could not be assessed. We assumed that voluntary non-reporting of a health problem was small because the selected health problems for this study were not particularly sensitive or stigmatizing.

As suggested by the validity studies of self and proxy information described above, OHS and QHHNS data may have been influenced by self and proxy reporting. However, because encouraging findings have been reported by various researchers for the validity of self and proxy data and because we selected non-stigmatizing health problems we postulated that measurement error was small. We also assumed that it was nondifferential, which would have tended to reduce the associations toward the null value and lead to more conservative results (Kelsey et al. 1986c).

8.3.5.2 Other limitations

The overall lack of association observed between the prevalence of health problems and immigrant status may have been influenced by several factors, some of which apply more particularly to recent migrants. Among others, there may have been no true difference between Canadian-born respondents and immigrant sub-groups for the likelihood of having one of these health problems. For example, self-selection of immigrants may have occurred (Kasl and Berkman 1983): as suggested by Marmot et al. (1984), a healthy migrant effect could explain the relatively low prevalence of certain health problems among immigrant groups that were expected to have a high prevalence compared with Canadian-born individuals (e.g., cardiovascular disease or diabetes among immigrants from South Asia; Ramaiya et al. 1990). This hypothesis is supported by the fact that the Canadian immigration system requires a general medical exam as part of normal immigration procedures to Canada (Employment and Immigration Canada 1984). This exam would tend to filter sick individuals from groups of new immigrants.

Some immigrant sub-groups were expected to have a lower likelihood of certain health problems than Canadian-born individuals (e.g., cardiovascular disease among South Europeans; Menotti 1991). We can hypothesize that these immigrants have been exposed to different environmental factors that reduced their "protection" against these health problems compared with non-immigrants. More generally, the individual adaptability and sensitivity of migrants to the host country and the changes associated with their new environment (Kasl and Berkman 1983; Adelstein et al. 1984) may have influenced the likelihood of health problems among the immigrants surveyed.

Differences in the diagnosis of health problems between non-immigrant and immigrant sub-groups may have taken place (Polednak 1989). As mentioned in section 8.3.2, barriers to medical care have been reported to be influenced by ethnicity and could consequently modify the likelihood of being diagnosed for a health problem. For example, Takeuchi and colleagues (1988) found that the perception of barriers to help-seeking for alcohol and severe emotional problems was associated with ethnicity in Hawaii; barriers such as shame and stigma were mentioned. Uba (1992) also suggested that the underuse of the health care system by South East Asian refugees living in the

United States could have cultural explanations such as: 1) the conviction that suffering and illness are unavoidable parts of life; 2) various cultural beliefs about the causes of illness and the appropriate forms of treatment (e.g., healers or herbal medicine versus medical treatment); 3) apprehensions related to diagnostic procedures and treatments; 4) the lack of familiarity with the culture of the host country and with the services available; and 5) the health care providers' ignorance of South East Asian and other cultures, including misinterpretation of side effects of folk medicines. In addition, the meanings and interpretations of physical signs of illness, including pain perception, may have varied between ethnic or immigrant groups (Greenwald 1991; Molzahn and Northcott 1989) and have influenced the reporting of health data among these groups. Finally, communication difficulties (inability to speak the official language of e host country (Saldov and Chow 1994; Wright 1983) and the lack of understanding of the expectations of both the migrant and the health care provider (Lipson and Meleis 1983) have been shown to influence the reporting of symptoms and health problems of immigrants.

However, because the number of visits to health professionals and more particularly to general practitioners and specialists did not vary notably by place of birth in this study, it seems reasonable to presume that immigrants and non-immigrants had a similar likelihood of having their health problems diagnosed. Moreover, we would expect that immigrants coming from countries where specific health problems are known to be highly prevalent would more likely be diagnosed; however, Canadian health care professionals may not yet be sufficiently aware of the diverse risks and needs of the increasingly multicultural population of Canada (Lechky 1992; Eisenbruch 1989; Hartog and Hartog 1983; Nietu and Fortin 1994). However, the fact that information on the use of alternative medicine to treat health problems was not collected could hide differences in the overall (traditional medicine and other forms of treatment -- healers, herb remedies, etc.) consultation pattern for health problems between immigrants and non-immigrants (Rogler et al. 1987; Kraut 1990). Because little is known about the use of alternative medicine in Canada, these practices need to be investigated more extensively.

The lack of association between place of birth and health parameters observed in the present study, compared with past studies, may also be associated with the fact that our geographical categorization of place of birth may have been too imprecise to allow for the detection of subtle differences in health problems between immigrant sub-groups and non-immigrants. As mentioned before, discrepancies between the results of this investigation and the results of past investigations may also be due to the fact that we adjusted for covariates while some investigators did not. This adjustment was necessary to obtain a clearer picture of the relationship between place of birth and health characteristics. Finally, immigrants to Canada may be healthier than immigrants to other countries (e.g., to the United States or the United Kingdom).

8.4 Research question 3: study of acculturation

8.4.1 Findings

Several investigations have examined the effect of acculturation on health among different ethnic or immigrant populations using various indicators such as cultural awareness, ethnic identification (personal, mother, father), affiliated tendencies, language preference (oral or written), language use (oral or written), mother tongue, own country of birth, country of birth of the mother or father, contact with the homeland, length of stay in the new country, attitudes and behaviours, and style of dressing (Berry 1980; Marks et al. 1987; Van der Stuyft et al. 1989; Marmot and Syme 1976). While some of these studies showed that acculturation or assimilation in the host society could strongly influence the dietary intake, health status, and illness behaviour of immigrants (Marmot and Syme 197; Harding et al. 1986; Marks 1990), other investigations found little effect of acculturation on health parameters (Marks et al. 1987; Van der Stuyft et al. 1989).

In the present study, acculturation, assessed using language spoken at home (ACCLANG), was associated with some of the selected nutritional and health characteristics. Most of the differences observed were between individuals classified as "not applicable" and those not acculturated for language spoken at home. Individuals in the "not applicable" group included those who were born in a country where English or French is an official language; we consequently assumed that these individuals knew English or French before their migration, and we supposed that they more easily adapted to the main Canadian culture and thus that they were more acculturated than those classified as not acculturated for language spoken at home.

From this point of view, the observation that dietary calcium intake was higher among respondents who were in the "not applicable" category than among not acculturated individuals could mean that calcium intake was positively associated with acculturation. This result agrees with the finding that calcium intake was higher among Canadian-born individuals than among immigrants, overall. However, a pilot study investigating the calcium consumption of elderly Korean Americans (Kim et al. 1984a) showed no association between years of residency in the host country and calcium intake.

The number of consultations with general practitioners or specialists among individuals in the "not applicable" category was smaller than the number of consultations among those not acculturated. Assuming again that immigrants in the "not applicable" group were somewhat acculturated, acculturation would be inversely related to the number of consultations with general practitioners and specialists. This finding suggests two hypotheses: 1) acculturation is associated with lower consultation with general practitioners and specialists due to more barriers to health care; or 2) acculturation is associated with lower consultation because acculturated individuals are healthier. The first hypothesis disagrees with the results reported by Estrada et al. (1990). These authors suggested that *less acculturated* Hispanic Americans were the most likely to be deprived of the health care they sought; however, their study was performed in the United States, where access to health care is not universal, as it is in Canada, and it was performed only on an Hispanic population. The second hypothesis does not agree with the observation in this study that acculturation was not associated with the likelihood of having one or more health problems, with the likelihood of having various health problems, and with the observation that few differences between immigrants and non-immigrants were observed for the number of consultations with health professionals. However, a borderline significant relationship was found between acculturation (ACCLANG) and the likelihood of reporting a health problem: individuals in the "not applicable" category were more likely to have a health problem than not acculturated respondents. This finding is consistent with the observation that non-immigrants also had a higher likelihood of reporting a health problem than did immigrants, but it does not agree with the second hypothesis. However, the severity of the health problems reported was not taken into account and the relationship between acculturation and health problems other than cardiovascular disease, hypertension, and diabetes was not investigated. Consequently, immigrants classified as "not applicable" may have had distinct characteristics that have affected the results.

Immigrants classified as "not applicable" or as acculturated for language spoken at home had a better perceived health status than did those not acculturated. This suggests that acculturation was positively related to self-perceived health; this may have been related to the fact that they consulted general practitioners and specialists less often than did individuals not acculturated during the last year. As well, if we assume that acculturated individuals were more similar to non-immigrants than were not acculturated respondents, this result parallels the general results described for self-perceived health (see section 8.3.4).

8.4.2 Limitations of acculturation information

Because the OHS was an "omnibus" survey, i.e., a comprehensive survey without narrow research questions or hypotheses, it was not designed to specifically study the relationship between acculturation and health among immigrants. Consequently, it included only a few indirect indicators of the acculturation level of immigrants (ethnicity, language spoken at home, and year of migration) and these indicators were not designed to give detailed information on acculturation. In addition, by including all immigrants (recent and long-term immigrants) in the acculturation analyses, we may have hidden special relationships between acculturation and health that could have been found among recent immigrants only. As well, the relatively small number of immigrant respondents in the OHS gave less power to acculturation analyses.

Ethnic identification and language use/preference are two indicators that are often used in the study of acculturation (Deyo et al. 1985; Solis et al. 1990). They are usually described by a set of questions that are compiled to create acculturation indices. In the present study, however, ethnic identification and language spoken at home were based on one question only, thus giving less accuracy to the acculturation indices used. Moreover, for language acculturation (ACCLANG), we had to assess acculturation by comparing language use at home with the official language(s) in the country of origin and not with mother tongue. This may have biased the estimation of acculturation if discrepancies existed between the official language(s) in the country of origin and mother tongue (or language used by the individual in the country of birth): 1) immigrants whose mother tongue was English and/or French but who were born in a non-English/non-French speaking country; 2) immigrants whose mother tongue was *not* English or French but who were born in an English/French country.

8.5 General limitations of design and data

8.5.1 Overall representativeness of the surveys

The OHS and QHHNS have the advantage of being based on samples of the general population of Ontario and Quebec; their generalizability may thus be considered an important strength (Kelsey et al. 1986b). They cover two provinces in which over two-thirds of all Canadian immigrants were living in 1991 (Statistics Canada 1993a), and Ontario and Quebec were the two most frequently intended Canadian destinations reported by new immigrants between 1980 and 1989 (Logan 1991). In addition, the OHS and QHHNS overall response rates were high, and the age and sex distribution of the samples were very close to the distribution found in Ontario and Quebec (Ontario Ministry of Health 1992a; Santé Québec et al. 1994). The proportion of the OHS and QHHNS study group members with valid answers was also generally high (see Table C2). This gives us more confidence in the representativeness of our findings. Again, the sample size (overall and for immigrants) of the OHS was much larger than the QHHNS sample size. For this reason, a stronger emphasis was placed on OHS data and results in this study.

Approximately 2% of the individuals asked to participate in the OHS refused because of sickness, because of a language problem, or because of an unusual circumstance or problem (Ontario Ministry of Health 1992a). Although this proportion is relatively small, we speculated that the majority of those who did not take part in the survey because of a language problem were immigrants; the proportion of those refusing to participate for this particular reason was not published (Ontario Ministry of Health 1992a). However, survey interviews were performed in English and French and the self-completed questionnaire was available in English, French, Italian, Portuguese, and Chinese, the five most commonly reported languages spoken at home by Ontarians (English: 86%; French: 3%; Chinese: 2%; Italian: 2%; Portuguese: 1%; Statistics Canada 1993c). The use of these languages of administration facilitated the participation of these ethnic groups in the survey, and we assumed that groups speaking these languages were relatively well represented in the survey sample. Surprisingly, however, information on language of administration of the questionnaires was not recorded as a variable by the Ontario Ministry of Health.

For the OHS, the lowest response rates were found in the Metropolitan Toronto area. In 1991 (Statistics Canada 1993a; 1993d), 34% of all immigrants living in Ontario were living in Toronto and 38% of the population of Toronto was immigrant. Thus, the lower response rates in the Toronto area suggest that immigrants may be underrepresented in the survey. For the QHHNS, response rates were lower in the Montreal and Quebec City areas (Santé Québec et al. 1994). Because the majority (72%) of immigrants residing in Quebec live in these areas (Statistics Canada 1994), we can also assume that immigrants may have been somewhat underrepresented in the QHHNS; this is also suggested by the lower proportion of immigrant respondents in the QHHNS study group than in Quebec (estimated using census data; Table 4.2). However, even if response rates may have been lower for immigrants, the distribution of the OHS and QHHNS respondents by place of birth was found to be similar to the distribution by place of birth of the overall population of Ontario and Quebec (see Tables 4.1 and 4.2).

8.5.2 Measurement of exposure

In the present study, place of birth was the main exposure of interest. Place of birth was preferred to ethnicity for two reasons: first, we wanted to investigate health in the context of immigrant status; and second, place of birth is a relatively simple and objective measure compared with ethnicity (Edwards 1992). This choice meant, however, classifying all individuals born in Canada, whatever their ethnic background, in one category only, i.e., Canada; to try counterbalance this, we have used ethnicity as a covariate to approximate the degree of adherence to the Canadian culture. In addition, selecting country of origin as the exposure of interest did not account for the fact that immigrants may have moved to various countries before coming to Canada and may have been exposed to various environmental conditions or hazards present in these countries. Thus, immigrants from one country may thus constitute a somewhat heterogeneous group.

In our analyses, Canada was used as the reference category for place of birth. Consequently, differences described in this report were for Canadian-born subjects and immigrants sub-groups only. This approach was selected because our main objective was to compare immigrants with non-immigrants living in Ontario and Quebec. In addition, comparing all immigrant sub-groups among themselves would have dramatically increased the number of statistical tests performed, and consequently enhanced the likelihood of type I error.

Classification by place of birth was limited by the number of respondents in each region, sub-region, and country of origin. Because of their proportionally high numbers, European and Asian sub-regions and countries took precedence in the analyses, and more statistical power was available for these places of birth. Because of their small sample size (see Appendix D), some sub-groups of respondents had to be excluded from the analyses or merged with other sub-groups for some outcomes, and, thus, no comparison between these groups and Canadian-born subjects is available. The "lack of difference" between individuals from these sub-groups and non-immigrants cannot be interpreted as an indication of the similarity between the two groups, but as a reflection of the insufficient number of subjects from these regions to perform such comparisons.

The number of immigrant participants in the QHHNS was fewer than expected, based on census data (Statistics Canada 1993a). For this reason, we were unable to look at sub-groups of immigrants (except for Europe), and the comparisons remained general, suggesting the importance of large population surveys or conversely the need for surveys focusing on specific population sub-groups (when the present study was designed, relatively little information about the QHHNS was available (e.g., number of immigrant respondents, design effect, etc.).

Even if country of birth is a more precise measure of place of birth than region or sub-region of birth, it remains an indirect ecological indicator since dietary consumption and health status may vary within a country (Ferro-Luzzi and Sette 1989; King et al. 1993). Although we used place of birth as our exposure of interest, it was really exposure to a variety of genetic, cultural, and unknown influences associated with place of birth that we were interested in. However, an immigrant born in a given country may not have been subjected to the influences generally associated (and assumed here) with his or her country of origin (e.g., because of a short residence in the country of birth; because of different lifestyles from that prevailing in the country of origin, even before migration; because the individual's parents were born in another country; etc.). Conversely, an individual born in Canada may have been affected by influences associated with another country even if he or she was not born in that country (e.g., if the individual's parents were born outside of Canada; if the individual lived in other countries for various periods of time; etc.).

Length of stay in a new country, acculturation, and immigration class (e.g., refugee, family reunification, independent) are known too be associated with the health of migrants (Kasl and Berkman 1983; Lipson and Meleis 1985). Unfortunately, information on immigration class was not available here. We decided to study all immigrants, regardless of their length of stay in Canada, instead of focusing on recent immigrants. Differences between the dietary intake and health status of long-term and short-term migrants may thus have been hidden. However, the study of acculturation indicated that time since migration was not related to the selected outcomes (when other acculturation variables were accounted for).

Acculturation variables were not used as covariates in the regression analyses based on *all* respondents (research question 1 and 2) for 2 reasons: 1) these variables were not appropriate for Canadian-born subjects; and 2) in the statistical analyses, Canadian-born subjects would have had to be classified as controls for all these variables, thus creating statistical problems. Acculturation was instead investigated for immigrants only (research question 3).

8.5.3 Other limitations related to data collection and result presentation

The present study was subject to biases that may have affected the OHS and the QHHNS. Despite the surveys' elaborate sampling designs and procedures, other sources of error may have been introduced and may have affected the quality of the data. Among others, the answers given by the respondents may have been affected by recall or reporting bias, as mentioned previously. OHS respondents may also have misunderstood some questions or they may have answered some questions incorrectly (e.g., height and weight reported in the wrong units). As well, despite their training, interviewers may have introduced some bias if they did not strictly follow the procedures. Errors at the editing stage of the data may also have occurred. None of these potential sources of error could be estimated. However, we assumed that they were small because the surveys methodologies were planned to minimize such biases (Ontario Ministry of Health 1992a; Santé Québec 1990a; 1990b; Santé Québec et al. 1994)).

Finally, because of the substantial amount of findings presented in this thesis, statistically significant results were primarily discussed. However, to limit the confusion of statistically significance with clinical or health care significance (Feinstein 1977; Rothman 1986), confidence intervals for all regression estimates were also presented in regression analysis tables to illustrate the magnitude of the effect and the variability in the estimate, and consequently allow for a better interpretation of both significant and non-significant results.

CHAPTER 9. DISCUSSION FOR THE EXPLORATORY RESEARCH QUESTIONS

9.1 Introduction

This chapter discusses the results described in Chapter 7. Limitations associated with these results are also described.

9.2 Research question 4: analyses taking account of "past diet"

9.2.1 Findings

When the analyses accounting for "past" diet were performed, differences similar to those reported for the primary research questions were found for the likelihood of overweight, the number of consultations with general practitioners and specialists, and self-perceived health. The findings were also generally similar for BMI. However, the association between place of birth and the likelihood of obesity or low BMI, and the likelihood of reporting at least one health problem were not found any longer. This observation suggests that for these outcomes, immigrants whose current diet was reflective of their past diet were more comparable to non-immigrants than were immigrants who had changed their diet. It is also possible to suggest that these outcomes were more likely to have been affected by recent changes in dietary habits. Knowing that the majority of the immigrants excluded from these analyses were recent immigrants (33% of those excluded migrated between 1985 and 1990), our findings may have also reflected more meaningful differences between recent immigrants and Canadian-born individuals for these outcomes (e.g., if recent immigrants were less likely to be obese and to report a health problem, and more likely to have a low BMI). This would be consistent with the healthy migrant effect theory.

9.2.2 Limitations in the estimation of "past diet"

The estimation of "past" diet has important limitations (see section 5.2.1.1). For this reason, the results presented in Chapter 7 have to be interpreted with great caution and treated only as exploratory. In addition, because a large proportion of recent immigrants were excluded from the analyses (their diet was assumed to have changed during the past twenty years), some power was lost for the comparison of immigrant sub-groups with non-immigrants (compared with the analyses used with all respondents; see Appendix G). As well some sub-groups of immigrants, which were originally studied independently, had to be combined because of their small sample sizes, and consequently could not be compared with non-immigrants in this portion of the analyses; this decreased the amount of information available. Finally, we assumed that non-immigrants and individuals who migrated more than twenty years before the survey had stable dietary habits.

9.3 Research question 5: influence of diet

The results of the analyses investigating if the association of place of birth and acculturation with anthropometric and health characteristics was modified when significant dietary covariates were not adjusted for, were less pronounced than expected. We had expected that diet would have a greater influence on the relationship studied, particularly for health problems such as cardiovascular disease, hypertension, diabetes, and cancer. High fat and energy intakes and low fibre intake have been associated with different degenerative diseases such as the ones mentioned above (U.S. Department of Health and Human Services 1988).

The limitations associated with the cross-sectional design of the OHS, with self and proxy reporting of health problems (Krueger 1957; Clarridge and Massagli 1989; see section 8.3.1.3), and with dietary data collection techniques may have influenced our findings. In addition, for simplicity, we selected only three nutrients to represent diet, and we did not adjust for other dietary components.

CHAPTER 10. SUMMARY AND CONCLUSIONS

10.1 Summary

Information on the relationship between place of birth and nutritional and health status is still scarce in Canada. However, studies performed in other countries have indicated that place of birth and ethnicity affect the health of their populations. For these reasons, and because the Canadian population has become increasingly multicultural, the present study explored the association of place of birth with dietary intake and anthropometric and health characteristics of the adult population of Ontario (main focus of the study) and Quebec, using cross-sectional data from the 1990 OHS and the 1990 QHHNS.

Contrary to what had been found by some authors in other countries, after adjusting for various covariates, the dietary intake, anthropometric traits, and health characteristics of the immigrant respondents to the two surveys were not, in general, unhealthier or poorer than those of the non-immigrant respondents, although the situation could be improved for some characteristics and some immigrant sub-groups.

At the dietary intake level, several immigrant sub-groups displayed food and nutrient intakes consistent with traditional dietary patterns in the countries of origin. Compared with Canadian-born individuals, immigrants tended to consume less fat and more carbohydrate and were more likely to meet current dietary recommendations for these nutrients. However, immigrants from some Asian sub-regions or from the Caribbean were more likely than non-immigrants to have an "inadequate" calcium intake. Some Asian sub-groups also had a higher likelihood of "inadequate" intakes of iron, thiamin, riboflavin, or niacin than did non-immigrants; in that case, biochemical measurements would be useful to estimate the prevalence of nutritional deficiencies for these nutrients in sub-groups at high risk. Immigrants born in Asian sub-regions (East Asia, South East Asia) were less likely than non-immigrants to be overweight or obese, which is desirable to help prevent various degenerative diseases. However, these immigrant sub-groups were also more likely to have a low BMI.

As for the selected health attributes, we observed that while immigrants were, overall, less likely to report at least one health problem, they had lower self-perceived health than did non-immigrants. Contrary to what was expected from previous studies, no differences between immigrants and non-immigrants were found for the likelihood of reporting cardiovascular, hypertensive, or digestive diseases, gastro-intestinal ulcers, and cancer. The number of consultations with health professionals was also rarely associated with place of birth, while the number of cut-down days or bed-days during the previous two weeks was not associated with any of the place of birth variables.

Finally, the acculturation level of the immigrant participants in the OHS was generally not related to the selected nutritional and health characteristics. This lack of association disagrees with the results of past investigations but may have occurred because of the crudeness of the measures of acculturation used in this study.

10.2. Implications of the findings

10.2.1 Future research

The openness of the Canadian immigration system and the results described above suggest that the study of nutritional and health differences between immigrants and non-immigrants should be pursued in Canada in order to better describe and understand these differences and their practical implications.

First, more research is required to better understand the influence of place of birth and ethnicity on the validity and reliability of dietary, acculturation, and health data collection techniques (Buzzard and Sievert 1994). Data collection instruments that better reflect ethnic differences in food choices should be designed for dietary surveys, and the nutritional composition of more ethnic foods used in Canada should be made available. As well, data collection instruments designed to study acculturation should be tested, and the influence of place of birth on the self and proxy reporting of health problems needs to be understood.

The relatively high prevalence of "inadequate" intakes of vitamin and minerals among some ethnic groups also suggests that studies of the nutritional status of particular immigrant sub-groups should be performed to assess the risk of nutritional deficiency (e.g., using biochemical and clinical measurements). In addition, the impact of acculturation on the dietary intake of immigrants should be clarified since it may lead to the westernization of the dietary patterns of some immigrants, with its associated generally unhealthy consequences (Popkin 1994; Food and Agriculture Organization 1990). Risk factors other than diet for important health problems in Canada and their relationship with place of birth, will also need to be investigated (e.g., smoking, physical activity, etc.). Such information is necessary to help compare the overall health risk of immigrants and non-immigrants.

Finally, the prevalence of health problems and the determinants of health care use by immigrants should be monitored (Stephen et al. 1994), particularly in sub-groups of immigrants who have been reported to have a higher risk for certain health problems (not only in terms of place of birth but also in terms of type of immigrants -- refugee, family reunification, etc.). A follow-up study of the immigrant and non-immigrant participants to the OHS could look at mortality differences relative to place of birth, adjusting for exposure to various factors; such a study would help provide etiological leads for the association of place of birth with mortality risks. As well, there is a need to study the use of alternative medicine by Canadians.

10.2.2 Future nutritional and health campaigns

This study suggests the necessity for further assessment of the needs for nutritional and health promotion campaigns for Canadians, both immigrants and non-immigrants. While campaigns against cigarette smoking are well organized and vigorous in Canada (Gray 1992; Walters 1991), there is no such strong concerted effort to improve Canadian eating habits (apart from the Canada Nutrition Month), or to prevent obesity and hypertension.

The Canadian population is highly interested in nutrition (Beggs et al. 1993), but it remains confused about some basic nutritional facts such as the fat content of foods or the link between fat intake and blood cholesterol (Beggs et al. 1993; Massé 1991). The results of this research indicated that food choices, and fat, fibre, and calcium intakes are still of concern and need to be improved in the populations of Ontario and Quebec, particularly in some population sub-groups. There is consequently a need to give more information to the population of these provinces about the relationship between nutrition and the development of chronic diseases, and about changes to make to the diet to help prevent these health problems. Future nutritional education campaigns will have to target particular population sub-groups which present a high risk of nutritional problems, and take into account the increasing ethnic diversity of the Canadian population (ethnic diversity has just recently been taken into account in the nutritional recommendations of the 1995 Nutrition Month campaign of the Canadian Dietetic Association; Canadian Dietetic Association 1995).

This study also suggests that while an increase in fibre intake should be promoted in all sub-groups of the population, the promotion of a lower fat intake should be targeted particularly to non-immigrants. Concurrently, the lower fat intake and higher carbohydrate consumption of many immigrant sub-groups should be reinforced, and the healthy food choices made by immigrants should be promoted. Nutrition programs supporting calcium and milk intake among immigrants born in Asia and in the Caribbean could also help increase calcium consumption among these individuals, as suggested by the results of a pilot study of elderly Korean Americans (Kim et al. 1984a). However, since lactose intolerance has been reported to vary by ethnicity (Lin-Fu 1988; Bayless and Rosensweig 1966), dietary advices need to be individualized and good sources of calcium other than milk should be proposed to individuals who have problems digesting dairy products.

The reduction of overweight and obesity should also be promoted in sub-groups of Canadians who have a high likelihood of excess weight (particularly Canadian-born individuals and sub-groups of immigrants from South-Europe). Efforts should also be made to prevent obesity (Corby 1988) in sub-groups of Canadians less likely to be overweight, for example among immigrants from countries where obesity is usually rare, but where it is viewed as a symbol of social status (Cassidy 1991). The importance of early detection of unhealthy behaviours and of health problems, such as high blood pressure and cardiovascular disease, need to be emphasized in Ontario and Quebec to help reduce the prevalence of these non-communicable diseases in these provinces.

10.2.3 Guidance to the health care system

The results of this study and of future investigations may help health care providers familiarize themselves with the influence of place of birth on the dietary risk factors and health attributes of the increasingly multiethnic populations of Ontario and Quebec. A better understanding of these differences should assist them in adjusting their approach to their clients' needs. This is a basis for the development of the culturally sensitive health care needed by the multicultural Canadian population (Lecky 1992).

10.3 Conclusion

In conclusion, this study indicated that after adjusting for differences in various covariates, place of birth was strongly associated with dietary intake and that some immigrant sub-groups presented healthier and/or unhealthier nutrient intake than did non-immigrants. Differences in health characteristics between individuals born in Canada or outside of Canada were not as frequent. Future investigations are necessary to better describe and understand the association of place of birth and immigration with the dietary intake, and the nutritional and health status of Canadians.

APPENDIX A

Summary of racial and ethnic differences in various disorders

Table A1: Racial and ethnic differences in various health disorders (from Polednak 1989).

Group	High frequency	Low frequency
JEWS		
Ashkenazic Jews	Diabetes mellitus Hypercholesterolemia Ulcerative colitis /regional enteritis Prostatic hyperplasia Polycythemia vera Leukaemia Hodgkin's disease Kaposi's sarcoma Pancreatic cancer Brain cancer	Alcoholism Pyloric stenosis Tuberculosis Lung cancer Cervical cancer
Sephardic Jews	Brain cancer Oesophageal cancer Lymphatic leukaemia (females) Lymphosarcoma Gallbladder cancer	Tuberculosis Rheumatoid arthritis
EUROPEANS (selected groups)		
French	Oesophageal cancer Cirrhosis of liver Pharyngeal cancer Oral cancer Bladder cancer Testicular cancer	Coronary or ischemic heart disease
Belgians	Motor vehicle deaths Ischemic heart disease Bladder cancer Lung cancer	
Czechs	Colorectal cancer Gallbladder cancer Stroke Ischemic heart disease	
Poles	Stomach cancer Bile duct and gallbladder cancer	Stroke
Russians	Stomach cancer Oesophageal cancer Oesophagitis Tuberculosis Stroke Ischemic heart disease (Siberia)	

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(continued) Table A1: Racial and ethnic differences in various disorders (from Polednak 1989).

Group	High frequency	Low frequency
Irish (Ireland)	Major central nervous system malformations Schizophrenia Stroke (Northern Ireland) Ischemic heart disease	
Finns	Ischemic heart disease Stroke Multiple sclerosis Oesophageal cancer (females) Diabetes mellitus (type 1) Suicide	Breast cancer Colorectal cancer
Icelanders	Glaucoma Peptic ulcer Breast cancer Thyroid cancer Kidney cancer	Cardiovascular (except ischemic heart disease) Infant mortality rate Chronic liver disease
Lapps	Congenital hip disorders	Ischemic heart disease
Norwegians	Breast cancer Ovarian cancer Peptic ulcer	
Danish	Rectal cancer Pancreatic cancer Ovarian cancer Chronic lung disease	Cirrhosis of liver Oropharynx cancer Stroke
MIDDLE EASTERNERS		
Iranians	Oesophageal cancer (North, Northwest) Bladder cancer (Caspian, South) Liver cancer (Kurds &Turkish-speaking) Stomach cancer	
Kuwaitis	Rheumatic heart disease Nasopharyngeal cancer Motor vehicle deaths	HIV virus seropositivity Suicide Cervical cancer Stomach cancer Colon cancer Penile cancer
Saudi Arabians	Lymphoma, gastrointestinal tract	
Egyptians	Hodgkin's disease in childhood	

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(continued) Table A1: Racial and ethnic differences in various disorders (from Polednak 1989).

Group	High frequency	Low frequency
ASIANS		
Chinese (various countries)	Trophoblastic disease Neurasthenia (China) Koro (South East Asia) Systemic lupus erythematous Oral clefts Nasopharyngeal cancer Hepatic cancer Grave's disease (Singapore) Gastric cancer (Shanghai, Singapore) Lung cancer (Singapore) Oesophageal cancer Hepatitis B Colorectal cancer (California)	Chronic lymphatic leukaemia Brain cancer Colorectal cancer (China) Melanoma of skin Breast cancer Prostatic cancer Prostatic hyperplasia Haemolytic disease of new born Sudden infant death syndrome (Hong Kong) Diabetes mellitus (type 1) Ischemic heart disease (Beijing, US)
Thais	Leprosy Hepatitis B Malaria Trichinosis Diabetes mellitus (type 2) Nasopharyngeal cancer Hepatic and biliary cancers Cancer of hypopharynx/larynx	Chronic lung disease
US immigrants from South East Asia	Tuberculosis Leprosy Hepatitis Malaria Trichinosis	
Japanese	Cerebrovascular disease Cleft lip/palate Hepatitis B Human T-cell lymphotropic virus-I infection (South Japan) Trophoblastic disease Gastric cancer Adult T-cell lymphoma (Japan) Choriocarcinoma Gallbladder cancer Primary open-angle glaucoma	Ischemic heart disease Congenital hip disorders Chronic lung disease Ocular melanoma Acne Otosclerosis Chronic lymphatic leukaemia Prostatic cancer Prostatic hyperplasia Breast cancer (Japan) Multiple myeloma Hodgkin's disease Lung cancer Melanoma of skin Diabetes mellitus (type 1) Diabetes mellitus (type 2)

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(continued) Table A1: Racial and ethnic differences in various disorders (from Polednak 1989).

Group	High frequency	Low frequency
Koreans (Korea, Japan)	Stomach cancer Cirrhosis of liver Penile cancer (US)	
Indians	Rheumatic heart disease Ischemic heart disease (India & migrants) Tuberculosis Tuberculous meningitis Vitamin D deficiency disorders (rickets) Cataract (Punjab) Cholera (Ganges; Bangladesh) Suicide Cervical cancer Oral cancer Cataract (Punjab plains) Diabetes mellitus	Multiple myeloma Breast cancer(Hindus) Gastric cancer Colorectal cancer Lung cancer Stroke (Sri Lanka) Ischemic heart disease (Sri Lanka)
Malays (including those in Singapore)	Ovarian cancer Female lung cancer Diabetes mellitus (type 2)	Lung cancer Pancreatic cancer Stomach cancer Colon cancer Breast cancer Cervical cancer
PACIFIC ISLANDERS		
Filipinos	Oral clefts Hyperuricemia (US) Hypertension (California) Diabetes mellitus(type 2) Thyroid cancer (Hawaii, California) Oral cancer	Cerebrovascular disease Ischemic heart disease (US) Bladder cancer (US)
Polynesians (Hawaii, etc)	Rheumatic heart disease (Rarotonga, French Polynesia) Club foot Systemic lupus erythematous Coronary heart disease Hepatitis B (New Zealand) Diabetes mellitus (type 2) Breast cancer Ovarian cancer (New Zealand) Myeloid leukaemia (New Zealand) Liver cancer (New Zealand) Pancreatic cancer Lymphosarcoma Thyroid cancer Myeloid leukaemia (males)	Stomach cancer Lung cancer

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(continued) Table A1: Racial and ethnic differences in various disorders (from Polednak 1989).

Group	High frequency	Low frequency
Maori, New Zealand	Rheumatic heart disease Ischemic heart disease Otitis media Sudden infant death syndrome Multiple myeloma Myeloid leukaemia (males) Pancreatic cancer Gastric/Stomach cancer Cervical cancer Uterine cancer Breast cancer Lung cancer (females) Hepatitis B carriers	Colorectal cancer Melanoma of skin Ocular melanoma Gallbladder cancer
Micronesians	Diabetes mellitus (type 2) Hepatitis B Hyperuricemia (but not clinical gout) Parkinsonism-dementia/Antilymphocyte serum (in Chamorros)	
Melanesians	Yaws Otitis media Pneumococcal disease Malaria Burkitt's lymphoma Kaposi's sarcoma Liver cancer Penile cancer (Lowlands, New Guinea) Oral cancer (Papua New Guinea) Kuru (Fore people) (in past) Tropical arthritis	Hypertension (some areas) Ischemic heart disease (some areas)
Indonesians	Cholera Oral cancer Nasopharyngeal cancer Diabetes mellitus (type 2)	
Australian aborigines (inadequate data)	Chronic lung disease Alcoholism Leprosy Trachoma Otitis media Rheumatic heart disease	

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(continued) Table A1: Racial and ethnic differences in various disorders (from Polednak 1989).

Group	High frequency	Low frequency
BLACKS		
US and/or Africa	Asthma (US)	Psoriasis
	AIDS/HIV-2	Gallstones
	Tuberculosis	Multiple sclerosis
	Leprosy (Africa)	Barrett's oesophagus
	Pneumococcal meningitis	Congenital hip disorders
	Sexually transmitted diseases	Major cental nervous system malformations
	Yaws (Africa)	Osteoporosis and hip fractures (US/Bantu)
	Ainhum (Africa, South America)	Temporal arteritis
	Sexually transmitted diseases	Renovascular disease
	Yaws (Africa)	Polycythemia vera
	Ainhum (Africa, South America)	Xerophthalmia (Africa)
	Xerophthalmia (Africa)	Poliomyelitis (Africa)
	Sarcoidosis (US)	Measles (Africa)
	Scleroderma (US)	Malaria (Africa)
	Keloids	Bladder cancer
	Systemic lupus erythematous (US)	Malignant melanoma (skin, eye)
	Polydactyly	Testicular cancer
	Hypertension	Acute lymphocytic leukaemia
	Glaucoma (open angle)	Hodgkin's disease
	Cataracts	Ewing's sarcoma (US and Africa)
	Sudden infant death syndrome	Colorectal cancer (Africa)
	Chronic liver disease (US)	Rectal cancer (US)
	Cervical cancer	Breast cancer (after age 40)
	Lung cancer (males)	Suicide (US)
	Oesophageal cancer	
	Prostatic cancer	
	Stomach cancer	
	Multiple myeloma	
	Hepatic cancer (Africa)	
	Orbito-ocular cancers (Africa)	
	Leiomyosarcoma	
	Kaposi's sarcoma (Africa)	
	Burkitt's lymphoma (Africa)	
	Adult T-cell lymphoma (Caribbean, US)	
	Chorionepithelioma (Africa)	
	Affective disorders (Africa)	
	Homicides (US)	
Caribbean	Human T-cell lymphomtropic virus-I and leukaemia	Ischemic heart disease (some areas)
	Yaws	Osteoarthritis (Jamaica)
	Stroke (Trinidad)	
	Tuberculosis (Haiti)	
	Infectious diseases	
	Penile cancer (Jamaica, Haiti)	

/continued...

(continued) Table A1: Racial and ethnic differences in various disorders (from Polednak 1989).

Group	High frequency	Low frequency
AMERINDIANS	Plague (Southwestern US) Otitis media Tuberculosis Congenital hip disorders Sudden infant death syndrome Alcoholism Chronic liver disease Gallbladder disease Diabetes mellitus (type 2) Rheumatoid arthritis Chorioepithelioma Kidney cancer (Canada) Gallbladder/bile duct cancer Cervical cancer (Colombia, Central America, Chile) Stomach cancer (South &Central Am.) Primary open-angle glaucoma	Duodenal ulcer Melanoma of skin Lung cancer Hodgkin's disease (males) Colon cancer (South and Central) Hypertension (isolated South American groups)
ESKIMOS (INUIT) GROUPS (& ALEUTS)	Iron deficiency anaemia Bacterial meningitis Hepatitis B Sudden infant death syndrome (Alaska) Salivary gland tumours Oesophageal cancers (Alaska) Nasopharyngeal cancer Liver cancer Kidney cancer (females) Glaucoma (angle-closure type) Reiter's syndrome	Ischemic heart disease Prostate cancer Breast cancer Leukaemia (males) Lymphomas (males) Osteoarthritis
PUERTO RICANS (Puerto Rico and US)	Cervical cancer Gastric cancer Oesophageal cancer Chronic liver disease	Rheumatoid arthritis Breast cancer Lung cancer Colorectal cancer Ischemic heart disease
HISPANICS US Southwest	AIDS Measles Tuberculosis Infectious and parasitic diseases Diabetes mellitus (type 2) Cervical cancer Gastric cancer Biliary tract cancer Leukaemia, childhood Homicide	Suicide Ischemic heart disease Melanoma of skin Lung cancer Breast cancer Colorectal cancer Fractures

/continued...

(continued) Table A1: Racial and ethnic differences in various disorders (from Polednak 1989).

Group	High frequency	Low frequency
MORMONS (US)		Ischemic heart disease Total cancers Colorectal cancer Pancreatic cancer Breast cancer Cervical cancer Ovarian cancer
HUTTERITES (US and Canada)	Stomach cancer (males) Leukaemia (males)	Total cancer Cervical cancer Lung cancer (males)
SEVENTH DAY ADVENTISTS (US and Netherlands)	Ischemic heart disease	Colorectal cancer
GYPSIES (US)	Diabetes mellitus Occlusive cardiovascular disease Hypertension	

APPENDIX B

Selected variables

Table B1. Selected variables for the regression analyses: categories or unit of measure, name, fonction(s) in the regression analyses (exposure, covariate, outcome), type of variable (categorical, continuous).

Variable (survey)	Categories or unit of measure	Name in analyses	Function E=exposure C=covariate O=outcome	Categorical/ continuous variable (# indicator variables)
PLACE OF BIRTH				
IMM (OHS, QHHNS)	0 Canada	(reference)	E	categ. (1)
	1 Others	Others		
REGION (OHS, QHHNS)	OHS:			
	0 Canada	Canada (reference)	EC	categ. (6)
	1 United States	USA		
	2 Europe	Europe		
	3 Asia	Asia		
	4 Caribbean	Caribbean		
	5 Africa	Africa		
	6 Central/South Am.	CS America		
	QHHNS:			
	0 Canada	Canada (reference)	E	categ. (2)
	1 Europe	Europe		
	2 Other region	Others		
SUB-REGION (OHS)	0 Canada	Canada (reference)	EC	categ. (15)
	1 United States	USA		
	2 West Europe	West Europe		
	3 North Europe	North Europe		
	4 Scandinavia	Scandinavia		
	5 South Europe	South Europe		
	6 East Europe	East Europe		
	7 East Asia	East Asia		
	8 South East Asia	SE Asia		
	9 South Asia	South Asia		
	10 Middle East	Middle East		
	11 Caribbean	Caribbean		
	12 East Africa	East Africa		
	13 Other Africa	Other Africa		
	14 Central America	Central Am.		
	15 South America	South Am.		

/continued...

(continued) Table B1. Selected variables for the regression analyses: categories or unit of measure, name, fonction(s) in the regression analyses (exposure, covariate, outcome), type of variable (categorical, continuous).

Variable (survey)	Categories or unit of measure	Name in analyses	Function E=exposure C=covariate O=outcome	Categorical/ continuous variable (# indicator variables)
COUNTRY (OHS)	0 Canada 1 United States 2 Germany 3 Netherlands 4 United Kingdom 5 Italy 6 Portugal 7 Yugoslavia 8 Greece 9 Poland 10 Hungary 11 Other Europe 12 Hong Kong 13 China 14 Philippines 15 Vietnam 16 India 17 Other Asia 18 Jamaica 19 Trinidad 20 Other Caribbean 21 Africa 22 Guyana 23 Other Central /South America	Canada (reference) USA Germany Netherlands UK Italy Portugal Yugoslavia Greece Poland Hungary Other Europe Hong Kong China Philippines Vietnam India Other Asia Jamaica Trinidad Other Caribb. Africa Guyana Other CS Am.	EC	categ. (23)
IMMIGRANT ATTRIBUTES				
Ethnicity (OHS, QHHNS)	0 Canadian 1 Canadian+Other 2 Other or Other+Other	(reference) ETHNI1 ETHNI2	C	categ. (2)
Acculturation -ethnicity (OHS)	 0 Other or Other+Other 1 Canadian+Other 2 Canadian	ACCETHNI Not acculturated (ref.) Medium acculturation High acculturation	E	categ. (2)
Acculturation -time since migration (OHS)	years	TIME	E	continuous

/continued...

(continued) Table B1. Selected variables for the regression analyses: categories or unit of measure, name, fonction(s) in the regression analyses (exposure, covariate, outcome), type of variable (categorical, continuous).

Variable (survey)	Categories or unit of measure	Name in analyses	Function E=exposure C=covariate O=outcome	Categorical/ continuous variable (# indicator variables)
Acculturation -language spoken at home (OHS)	 0 Not Engl., not French 1 English or French 2 Not Applicable	ACCLANG Not acculturated (ref.) Acculturated Not applicable	E	categ. (2)
DEMOGRAPHIC				
Gender (OHS, QHHNS)	0 female 1 male	GENDER	C	categ. (1)
Age (OHS, QHHNS)	years	AGE	C	continuous
Marital status (OHS, QHHNS)	0 married 1 single 2 separated/divorced/ widow(er)	(reference) MS1 MS2	C	categ. (2)
Stratum (OHS, QHHNS)	0 rural 1 urban	STRATUM	C	categ. (1)
SOCIOECONOMIC AND SOCIAL				
Education (OHS: highest education in the household; QHHNS: personal education)	OHS: 1 no formal schooling 2 some primary 3 completed primary 4 some secondary 5 completed secondary 6 some college 7 completed college 8 some university 9 completed university	EDUCATION	C	treated as continuous
	QHHNS: 1 some primary 2 completed primary 3 some secondary 4 completed secondary 5 some college 6 completed college 7 some university 8 completed university	EDUCATION	C	treated as continuous

/continued...

(continued) Table B1. Selected variables for the regression analyses: categories or unit of measure, name, fonction(s) in the regression analyses (exposure, covariate, outcome), type of variable (categorical, continuous).

Variable (survey)	Categories or unit of measure	Name in analyses	Function E=exposure C=covariate O=outcome	Categorical/ continuous variable (# indicator variables)
Income (OHS, QHHNS)	1 low 2 not low but <$50,000 3 ≥$50,000	INCOME	C	treated as continuous
Stress level (OHS)	1 not at all stressful 2 not very stressful 3 fairly stressful 4 very stressful	STRESS	C	treated as continuous
Satisfaction with social life (OHS, QHHNS)	1 very unsatisfied 2 somewhat unsatisfied 3 somewhat satisfied 4 very satisfied	SOCIAL	C	treated as continuous
NUTRITION RELATED				
Chewing problems (OHS)	0 no problem 1 some problems	CHEWING	C	categ. (1)
Think you can improve health by changing eating habits (OHS)	0 yes 1 no/don't know	THINK	C	categ. (1)
NUTRITIONAL KNOWLEDGE				
Think the amount of salt eaten can affect health (QHHNS)	0 yes 1 no/don't know	SALT-KNOW	O	categ. (1)
Has heard about health problems that might be related to how much fat people eat (QHHNS)	0 yes 1 no/don't know	FAT-KNOW	CO	categ. (1)
Has heard about cholesterol, think that cholesterol is found in foods, and think that cholesterol in foods can affect health (QHHNS)	0 yes 1 no/don't know to any of the three affirmations	CHOLEST-KNOW	CO	categ. (1)
HEALTH BEHAVIOURS				
Smoking status (OHS, QHHNS)	0 never smoker 1 past smoker 2 current smoker	(reference) SMOKING1 SMOKING2	C	categ. (1)

/continued..

(continued) Table B1. Selected variables for the regression analyses: categories or unit of measure, name, fonction(s) in the regression analyses (exposure, covariate, outcome), type of variable (categorical, continuous).

Variable (survey)	Categories or unit of measure	Name in analyses	Function E=exposure C=covariate O=outcome	Categorical/ continuous variable (# indicator variables)
Physical activity (OHS, QHHNS)	OHS: energy expenditure (kcal/kg/day)	EE	C	continuous
	QHHNS: frequency of physical activities during the past 4 months 1 never 2 <once a month 3 once a month 4 2-3 times a month 5 1-2 times a week 6 3+ times a week	EXERCISE	C	treated as continuous
DIETARY				
Food groups meeting the recommendations of the 1992 Canada Food Guide (OHS)	# of groups	CFG	O	treated as continuous
	0 < 4 groups 1 4 groups	CFGALL	O	categ. (1)
Cereals and Breads (OHS)	0 ≥ 3.75 servings 1 < 3.75 servings	BREADS	O	categ. (1)
Vegetables and Fruits (OHS)	0 ≥ 3.75 servings 1 < 3.75 servings	VEG-FRUITS	O	categ. (1)
Milk Products (OHS)	0 ≥ 1.5 serving 1 < 1.5 serving	MILK	O	categ. (1)
Meats and Alternates (OHS)	0 ≥ 1.5 serving 1 < 1.5 serving	MEATS	O	categ. (1)
Fat intake (OHS, QHHNS)	% of dietary energy	FAT	CO	continuous
	0 ≤ 30 % 1 > 30 %	FAT-HIGH	O	categ. (1)
Saturated fat intake (QHHNS)	% of dietary energy	SAT-FAT	CO	continuous
	0 ≤ 10 % 1 > 10 %	SAT-FAT-HIGH		categ. (1)
Polyunsaturated fat intake (QHHNS)	% of dietary energy	POLY-FAT	O	continuous

/continued...

(continued) Table B1. Selected variables for the regression analyses: categories or unit of measure, name, fonction(s) in the regression analyses (exposure, covariate, outcome), type of variable (categorical, continuous).

Variable (survey)	Categories or unit of measure	Name in analyses	Function E=exposure C=covariate O=outcome	Categorical/ continuous variable (# indicator variables)
Cholesterol intake (OHS, QHHNS)	mg/day	CHOLESTEROL	O	continuous
	0 ≤ 300 mg/day 1 > 300 mg/day	CHOLEST-HIGH	O	categ. (1)
Fibre intake (OHS, QHHNS)	g/MJ (g/megajoules) or g/1000 kcal	FIBRE	CO	continuous
	0 ≥ 3.0 g/MJ 1 < 3.0 g/MJ	FIBRE-LOW	O	categ. (1)
Calcium intake (OHS, QHHNS)	mg/day	CALCIUM	O	continuous
	RNI recommendations: 0 "adequate" intake 1 "inadequate" intake	CALCIUM-INADEQ-RNI	O	categ. (1)
	WHO recommend.: 0 "adequate" intake 1 "inadequate" intake	CALCIUM-INADEQ-WHO	O	categ. (1)
Energy intake (OHS, QHHNS)	kilojoules (kJ) or kilocalories (kcal)	ENERGY	CO	continuous
Carbohydrate intake (OHS, QHHNS)	% of dietary energy	CARBOHYDRATE	O	continuous
	0 ≥ 50% 1 < 50%	CARBOHYD-LOW	O	categ. (1)
Protein intake (OHS, QHHNS)	% of dietary energy	PROTEIN	O	continuous
	0 "adequate" intake 1 "inadequate" intake	PROTEIN-INADEQ	O	categ. (1)
Alcoholic drinks taken during past 7 days--approximates alcohol intake (OHS, QHHNS)	# of drinks	DRINKS	C	continuous
	0 ≤ 14 drinks 1 > 14 drinks	ALCOHOL-INADEQ	O	categ. (1)
Iron intake (OHS, QHHNS)	mg/day	IRON	O	continuous
	0 "adequate" intake 1 "inadequate" intake	IRON-INADEQ	O	categ. (1)

/continued...

(continued) Table B1. Selected variables for the regression analyses: categories or unit of measure, name, fonction(s) in the regression analyses (exposure, covariate, outcome), type of variable (categorical, continuous).

Variable (survey)	Categories or unit of measure	Name in analyses	Function E=exposure C=covariate O=outcome	Categorical/ continuous variable (# indicator variables)
Vitamin C intake (OHS, QHHNS)	mg/day	VITAMINC	O	continuous
	0 "adequate" intake 1 "inadequate" intake	VITAMINC-INADEQ	O	categ. (1)
Thiamin intake (OHS, QHHNS)	mg/5 MJ (megajoules)	THIAMIN	O	continuous
	0 "adequate" intake 1 "inadequate" intake	THIAMIN-INADEQ	O	categ. (1)
Riboflavin intake (OHS, QHHNS)	mg/5 MJ (megajoules)	RIBOFLAVIN	O	continuous
	0 "adequate" intake 1 "inadequate" intake	RIBOFL-INADEQ	O	categ. (1)
Niacin intake (OHS, QHHNS)	mg/5 MJ (megajoules)	NIACIN	O	continuous
	0 "adequate" intake 1 "inadequate" intake	NIACIN-INADEQ	O	categ. (1)
ANTHROPOMETRIC				
BMI (OHS, QHHNS)	kg/m^2	BMI	CO	continuous
Overweight (OHS, QHHNS)	0 BMI > 25.0 kg/m^2 1 BMI ≤ 25.0 kg/m^2	OVERWT	O	categ. (1)
Obesity (OHS, QHHNS)	0 BMI > 27.0 kg/m^2 1 BMI ≤ 27.0 kg/m^2	OBESITY	O	categ. (1)
Low BMI (OHS, QHHNS)	0 BMI < 20.0 kg/m^2 1 BMI ≥ 20.0 kg/m^2	LOW-BMI	O	categ. (1)
Difference between reported and measured weight (QHHNS)	kilograms	DIFF-WEIGHT	O	continuous
Difference between reported and measured height (QHHNS)	centimetres	DIFF-HEIGHT	O	continuous
Waist-to-hip circumference ratio (QHHNS)	0 normal 1 high (>1.0 in men >0.8 in women)	WAIST-HIP-RATIO	O	categ. (1)

/continued...

(continued) Table B1. Selected variables for the regression analyses: categories or unit of measure, name, fonction(s) in the regression analyses (exposure, covariate, outcome), type of variable (categorical, continuous).

Variable (survey)	Categories or unit of measure	Name in analyses	Function E=exposure C=covariate O=outcome	Categorical/ continuous variable (# indicator variables)
HEALTH PROBLEMS				
Health problems (OHS)	# of problems 0 no problem 1 ≥ 1 problem	NUMBPRB NUMBPRB≥1	C O	treated as continuous categ. (1)
Cardiovascular diseases (OHS, QHHNS)	0 no 1 yes	CVD	CO	categ. (1)
Hypertensive diseases (OHS)	0 no 1 yes	HT-DIS	O	categ. (1)
Hypertension (QHHNS)	0 no 1 yes	HYPERTENSION	CO	categ. (1)
Knowledge of having hypertension (QHHNS)	0 yes /normal blood pressure 1 no	KNOW-HYPERTENS	O	categ. (1)
Angina (QHHNS)	0 no 1 yes	ANGINA	O	categ. (1)
Intermittent claudication (QHHNS)	0 no 1 yes	CLAUDICATION	O	categ. (1)
Infarction (QHHNS)	0 no 1 yes	INFARCTION	O	categ. (1)
Family history of cardiovascular disease (QHHNS)	0 no 1 yes	FAMILY-HX	C	categ. (1)
Diabetes mellitus (OHS, QHHNS)	0 no 1 yes	DB	CO	categ. (1)
Digestive diseases (OHS)	0 no 1 yes	DIGESTIVE	CO	categ. (1)
Gastro-intestinal ulcer (OHS)	0 no 1 yes	ULCER	O	categ. (1)
Cancer (OHS)	0 no 1 yes	CANCER	CO	categ. (1)
Other health problems (OHS)	0 no 1 yes	OTHER DISEASE	C	categ. (1)

/continued...

(continued) Table B1. Selected variables for the regression analyses: categories or unit of measure, name, fonction(s) in the regression analyses (exposure, covariate, outcome), type of variable (categorical, continuous).

Variable (survey)	Categories or unit of measure	Name in analyses	Function E=exposure C=covariate O=outcome	Categorical/ continuous variable (# indicator variables)
Serum cholesterol (QHHNS)	0 < 5.2 mmol/L 1 ≥ 5.2 mmol/L	CHL≥5.2	O	categ. (1)
	0 < 6.2 mmol/L 1 ≥ 6.2 mmol/L	CHL≥6.2	O	categ. (1)
Knowledge of having blood cholesterol ≥5.2mmol/L (QHHNS)	0 yes or normal blood chol. 1 no	KNOW-CHL≥5.2	O	categ. (1)
Serum LDL-cholesterol (QHHNS)	0 < 3.4 mmol/L 1 ≥ 3.4 mmol/L	LDL-CHL	CO	categ. (1)
Serum HDL-cholesterol (QHHNS)	0 ≥ 0.9 mmol/L 1 < 0.9 mmol/L	HDL-CHL	O	categ. (1)
Serum triglycerides (QHHNS)	0 < 2.3 mmol/L 1 ≥ 2.3 mmol/L	TRIGLYCERIDES	O	categ. (1)
Ratio total blood cholesterol to HDL-cholesterol (QHHNS)	0 < 5.0 1 ≥ 5.0	CHL/HDL	O	categ. (1)
CONSULTATIONS WITH HEALTH PROFESSIONALS (LAST 12 MONTHS)				
Consultations with all health professionals (OHS, QHHNS)	OHS: # of consultations	CONSULT-HPROF	O	continuous
	QHHNS: 0 no consultation 1 ≥1 consultations	CONSULT-HPROF≥1	O	categ. (1)
Consultations with general practitioners /specialists (OHS, QHHNS)	OHS: # of consultations	CONSULT-GPSP	CO	continuous
	QHHNS: 0 no consultation 1 ≥1 consultations	CONSULT-GPSP≥1	O	categ. (1)
CUT-DOWN DAYS OR BED-DAYS DURING THE PAST 2 WEEKS				
Number of cut-down days or bed-days (OHS)	0 none 1 ≥ 1 days	CUT-DOWN-BED-DAY	O	categ. (1)
SELF-PERCEIVED HEALTH				
Self-perceived health (OHS)	1 poor 2 fair 3 good 4 very good 5 excellent	SELF-HEALTH	CO	treated as continuous

Table B2. Number and proportion of respondents with valid answer for the selected variables, by survey (crude and effective sample sizes).

Variables	OHS				QHHNS			
	Crude sample size		Effective sample size		Crude sample size		Effective sample size	
	Total number	%	Total number	%	Total number	%	Total number	%
Place of birth	43,292	100.0	9,171	100.0	2,316	100.0	1,164	100.0
Gender	43,292	100.0	9,171	100.0	2,316	100.0	1,164	100.0
Age	43,292	100.0	9,171	100.0	2,316	100.0	1,164	100.0
Marital status	43,170	99.7	9,130	99.6	2,316	100.0	1,164	100.0
Stratum	43,292	100.0	9,171	100.0	2,316	100.0	1,164	100.0
Education	43,221	99.8	9,148	99.8	2,313	99.9	1,162	99.8
Household income	36,884	85.2	7,825	85.3	2,055	88.7	1,033	88.7
Stress level	42,458	98.1	8,993	98.1	--	--	--	--
Satisfaction with social life	40,757	94.1	8,581	93.[illegible]	2,311	99.8	1,161	99.7
Ethnicity-all	43,186	99.8	9,134	99.6	2,309	99.7	1,161	99.7
Acculturation-ethnicity-immigrants only	8,794	99.4	2,612	99.1	--	--	--	--
Acculturation-language-immigrants only	8,749	98.9	2,598	98.5	--	--	--	--
Time since migration	8,635	97.6	2,578	97.9	131	99.2	88	99.3
Dietary intake	36,616	84.6	7,726	84.2	2,109	91.1	1,066	91.6
Chewing problems	41,933	96.9	8,848	96.5	--	--	--	--
Thinks diet can influence health[1]	40,674	94.0	8,565	93.4	--	--	--	--
Nutritional knowledge[1]								
-Fat	--	--	--	--	2,316	100.0	1,164	100.0
-Cholesterol	--	--	--	--	2,314	99.9	1,163	99.9
-Salt	--	--	--	--	2,316	100.0	1,164	100.0

/continued...

(continued) Table B2. Number and proportion of respondents with valid answer for the selected variables, by survey (crude and effective sample sizes).

Variables	OHS				QHHNS			
	Crude sample size		Effective sample size		Crude sample size		Effective sample size	
	Total number	%	Total number	%	Total number	%	Total number	%
Alcoholic drinks during past week	38,946	90.0	8,242	89.9	2,313	99.9	1,163	99.9
Energy expenditure/physical activity	34,846	80.5	7,405	80.8	2,308	99.7	1,159	99.6
Smoking	39,146	90.4	8,300	90.5	2,258	97.5	1,136	97.6
BMI[2]	31,805	91.9	6,702	91.2	1,591	87.4	886	87.8
Waist-to-hip circumference ratio	--	--	--	--	2,040	88.1	1,035	88.9
Difference between self-reported and measured weight	--	--	--	--	1,989	85.9	1,007	86.5
Difference between self-reported and measured height	--	--	--	--	2,006	86.6	1,018	87.5
Number of health problems	43,292	100.0	9,171	100.0	--	--	--	--
Specific health problems								
-Cardiovascular diseases	43,292	100.0	9,171	100.0	2,316	100.0	1,164	100.0
-Hypertensive diseases/hypertension	43,292	100.0	9,171	100.0	2,314	99.9	~1,164	100.0
-Angina	--	--	--	--	2,316	100.0	1,164	100.0
-Intermittent Claudication	--	--	--	--	2,316	100.0	1,164	100.0
-Infarction	--	--	--	--	2,316	100.0	1,164	100.0
-Diabetes mellitus	43,292	100.0	9,171	100.0	2,312	99.8	1,162	99.8
-Digestive diseases	43,292	100.0	9,171	100.0	--	--	--	--
-Gastro-intestinal ulcer	43,292	100.0	9,171	100.0	--	--	--	--
-Cancer	43,292	100.0	9,171	100.0	--	--	--	--
-Other diseases	43,292	100.0	9,171	100.0	--	--	--	--

/continued...

(continued) Table B2. Number and proportion of respondents with valid answer for the selected variables, by survey (crude and effective sample sizes).

Variables	OHS				QHHNS			
	Crude sample size		Effective sample size		Crude sample size		Effective sample size	
	Total number	%	Total number	%	Total number	%	Total number	%
Family history of cardiovascular disease	--	--	--	--	2,288	98.8	1,151	98.9
Blood cholesterol								
-Total cholesterol	--	--	--	--	2,108	91.9	1,025	88.1
-LDL-cholesterol	--	--	--	--	1,950	84.2	981	84.3
-HDL-cholesterol	--	--	--	--	1,975	85.3	1,000	85.9
-Total cholesterol-to-HDL-cholesterol ratio	--	--	--	--	1,974	85.2	1,000	85.9
-Triglycerides	--	--	--	--	1,992	86.0	1,010	86.8
Knowledge that you have hypertension[1]	--	--	--	--	2,300	99.3	1,158	99.5
Knowledge that you have high blood cholesterol (≥5.2mmol/L)[1]	--	--	--	--	1,932	83.4	985	85.6
Consultations with all health professionals	43,286	~100.0	9,169	100.0	2,307	99.6	1,159	99.6
Consultations with general practitioners and specialists	43,271	~100.0	9,165	99.9	2,307	99.6	1,159	99.6
Number of cut-down days or bed-days	42,841	99.0	9,063	98.8	--	--	--	--
Self-perceived health	42,906	99.1	9,079	99.0	--	--	--	--

[1] Includes "Don't know".
[2] Based on individuals between 20 and 65 years of age only.

Table B3. Number and proportion of non-immigrant and immigrant respondents with valid answer for the selected variables, by survey (effective sample sizes).

Variables	OHS				QHHNS			
	Non-immigrants		Immigrants		Non-immigrants		Immigrants	
	Total number[1]	%	Total number[1]	%	Total number[1]	%	Total number[1]	%
Place of birth	6,535	100.0	2,636	100.0	1,075	100.0	89	100.0
Gender	6,535	100.0	2,636	100.0	1,075	100.0	89	100.0
Age	6,535	100.0	2,636	100.0	1,075	100.0	89	100.0
Marital status	6,507	99.6	2,623	99.5	1,075	100.0	89	100.0
Stratum	6,535	100.0	2,636	100.0	1,075	100.0	89	100.0
Education	6,529	99.9	2,620	99.4	~1,075	~100.0	87	98.5
Household income	5,639	86.3	2,187	83.0	955	88.9	77	87.1
Stress level	6,431	98.4	2,563	97.2	--	--	--	--
Satisfaction with social life	6,174	94.5	2,408	91.3	1,072	99.7	89	100.0
Ethnicity-all Acculturation-ethnicity-immigrants only	6,523 --	99.8 --	2,612 2,612	99.1 99.1	1,072 --	99.7 --	89 --	100.0 --
Acculturation-language-immigrants only	--	--	2,598	98.5	--	--	--	--
Time since migration	--	--	2,578	97.9	--	--	88	99.3
Dietary intake	5,640	86.3	2,086	79.1	987	91.8	79	89.0
Chewing problems	6,338	97.0	2,510	95.2	--	--	--	--
Thinks diet can influence health[1]	6,175	94.5	2,390	90.7	--	--	--	--
Nutritional knowledge[1] -Fat -Cholesterol -Salt	 -- -- --	 -- -- --	 -- -- --	 -- -- --	 1,075 ~1,075 1,075	 100.0 ~100.0 100.0	 89 89 89	 100.0 100.0 100.0

/continued...

(continued) Table B3. Number and proportion of non-immigrant and immigrant respondents with valid answer for the selected variables, by survey (effective sample sizes).

Variables	OHS				QHHNS			
	Non-immigrants		Immigrants		Non-immigrants		Immigrants	
	Total number[1]	%	Total number[1]	%	Total number[1]	%	Total number[1]	%
Alcoholic drinks during past week	5,950	91.0	2,292	87.0	1,074	99.9	~89	~100.0
Energy expenditure/physical activity	5,412	82.8	1,994	75.6	1,072	99.7	88	98.7
Smoking	5,996	91.8	2,304	87.4	1,048	97.5	88	98.6
BMI[2]	4,943	92.7	1,876	87.4	820	88.1	66	83.6
Waist-to-hip circumference ratio	--	--	--	--	957	89.1	78	87.6
Difference between self-reported and measured weight	--	--	--	--	935	86.9	72	81.4
Difference between self-reported and measured height	--	--	--	--	943	87.7	74	83.4
Number of health problems	6,535	100.0	2,636	100.0	--	--	--	--
Specific health problems								
-Cardiovascular diseases	6,535	100.0	2,636	100.0	1,075	100.0	89	100.0
-Hypertensive diseases/hypertension	6,535	100.0	2,636	100.0	~1,075	~100.0	89	100.0
-Angina	--	--	--	--	1,075	100.0	89	100.0
-Intermittent Claudication	--	--	--	--	1,075	100.0	89	100.0
-Infarction	--	--	--	--	1,075	100.0	89	100.0
-Diabetes mellitus	6,535	100.0	2,636	100.0	1,073	99.8	~89	99.7
-Digestive diseases	6,535	100.0	2,636	100.0	--	--	--	--
-Gastro-intestinal ulcer	6,535	100.0	2,636	100.0	--	--	--	--
-Cancer	6,535	100.0	2,636	100.0	--	--	--	--
-Other diseases	6,535	100.0	2,636	100.0	--	--	--	--

/continued...

(continued) Table B3. Number and proportion of non-immigrant and immigrant respondents with valid answer for the selected variables, by survey (effective sample sizes).

Variables	OHS				QHHNS			
	Non-immigrants		Immigrants		Non-immigrants		Immigrants	
	Total number[1]	%	Total number[1]	%	Total number[1]	%	Total number[1]	%
Family history of cardiovascular disease	--	--	--	--	1,063	98.8	88	98.8
Blood cholesterol								
-Total cholesterol	--	--	--	--	948	88.2	78	87.3
-LDL-cholesterol	--	--	--	--	908	84.5	73	82.6
-HDL-cholesterol	--	--	--	--	923	85.8	77	87.0
-Total cholesterol-to-HDL-cholesterol ratio	--	--	--	--	923	85.8	77	87.0
-Triglycerides	--	--	--	--	932	86.7	78	87.3
Knowledge that you have hypertension[1]	--	--	--	--	1,070	99.6	88	99.0
Knowledge that you have high blood cholesterol (≥5.2mmol/L)[1]	--	--	--	--	917	85.3	68	76.1
Consultations with all health professionals	6,533	~100.0	2,636	100.0	1,070	99.5	89	100.0
Consultations with general practitioners and specialists	6,531	99.9	2,634	99.9	1,070	99.5	89	100.0
Number of cut-down days or bed-days	6,463	98.9	2,600	98.6	--	--	--	--
Self-perceived health	6,477	99.1	2,602	98.7	--	--	--	--

[1] Includes "Don't know".

[2] Based on individuals between 20 and 65 years of age only.

APPENDIX C

Geographical classification

1991 Canada Census geographical classification (for countries of birth; Statistics Canada 1993a)

AMERICA

Canada:	Newfoundland, Prince Edward Island, Nova Scotia, New Brunswick, Quebec, Ontario, Manitoba, Saskatchewan, Alberta, British Columbia, Yukon, Northwest Territories
North America:	Greenland, St. Pierre and Miquelon, United States of America
Central America:	Belize, Costa Rica, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama
Caribbean and Bermuda:	Anguilla, Antigua, Aruba, Bahamas, Barbados, Bermuda, Cayman Islands, Cuba, Dominica, Dominican Republic, Grenada, Guadeloupe, Haiti, Jamaica, Martinique, Montserrat, Netherlands Antilles, Puerto Rico, St. Christopher and Nevis, St. Lucia, St. Vincent and the Grenadines, Trinidad and Tobago, Turks and Caicos Islands, Virgin Islands (British), Virgin Islands (U.S.)
South America:	Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Falkland Islands, French Guiana, Guyana, Paraguay, Peru, Suriname, Uruguay, Venezuala

EUROPE

Western Europe:	Austria, Belgium, France, Germany (Federated Republic of), Liechtenstein, Luxembourg, Monaco, Netherlands, Switzerland
Eastern Europe:	Bulgaria, Czech and Slovak Federal Republic, Hungary, Poland, Romania, Union Soviet Socialist Republics
Nothern Europe:	Republic of Ireland (Eire), United Kingdom
Scandinavia:	Denmark, Finland, Iceland, Norway, Sweden
Southern Europe:	Albania, Andorra, Cyprus, Gibraltar, Greece, Italy, Malta, Portugal, San Marino, Spain, Vatican City State, Yugoslavia

AFRICA

Western Africa:	Benin, Burkina Faso, Cape Verde Islands, Gambia, Ghana, Guinea, Guinea-Bissau, Ivory Coast, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone, St. Helena and Ascension, Togo
Eastern Africa:	Burundi, Comoros, Djibouti (Republic of), Ethiopia, Kenya, Madascar, Malawi, Mauritius, Mayotte, Mozambique, Reunion, Rwanda, Seychelles, Somali Democratic Republic, Tanzania, Uganda, Zambia, Zimbabwe
Northern Africa:	Algeria, Egypt, Libya, Morocco, Sudan, Tunisia, Western Sahara
Central Africa:	Angola, Cameroon, Central African Republic, Chad, Congo, Equatorial Guinea, Gabon, Sao Tome and Principe, Zaire
Southern Africa:	Botswana, Lesotho, Namibia, South Africa (Republic of), Swaziland

ASIA

Western Asia:	Afghanistan, Turkey
Middle East:	Bahrain, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Syria, United Arab Emirates, Yemen (Republic of)
Eastern Asia:	China (People's Democratic Republic of), Hong Kong, Japan, Korea (North), Korea (South), Macao
South East Asia:	Brunei, Indonesia, Kampuchea, Laos, Malaysia, Philippines, Singapore, Thailand, Union of Myanmar, Viet Nam
Southern Asia:	Bangladesh, Bhutan, India, Maldives (Republic of), Nepal, Pakistan, Sri Lanka

OCEANIA	American Samoa, Australia, Belau (Republic of), Cook Islands, Fiji, French Polynesia, Guam (U.S.), Kiribati, Marshall Islands Micronesia (Federated States of), Nauru, New Caleonia, New Zealand, Papua New Guinea, Pitcairn Island, Solomon Islands, Tonga, Tuvalu, U.S. Pacific Trust Territories, Vanuata, Wallis and Futuna, Western Samoa

OTHER

APPENDIX D

Modifications in place of birth categories

Table D1. Outcomes for which place of birth variables were modified, reason for the modification, categories modified, and type of modification, for the CHS and for the basic analyses (research questions 1 and 2).

Outcome[1]	Reason for the modification[2,3]	Category(ies) modified[2]	Final modification[2]
FAT (fat as % of energy) FAT-HIGH (fat, binary) CHOLESTEROL (cholesterol in mg/day) CHOLEST-HIGH (cholesterol, binary) FIBRE (fibres in g/MJ) FIBRE-LOW (fibres, binary) CALCIUM (calcium in mg/day) CALCIUM-INADEQ-RNI (calcium, binary) CALCIUM-INADEQ-WHO (calcium, binary) ENERGY (energy in kJ) CARBOHYDRATE (carbohydrates as % of energy) CARBOHYD-LOW (carbohydrates, binary) PROTEIN (proteins as % of energy) PROTEIN-INADEQ (proteins, binary) ALCOHOL (binary) IRON (iron in mg/day) IRON-INADEQ (iron, binary) VITAMINC (vitamin C in mg/day) THIAMIN (thiamin in mg/5MJ) THIAMIN-INADEQ (thiamin, binary) RIBOFLAVIN (riboflavin in mg/5MJ) NIACIN (niacin, NE/5MJ)	size<25	COUNTRY: Other Caribbean	removed
VITAMINC-INADEQ (vitamin C, binary)	zero cell zero cell	SUB-REGION: Other Africa COUNTRY: Jamaica	removed with Other Caribbean

/continued...

(continued) Table D1. Outcomes for which place of birth variables were modified, reason for the modification, categories modified, and type of modification, for the OHS and for the basic analyses (research questions 1 and 2).

Outcome[1]	Reason for the modification[2,3]	Category(ies) modified[2]	Final modification[2]
RIBOFLAV-INADEQ (riboflavin, binary)	zero cell	SUB-REGION: Scandinavia	removed
	high variance	COUNTRY: Poland	with Other Europe
	high variance	COUNTRY: Hungary	with Other Europe
	size<25	COUNTRY: Other Caribbean	removed
NIACIN-INADEQ (niacin, binary)	zero cell	SUB-REGION: Other Africa	removed
	zero cell	COUNTRY: Greece	with Other Europe
	zero cell	COUNTRY: Hungary	with Other Europe
	zero cell	COUNTRY: Jamaica	with Other Caribbean
BMI (kg/m^2)	size<25	SUB-REGION: Scandinavia	removed
OVERWT (overweight, binary)	size<25	SUB-REGION: Central Am.	removed
OBESITY (obesity, binary)			
LOW-BMI (low BMI, binary)	<25	COUNTRY: Other Caribbean	removed
HYPERTENS-DIS (hypertensive diseases, binary)	zero cell	COUNTRY: Vietnam	with Other Asia
DB (diabetes mellitus, binary)	zero cell	COUNTRY: Portugal	with Other Europe
	zero cell	COUNTRY: Greece	with Other Europe
	zero cell	COUNTRY: Vietnam	with Other Asia
	zero cell	COUNTRY: Trinidad	removed
	zero cell	COUNTRY: Other Caribbean	removed
ULCER (gastrointestinal ulcer, binary)	zero cell	SUB-REGION: Scandinavia	removed
	zero cell	SUB-REGION: South Asia	removed
	zero cell	SUB-REGION: Central Am.	removed
	zero cell	COUNTRY: Yugoslavia	with Other Europe
	zero cell	COUNTRY: India	with Other Asia
	zero cell	COUNTRY: Trinidad	with Other Caribbean
	zero cell	COUNTRY: Other CS Am.	removed

/continued...

(continued) Table D1. Outcomes for which place of birth variables needed to be modified, reason for the modification, categories modified, and final modification, for the OHS and for for basic analyses (research questions 1 and 2).

Outcome[1]	Reason for the modification[2,3]	Category(ies) modified[2]	Final modification[2]
CANCER (binary)	zero cell	REGION: CS America	removed
	zero cell	SUB-REGION: Scandinavia	no analysis for SUB-REGION
	zero cell	SUB-REGION: South-East Asia	"
	zero cell	SUB-REGION: Middle East	"
	zero cell	SUB-REGION: Other Africa	"
	zero cell	SUB-REGION: Central America	"
	zero cell	SUB-REGION: South America	"
	zero cell	COUNTRY: Portugal	no analysis for COUNTRY
	zero cell	COUNTRY: Greece	"
	zero cell	COUNTRY: Hong Kong	"
	zero cell	COUNTRY: Philippines	"
	zero cell	COUNTRY: Vietnam	"
	zero cell	COUNTRY: India	"
	zero cell	COUNTRY: Trinidad	"
	zero cell	COUNTRY: Other Caribbean	"
	zero cell	COUNTRY: Guyana	"
	zero cell	COUNTRY: Other CS America	"
CONSULT-HPROF (consult. with all health professionals) CONSULT-GPSP (consultat. with gen. practitioners/spec.) CUT-DOWN-BED-DAYS (cut-down/bed-days, binary) SELF-HEALTH (self-perceived health, ordinal)	size<25	COUNTRY: Other Caribbean	removed

[1] See Table C1 for more a more complete description of the outcomes.
[2] For all the selected outcomes included together in a row.
[3] For the full model.

Table D2. Outcomes for which place of birth variables were be modified, reason for the modification, categories modified, and type of modification, for the QHHNS (research questions 1 and 2).

Outcome[1]	Reason for the modification[2,3]	Category(ies) modified[2]	Type of modification[2]
NIACIN-INADEQ (niacin, binary)	no convergence in as much as 250 iterations	IMM	no analysis for IMM
	zero cell	REGION: Others	no analysis for REGION
CLAUDICATION (intermittent claudication, binary) INFARCTION (infarction, binary)	zero cell	IMM: Others	no analysis for IMM
	zero cell	REGION: Europe REGION: Others	no analysis for REGION

[1] See Table C1 for more a more complete description of the outcomes.

[2] For all the selected outcomes included together in a row.

[3] For the full model.

Table D3. Outcomes for which place of birth variables were be modified, reason for the modification, categories modified, and type of modification, for the OHS and for the study of acculturation (research question 3).

Outcome[1]	Reason for the modification[2,3]	Category(ies) modified[2]	Type of modification[2]
FAT (fat as % energy) FAT-HIGH(fat, binary) FIBRE (fibres in g/MJ) FIBRE-LOW (fibres, binary) CALCIUM (calcium in mg/day)	sample size<25	COUNTRY: Other Caribbean	removed
BMI (in kg/m^2) OVERWT (overweight, binary) OBESITY (obesity, binary) LOW-BMI (low BMI, binary)	sample size<25 sample size<25 sample size<25	SUB-REGION: Scandinavia SUB-REGION: Central America COUNTRY: Other Caribbean	removed removed removed
HYPERTENS-DIS (hypertensive disease, binary)	zero cell	COUNTRY: Vietnam	with Other Asia

[1] See Table C1 for more a more complete description of the outcomes.
[2] For all the selected outcomes included together in a row.
[3] For the full model.

Table D-7. Outcomes for which place of birth variables were modified, reason for the modification, categories modified, and type of modification, for the OHS and for the analyses involving participants whose dietary pattern has not changed (research question 4).

Outcome[1]	Reason for the modification[2,3]	Category(ies) modified[2]	Type of modification[2]
BMI (in kg/m^2)	sample size<25	REGION: Africa	join=> Africa/CS America
OVERWT (overweight, binary)	sample size<25	REGION: CS America	"
OBESITY (obesity, binary)			
LOW-BMI (low BMI, binary)	sample size<25	SUB-REGION: Scandinavia	removed
	sample size<25	SUB-REGION: South-East Asia	join=> Other Asia
	sample size<25	SUB-REGION: South Asia	"
	sample size<25	SUB-REGION: Middle East	"
	sample size<25	SUB-REGION: East Africa	join=> Africa/CS America
	sample size<25	SUB-REGION: Other Africa	"
	sample size<25	SUB-REGION: Central America	"
	sample size<25	SUB-REGION: South America	"
	sample size<25	COUNTRY: Hungary	with Other Europe
	sample size<25	COUNTRY: Hong Kong	join=> Asia
	sample size<25	COUNTRY: China	"
	sample size<25	COUNTRY: Philippines	"
	sample size<25	COUNTRY: Vietnam	"
	sample size<25	COUNTRY: India	"
	sample size<25	COUNTRY: Other Asia	"
	sample size<25	COUNTRY: Jamaica	join=> Caribbean
	sample size<25	COUNTRY: Trinidad	"
	sample size<25	COUNTRY: Other Caribbean	"
	sample size<25	COUNTRY: Africa	join=> Africa/CS America
	sample size<25	COUNTRY: Guyana	"
	sample size<25	COUNTRY: Other CS America	"

/continued...

(continued) Table D4. Outcomes for which place of birth variables were modified, reason for the modification, categories modified, and type of modification, for the OHS and for for the analyses involving participants whose dietary pattern has not changed (research question 4).

Outcome[1]	Reason for the modification[2,3]	Category(ies) modified[2]	Type of modification[2]
NUMBPRB≥1 (number of health problems, binary)	sample size<25	REGION: Africa	join=> Africa/CS America
DIGESTIVE (digestive diseases, binary)	sample size<25	REGION: CS America	"
CONSULT-HPROF (consult. with all health professionals)			
CONSULT-GPSP (consultat. with gen.practitioners/spec.)	sample size<25	SUB-REGION: South-East Asia	join=> Other Asia
CUT-DOWN-BED-DAYS (cut-down/bed-days, binary)	sample size<25	SUB-REGION: South Asia	"
SELF-HEALTH (self-perceived health, ordinal)	sample size<25	SUB-REGION: Middle East	"
	sample size<25	SUB-REGION: East Africa	join=> Africa/CS America
	sample size<25	SUB-REGION: Other Africa	"
	sample size<25	SUB-REGION: Central America	"
	sample size<25	SUB-REGION: South America	"
	sample size<25	COUNTRY: Hong Kong	join=> Asia
	sample size<25	COUNTRY: China	"
	sample size<25	COUNTRY: Philippines	"
	sample size<25	COUNTRY: Vietnam	"
	sample size<25	COUNTRY: India	"
	sample size<25	COUNTRY: Other Asia	"
	sample size<25	COUNTRY: Jamaica	join=> Caribbean
	sample size<25	COUNTRY: Trinidad	"
	sample size<25	COUNTRY: Other Caribbean	"
	sample size<25	COUNTRY: Africa	join=> Africa/CS America
	sample size<25	COUNTRY: Guyana	"
	sample size<25	COUNTRY: Other CS America	"
CVD (cardiovascular diseases, binary)	as HPROBLEM	as HPROBLEM	as HPROBLEM
HYPERTENS-DIS (hypertensive diseases, binary)	*plus*	*plus*	*plus*
	zero cell	COUNTRY: Portugal	with Other Europe

/continued...

(continued) Table D4. Outcomes for which place of birth variables were modified, reason for the modification, categories modified, and type of modification, for the OHS and for for the analyses involving participants whose dietary pattern has not changed (research question 4).

Outcome[1]	Reason for the modification[2,3]	Category(ies) modified[2]	Type of modification[2]
DB (diabetes mellitus, binary)	as HPROBLEM *plus*	as HPROBLEM *plus*	as HPROBLEM *plus*
	zero cell	REGION: Caribbean	with Africa/CS America=> Caribb./Africa/CS Am.
	zero cell	SUB-REGION: Caribbean	with Africa/CS America=> Caribb./Africa/CS Am.
	zero cell	COUNTRY: Portugal	with Other Europe
	zero cell	COUNTRY: Greece	with Other Europe
	zero cell	COUNTRY: Caribbean	with Africa/CS America=> Caribb./Africa/CS Am.
ULCER (gastrointestinal ulcer, binary)	as HPROBLEM *plus*	as HPROBLEM *plus*	as HPROBLEM *plus*
	zero cell	SUB-REGION: Scandinavia	removed
	zero cell	COUNTRY: Portugal	with Other Europe
	zero cell	COUNTRY: Yugoslavia	with Other Europe

/continued...

(continued) Table D4. Outcomes for which place of birth variables were modified, reason for the modification, categories modified, and type of modification, for the OHS and for for the analyses involving participants whose dietary pattern has not changed (research question 4).

Outcome[1]	Reason for the modification[2,3]	Category(ies) modified[2]	Final modification[2]
CANCER (binary)	as HPROBLEM *plus*	as HPROBLEM *plus*	as HPROBLEM *plus*
	zero cell	REGION: Africa/CS America	removed
	zero cell zero cell	SUB-REGION: Scandinavia SUB-REGION: Africa/CS America	no analysis for SUB-REGION
	zero cell zero cell zero cell	COUNTRY: Portugal COUNTRY: Greece COUNTRY: Africa/CS America	no analysis for COUNTRY "

[1] See Table C1 for more a more complete description of the outcomes.
[2] For all the selected outcomes included together in a row.
[3] For the full model.

APPENDIX E

Nutritional recommendations

Table E1. Nutritional recommendations for the selected dietary outcomes.

Dietary outcome	Recommendation
1992 Canada Food Guide[1]	
Cereals and Breads	≥ 5 servings/day
Vegetables and Fruits	≥ 5 servings/day
Milk products	≥ 2 servings/day
Meats and alternates	≥ 2 servings/day
Fat[2]	≤ 30% of dietary energy
Cholesterol[2,3]	RNI[2]: reduce intake to approximately 300 mg/day[2] American National Research Council[3]: ≤ 300 mg/day
Saturated fat[2]	≤ 10 % of dietary energy
Dietary fibers[4]	≥ 3.0 g/MJ (i.e. double current intake)
Calcium[2,5]	RNI[2]: Age / Gender 18 y M 900 mg/day 18 y F 700 mg/day ≥19 y M 800 mg/day 19-49 y F 700 mg/day ≥50 y F 800 mg/day WHO[5]: All MF 400 mg/day
Carbohydrates[2]	between 50 and 60% of dietary energy
Proteins[2]	Age / Gender 18 y M 58 g/day 18 y F 47 g/day 19-24 y M 61 g/day 19-24 y F 50 g/day 25-49 y M 64 g/day 25-49 y F 51 g/day 50-74 y M 63 g/day 50-74 y F 54 g/day ≥75 y M 59 g/day ≥75 y F 55 g/day
Number of alcholic drinks/week[6]	No/low risk: 0-14 drinks/week Moderate/high risk: > 14 drinks/week
Iron[7,8]	Group / Gender Adult M 14 mg/day absorbed iron *or* 8 mg/day Menstruating F 2.38 mg/day absorbed iron *or* 16 mg/day Post-menopausal F 0.96 mg/day absorbed iron *or* 6 mg/day

/continued. .

(continued) Table E1. Nutritional recommendations for the selected dietary outcomes.

Dietary outcome	Recommendation
Vitamin C[2]	Age Gender ≥18 y M 40 mg/day ≥18 y F 30 mg/day Smokers are advised to increase their intake by 50%.
Thiamin[2]	If energy intake ≥2,000 kcal: 0.40 mg/1,000 kcal or 0.48 mg/5 MJ If energy intake <2,000 kcal: 0.80 mg/day
Riboflavin[2]	If energy intake ≥2,000 kcal: 0.50 mg/1,000 kcal or 0.60 mg/5 MJ If energy intake <2,000 kcal: 1.00 mg/day
Niacin[2]	If energy intake ≥2,000 kcal: 7.2 NE/1,000 kcal or 8.6 NE/5MJ If energy intake <2,000 kcal: 14.4 NE/day

[1] Health and Welfare Canada 1992.
[2] Health and Welfare Canada 1990.
[3] National Research Council 1989.
[4] Health and Welfare Canada 1985.
[5] World Health Organization 1961.
[6] Ontario Ministry of Health 1985.
[7] World Health Organization 1988.
[8] Assuming that iron absorption is 15% (World Health Organization 1988; Health and Welfare Canada 1990a).

APPENDIX F

Choice of covariates for the selected outcomes

Table F1 Selected chunks of variables by category of outcome, for analyses involving OHS data.

Chunk of covariates	Outcome					
	Dietary intake	Anthropometric measures	Health problems	Number of consultations with health professionals	Cut-down/ bed-days	Self-perceived health
PLACE OF BIRTH						
IMM or REGION or SUB-REGION or COUNTRY (for analyses re acculturation only)	x	x	x	x	x	x
DEMOGRAPHIC						
GENDER	x	x	x	x	x	x
AGE	x	x	x	x	x	x
MS1+MS2	x	x	x	x	x	x
STRATUM	x	x	x	x	x	x
ETHNICITY						
ETHNI1+ETHNI2	x	x	x	x	x	x
SOCIOECONOMIC AND SOCIAL						
EDUCATION	x	x	x	x	x	x
INCOME	x	x	x	x	x	x
STRESS	x	x	x	x	x	x
SOCIAL	x	x	x	x	x	x
NUTRITION RELATED						
CHEWING	x					
THINK	x					

/continued...

(continued) Table F1 Selected chunks of variables by category of outcome, for analyses involving OHS data.

Chunk of covariates	Outcome					
	Dietary intake	Anthropometric measures	Health problems	Number of consultations with health professionals	Cut-down/ bed-days	Self-perceived health
DIETARY						
FAT		x	x	x	x	x
FIBRE		x	x	x	x	x
ENERGY		x	x	x	x	x
HEALTH BEHAVIOURS						
SMOKING1+SMOKING2	x	x	x	x	x	x
DRINKS	x	x	x	x	x	x
EE	x	x	x	x	x	x
BMI	x		x	x	x	x
HEALTH PROBLEMS/ CONSULTATIONS WITH HEALTH PROFESSIONALS						
CVD	x					
DB	x		x[1]			
DIGESTIVE	x					
CANCER	x					
OTHER-DISEASE	x					
NUMBPRB				x	x	x
CONSULT-GPSP					x	x
SELF-PERCEIVED HEALTH						
SELF-HEALTH	x					

[1] For CVD only

Table F2 Selected chunks of variables by category of outcome, for analyses involving QHHNS data.

Chunk of covariates	Outcome						
	Dietary intake	Nutrition knowledge	Anthropometric measures	Health problems	Lipidemia	Knowledge: hypertension or high blood cholesterol	Number of consultations with health professionals
DEMOGRAPHIC							
GENDER	x	x	x	x	x	x	x
AGE	x	x	x	x	x	x	x
MS1+MS2	x	x	x	x	x	x	x
STRATUM	x	x	x	x	x	x	x
ETHNICITY							
ETHNI1+ETHNI2	x	x	x	x	x	x	x
SOCIOECONOMIC AND SOCIAL							
EDUCATION	x	x	x	x	x	x	x
INCOME	x	x	x	x	x	x	x
SOCIAL	x	x	x	x	x	x	x
NUTRITION RELATED							
FAT-KNOW	x^1						
CHOLEST-KNOW	x^2						
DIETARY							
FAT			x	x	x^3		x
SAT-FAT					x^4		
FIBRE			x	x	x^4		x
ENERGY			x	x	x^4		x
HEALTH BEHAVIOURS							
SMOKING1+SMOKING2	x		x	x	x^5		x
DRINKS	x		x	x	x^5		x
EXERCISE	x		x	x	x^5		x

/continued...

(continued) Table F2. Selected chunks of variables by category of outcome, for analyses involving QHHNS data.

Chunk of covariates	Outcome						
	Dietary intake	Nutrition knowledge	Anthropometric measures	Health problems	Lipidemia	Knowledge: hypertension or high blood cholesterol	Number of consultations with health professionals
BMI	x		x[6]	x	x		x
HEALTH PROBLEMS							
LDL-CHL				x[7]			
CVD	x						
DB	x			x[7]	x[9]		
HYPERTENSION				x[8]			
FAMILY-HX				x[9]	x		

[1] For FAT and FAT-ADEQ only
[2] For CHOLESTEROL and CHOLEST-ADEQ only
[3] For TRIGLYCERIDES only
[4] For CHOL≥5.2, CHOL≥6.2, LDL-CHL, HDL-CHL, and CHL/HDL only.
[5] For HDL-CHL, CHL/HDL, and TRIGLYCERIDES only
[6] For DIFF-WEIGHT and DIFF-HEIGHT only
[7] For CVD only
[8] For ANGINA only
[9] For CVD, HYPERTENSION, and ANGINA only

APPENDIX G

Power calculations

Table G1. Research question 1: power of the analyses involving place of birth and dietary outcome variables, for the OHS (power values ≥ 0.80 are in bold).

Exposure variable	Outcome[1]						
	FAT	FAT-HIGH	FIBRE	FIBRE-LOW	CALCIUM	CALCIUM-INADEQ-RNI	CALCIUM-INADEQ-WHO
IMM							
Canada (ref.)							
Others	**1.00**	**1.00**	**1.00**	0.51	**1.00**	**1.00**	**1.00**
REGION							
Canada (ref.)							
USA	0.63	0.26	0.17	0.02	0.01	0.01	0.01
Europe	**1.00**	**1.00**	**1.00**	0.45	**0.80**	0.23	0.15
Asia	**1.00**	**1.00**	0.09	0.01	**1.00**	**1.00**	**1.00**
Caribbean	**1.00**	**1.00**	0.51	0.17	0.76	**0.82**	**0.94**
Africa	**0.99**	**0.96**	**0.80**	0.17	0.16	0.19	0.02
CS America	**1.00**	0.69	0.05	0.01	0.43	0.21	0.04
SUB-REGION							
Canada (ref.)							
USA	0.67	0.25	0.17	0.02	0.01	0.01	0.01
West Europe	0.05	0.01	0.20	0.01	0.11	0.01	0.06
North Europe	**0.99**	0.13	**0.99**	0.37	0.04	0.10	0.02
Scandinavia	0.07	0.01	0.04	0.06	0.02	0.01	0.06
South Europe	**1.00**	**1.00**	0.51	0.20	**1.00**	**0.98**	0.29
East Europe	0.64	0.33	**0.83**	0.03	0.11	0.03	0.04
East Asia	**1.00**	**1.00**	0.22	0.01	**1.00**	**1.00**	**1.00**
SE Asia	**1.00**	**1.00**	0.40	0.10	**1.00**	**1.00**	**1.00**
South Asia	**1.00**	**1.00**	0.31	0.12	0.05	0.02	0.02
Middle East	**0.96**	**0.86**	0.41	0.06	0.11	0.02	0.12
Caribbean	**1.00**	**0.99**	0.46	0.17	**0.85**	**0.82**	**0.94**
East Africa	**0.99**	**0.80**	0.16	0.04	0.11	0.61	0.01
Other Africa	0.36	0.66	0.49	0.03	0.04	0.01	0.01
Central America	0.67	0.02	0.10	0.01	0.06	0.02	0.01
South America	**1.00**	0.69	0.02	0.01	0.34	0.22	0.06

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(continued) Table G1 Research question 1: power of the analyses involving place of birth and dietary outcome variables, for the OHS (power values ≥ 0.80 are in bold).

Exposure variable	Outcome[1]						
	FAT	FAT-HIGH	FIBRE	FIBRE-LOW	CALCIUM	CALCIUM-INADEQ-RNI	CALCIUM-INADEQ-WHO
COUNTRY							
Canada (ref.)							
USA	0.67	0.26	0.17	0.02	0.01	0.01	0.01
Germany	0.03	0.01	0.30	0.06	0.37	0.02	0.10
Netherland	0.03	0.01	0.01	0.01	0.01	0.02	0.02
UK	**0.99**	0.16	**0.98**	0.42	0.03	0.07	0.01
Italy	**1.00**	**1.00**	0.16	0.03	**0.98**	0.50	0.01
Portugal	**0.98**	0.69	0.05	0.01	0.54	**0.97**	0.54
Yugoslavia	0.63	0.34	0.4[illegible]	0.41	0.01	0.02	0.03
Greece	**0.94**	0.13	0.01	0.15	0.63	0.56	0.74
Poland	0.09	0.05	0.28	0.01	0.15	0.14	.
Hungary	0.19	0.03	0.45	0.12	0.19	0.14	0.14
Other Europe	0.75	0.11	0.23	0.02	0.28	0.01	0.03
Hong Kong	**1.00**	**1.00**	0.11	0.10	**0.99**	**1.00**	**1.00**
China	**0.98**	**0.85**	0.01	0.05	**1.00**	**1.00**	**1.00**
Philippines	**1.00**	**1.00**	0.48	0.03	0.76	0.41	**0.99**
Vietnam	**1.00**	**1.00**	0.32	0.07	**0.99**	**1.00**	**1.00**
India	**1.00**	**1.00**	0.24	0.04	0.01	0.18	0.04
Other Asia	**1.00**	**1.00**	**0.99**	0.49	**0.98**	0.77	**1.00**
Jamaica	**0.99**	**0.95**	0.26	0.06	0.47	0.60	0.60
Trinidad	**0.97**	0.62	0.07	0.01	0.32	0.07	0.05
Other Caribbean	.	.	.	.	.	.	.
Africa	**0.99**	**0.96**	0.79	0.17	0.16	0.24	0.02
Guyana	**1.00**	0.79	0.25	0.02	0.09	**0.80**	0.30
Other CS America	**0.88**	0.10	0.01	0.01	0.32	0.01	0.02

[1] FAT: fat intake (% energy); FAT-HIGH: likelihood of high fat intake (>30% of dietary energy), FIBRE: fibre intake (g/MJ); FIBRE-LOW: likelihood of low fibre intake (<3.0 g/MJ); CALCIUM: calcium intake (mg/day); CALCIUM-INADEQ-RNI: likelihood of "inadequate" calcium intake, using Canadian recommendations; CALCIUM-INADEQ-WHO: likelihood of "inadequate" calcium intake, using WHO recommendations.

Table G2. Research question 1-2: power of the analyses involving place of birth, and anthropometric and health variables, for the OHS (power values ≥ 0.80 are in bold).

Exposure variable	Outcome[1] BMI	OVERWT	OBESITY	LOW-BMI	NUMBPRB ≥1	CVD	HYPERTENS-DIS	DB	CONSULT-HPROF	CONSULT-GPSP	SELF-HEALTH
IMM											
Canada (ref.)											
Others	**0.88**	0.38	0.03	0.38	0.37	0.58	0.52	0.06	0.03	0.09	**0.88**
REGION											
Canada (ref.)											
USA	0.05	0.09	0.10	0.01	0.11	0.01	0.01	0.04	0.03	0.01	0.05
Europe	0.00	0.06	0.08	0.07	0.01	**0.98**	**0.88**	0.13	0.08	0.26	0.00
Asia	**1.00**	**1.00**	**0.88**	**1.00**	**1.00**	0.34	0.13	0.01	**0.95**	0.01	**1.00**
Caribbean	0.01	0.01	0.05	0.01	0.03	0.04	0.11	0.01	0.07	0.02	0.01
Africa	0.20	0.03	0.04	0.01	0.03	0.03	0.03	0.01	0.01	0.02	0.20
CS America	0.07	0.09	0.09	0.12	0.61	0.02	0.01	0.03	0.04	0.02	0.07
SUB-REGION											
Canada (ref.)											
USA	0.09	0.09	0.10	0.01	0.11	0.01	0.01	0.04	0.01	0.01	0.09
West Europe	0.05	0.02	0.01	0.03	0.01	0.04	0.07	0.01	0.03	0.05	0.05
North Europe	0.57	0.35	0.39	0.03	0.34	0.50	0.31	0.02	0.01	0.01	0.57
Scandinavia	.	.	.	.	0.01	0.11	0.01	.	0.01	0.11	.
South Europe	**0.90**	**0.98**	**0.86**	0.13	0.14	0.72	0.63	0.43	0.18	**0.90**	**0.90**
East Europe	0.04	0.02	0.08	0.04	0.01	**0.84**	0.37	0.01	0.01	0.01	0.04
East Asia	**1.00**	**1.00**	**0.90**	**1.00**	0.62	0.05	0.01	0.01	0.25	0.02	**1.00**
SE Asia	**0.98**	**0.89**	0.26	**0.88**	**0.94**	0.12	0.07	0.01	0.28	0.03	**0.98**
South Asia	0.46	0.26	0.15	0.03	**0.82**	0.11	0.12	0.01	0.26	0.01	0.46
Middle East	0.04	0.01	0.05	0.08	0.02	0.03	0.05		0.02	0.01	0.04
Caribbean	0.01	0.01	0.03	0.02	0.03	0.04	0.11	0.01	0.05	0.02	0.01
East Asia	0.09	0.01	0.02	0.02	0.03	0.01	0.01	0.01	0.02	0.01	0.09
Other Asia	0.25	0.09	0.18	0.02	0.01	0.03	0.02		0.05	0.02	0.25
Central America	.		.		0.02	0.01	0.02	.	0.01	0.02	.
South America	0.27	0.05	0.08	0.05	0.65	0.02	0.01	0.03	0.04	0.05	0.27

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(continued) Table G2. Research quesion 1-2: power of the analyses involving place of birth, and anthropometric and health variables, for the OHS (power values ≥ 0.80 are in bold)

Exposure variable	Outcome[1]										
	BMI	OVERWT	OBESITY	LOW-BMI	NUMBPRB ≥1	CVD	HYPERTENS-DIS	DB	CONSULT-HPROF	CONSULT-GPSP	SELF-HEALTH
COUNTRY											
Canada (ref.)											
USA	0.05	0.09	0.10	0.01	0.11	0.01	0.01	0.04	0.02	0.01	0.05
Germany	0.01	0.04	0.12	0.01	0.01	0.09	0.07	0.01	0.01	0.01	0.01
Netherland	0.02	0.01	0.01	0.02	0.07	0.04	0.06	0.01	0.04	0.03	0.02
UK	0.59	0.35	0.33	0.0[illegible]	0.34	0.52	0.36	0.01	0.02	0.01	0.59
Italy	**0.94**	**1.00**	**0.91**	0.33	0.01	**1.00**	**0.84**	**0.81**	0.54	**0.98**	**0.94**
Portugal	0.06	0.07	0.14	0.05	0.10	0.22	0.01	.	0.01	0.05	0.06
Yugoslavia	0.15	0.02	0.14	0.12	0.03	0.01	0.01	0.07	0.07	0.01	0.15
Greece	0.05	0.01	0.01	0.01	0.39	0.01	0.01	.	0.01	0.01	0.05
Poland	0.01	0.01	0.01	0.02	0.02	0.42	0.46	0.01	0.01	0.01	0.01
Hungary	0.12	0.07	0.36	0.01	0.04	0.06	0.01	0.03	0.09	0.02	0.12
Other Europe	0.17	0.15	0.21	0.03	0.09	0.13	0.03	0.04	0.02	0.01	0.17
Hong Kong	**1.00**	**0.96**	0.70	**1.00**	0.68	0.02	0.01	0.05	0.32	0.04	**1.00**
China	0.48	0.68	0.12	0.21	0.38	0.02	0.02	0.01	0.28	0.02	0.48
Phillipines	0.01	0.22	0.02	0.01	0.41	0.01	0.01	0.02	0.31	0.02	0.01
Vietnam	**0.99**	0.53	0.33	**1.00**	**0.97**	0.18	.	.	0.10	0.01	**0.99**
India	0.56	0.34	0.27	0.05	0.67	0.12	0.08	0.01	0.23	0.01	0.56
Other Asia	0.60	0.49	0.07	0.27	0.02	0.09	0.04	0.10	0.01	0.14	0.60
Jamaica	0.01	0.01	0.12	0.07	0.01	0.06	0.07	0.02	0.01	0.01	0.01
Trinidad	0.02	0.01	0.05	0.01	0.40	0.02	0.01	.	0.04	0.02	0.02
Other Caribb.	.	.	.	.	0.04	0.08	0.50	.	0.02	0.04	.
Africa	.	0.03	0.04	0.01	0.03	0.03	0.02	0.01	0.01	0.02	.
Guyana	0.36	0.02	0.13	0.21	0.35	0.01	0.02	0.01	0.04	0.02	0.36
Other CS Am.	0.01	0.10	0.02	0.01	0.27	0.03	0.01	0.04	0.01	0.01	0.01

[1] BMI: BMI (kg/m^2); OVERWT: likelihood of overweight (BMI>25 kg/m^2); OBESITY: likelihood of obesity (BMI>27 kg/m^2); LOW-BMI: likelihood of low BMI (BMI<20 kg/m^2); NUMBPRB≥1: likelihood of having at least one health problem; CVD: likelihood of having a cardiovascular disease; HYPERTENS-DIS: likelihood of having a hypertensive disease; DB: likelihood of having diabetes mellitus; CONSULT-HPROF: number of consultations with all health professionals during the past twelve months; CONSULT-GPSP: number of consultations with general practitioners or specialists during the past twelve months, SELF-HEALTH: self-perceived health.

Table G3. Ressearch question 1: power of the analyses involving place of birth and dietary variables, for the QHHNS (power values ≥ 0.80 are in bold).

Exposure variable	Outcome[1]						
	FAT	FAT-HIGH	FIBRE	FIBRE-LOW	CALCIUM	CALCIUM-INADEQ-RNI	CALCIUM-INADEQ-WHO
IMM							
Canada (ref.)							
Others	0.73	0.20	**0.97**	0.03	0.03	0.05	0.01
REGION							
Canada (ref.)							
Europe	0.14	0.05	0.04	0.01	0.06	0.12	0.03
Others	0.69	0.15	0.03	0.04	0.01	0.01	0.01

[1] FAT: fat intake (% energy); FAT-HIGH: likelihood of high fat intake (>30% of dietary energy); FIBRE: fibre intake (g/MJ); FIBRE-LOW: likelihood of low fibre intake (<3.0 g/MJ); CALCIUM: calcium intake (mg/day); CALCIUM-INADEQ-RNI: likelihood of "inadequate" calcium intake, using dietary calcium intake and Canadian recommendations; CALCIUM-INADEQ-WHO: likelihood of "inadequate" calcium intake, using dietary calcium inta... and WHO recommendations.

Table G4. Research question 1-2: power of the analyses involving place of birth, and anthropometric and health outcome variables, for the QHHNS (power values ≥ 0.80 are in bold).

Exposure variable	Outcome[1]						
	BMI	OVERWT	OBESITY	LOW-BMI	CVD	HYPERTENSION	DB
IMM							
Canada (ref.)							
Others	0.02	0.02	0.03	0.02	0.05	0.18	0.41
REGION							
Canada (ref.)							
Europe	0.04	0.03	0.15	0.13	0.05	0.04	0.23
Others	0.01	0.01	0.02	0.04	0.02	0.17	0.17

[1] BMI: BMI (kg/m^2); OVERWT: likelihood of overweight (BMI>25 kg/m^2); OBESITY: likelihood of obesity (BMI>27 kg/m^2); LOW-BMI: likelihood of low BMI (BMI<20 kg/m^2); CVD: likelihood of having a cardiovascular disease; HYPERTENSION: likelihood of having hypertension; DB: likelihood of having diabetes mellitus.

Table G5. Research question 3: power of the analyses involving acculturation and dietary variables, for the OHS (power values ≥ 0.80 are in bold).

Exposure variable	Outcome[1]						
	FAT	FAT-HIGH	FIBRE	FIBRE-LOW	CALCIUM	CALCIUM-INADEQ-RNI	CALCIUM-INADEQ-WHO
ACCETHNI							
Low accult. (ref.)							
Medium accult.	0.02	0.01	0.03	0.03	0.10	0.24	0.18
High accult.	0.15	0.01	0.01	0.02	0.08	0.13	0.12
ACCLANG							
Not accult. (ref.)							
Acculturated	**1.00**	**0.86**	0.02	0.21	0.78	0.73	0.18
Not applicable	0.72	0.61	0.06	0.22	**0.98**	**0.81**	0.20
TIME	**0.98**	0.31	0.86	**0.99**	0.30	**0.96**	0.75

[1] FAT: fat intake (% energy); FAT-HIGH: likelihood of high fat intake (>30% of dietary energy); FIBRE: fibre intake (g/MJ); FIBRE-LOW: likelihood of low fibre intake (<3.0 g/MJ); CALCIUM: calcium intake (mg/day); CALCIUM-INADEQ-RNI: likelihood of "inadequate" calcium intake, using Canadian recommendations; CALCIUM-INADEQ-WHO: likelihood of "inadequate" calcium intake, using WHO recommendations.

Table G6. Research question 3: power of the analyses involving acculturation and health variables, for the OHS (power values ≥ 0.80 are in bold).

Exposure variable	Outcome[1]									
	BMI	OVERWT	OBESITY	LOW-BMI	NUMBPRB≥1	CVD	HYPERTENS-DIS	CONSULT-HPROF	CONSULT-GPSP	SELF-HEALTH
ACCETHNI										
Low accult. (ref.)										
Medium accult.	0.11	0.09	0.01	0.12	0.16	0.36	0.09	0.14	0.12	0.01
High accult.	0.03	0.01	0.01	0.05	0.09	0.01	0.01	0.04	0.03	0.01
ACCLANG										
Not accult. (ref.)										
Accultur	0.01	0.01	0.04	0.27	0.14	0.05	0.04	0.10	**0.87**	0.01
Not applicable	0.60	**0.98**	**1.00**	0.03	0.44	0.28	0.18	0.37	**0.99**	0.02
TIME	**1.00**	**1.00**	**0.99**	**1.00**	**1.00**	**1.00**	**1.00**	**0.97**	**0.92**	**0.97**

[1] BMI: BMI (kg/m^2); OVERWT: likelihood of overweight (BMI>25 kg/m^2); OBESITY: likelihood of obesity (PMI>27 kg/m^2); LOW-BMI: likelihood of low BMI (BMI<20 kg/m^2); NUMBPRB≥1: likelihood of having at least one health problem; CVD: likelihood of l wing a cardiovascular disease; HYPERTENS-DIS: likelihood of having a hypertensive disease; DB: likelihood of having diabetes mellitus; CONSULT-HPROF: number of consultations with all health professionals during the past twelve months; CONSULT-GPSP: number of consultations with general practitioners or specialists during the past twelve months; SELF-HEALTH: self-perceived health.

Table G7. Research question 4: power of the analyses involving place of birth, and anthropometric and health variables, for the OHS respondents whose dietary pattern has not changed (power values ≥ 0.80 are in bold).

Exposure variables	Outcome										
	BMI	OVERWT	OBESITY	LOW-BMI	NUMBPRB ≥1	CVD	HYPERTENS -DIS	DB	CONSULT -HPROF	CONSULT -GPSP	SELF-HEALTH
IMM											
Canada (ref.)											
Others	0.01	0.07	0.08	0.39	0.04	**1.00**	**0.98**	0.35	0.20	0.52	**1.00**
REGION											
Canada (ref.)											
USA	0.06	0.12	0.05	0.01	0.22	0.02	0.01	0.07	0.01	0.03	0.04
Europe	0.18	0.48	0.37	0.70	0.06	**1.00**	**0.98**	0.35	0.24	0.59	**1.00**
Asia	0.72	0.59	0.12	0.21	0.11	0.01	0.03	0.02	0.03	0.01	0.53
Caribbean	0.01	0.02	0.01	0.01	0.01	0.08	0.27	.	0.04	0.01	0.11
Africa/CS Am.	0.24	0.25	0.21	0.01	0.02	0.01	0.01	.	0.05	0.01	0.02
Caribb./Africa/CS Am		.		.	.	.	.	0.02	.	.	.
SUB-REGION											
Canada (ref.)											
USA	0.06	0.10	0.05	0.01	0.22	0.02	0.01	0.07	0.01	0.03	0.04
West Europe	0.01	0.02	0.04	0.25	0.01	0.13	0.11	0.01	0.01	0.01	0.01
North Europe	0.18	0.16	0.16	0.01	0.36	**0.87**	0.35	0.03	0.09	0.02	0.00
South Europe	**0.98**	**1.00**	**0.94**	0.54	0.05	**0.92**	**0.93**	0.64	0.13	**0.92**	**1.00**
East Europe	0.11	0.07	0.26	0.17	0.07	**0.99**	0.44	0.04	0.07	0.05	**0.99**
East Asia	0.76	0.60	0.24	0.43	0.39	0.01	0.05	0.01	0.01	0.02	0.46
Other Asia	0.02	0.03	0.01	0.01	0.01	0.08	0.27	0.06	0.04	0.01	0.11
Caribbean	0.04	0.05	0.01	0.01	0.04	0.01	0.01	.	0.09	0.02	0.08
Africa/CS Am	0.48	0.35	0.23	0.01	0.02	0.01	0.01	.	0.05	0.01	0.02
Caribb./Africa/CS Am	.	.			.		.	0.02	.	.	.

/continued..

(continued) Table G7. Research question 4: power of the analyses involving place of birth and anthropometric and health variables, for the OHS respondents whose dietary pattern has not changed (power values ≥ 0.80 are in bold).

Exposure variables	Outcome										
	BMI	OVERWT	OBESITY	LOW-BMI	NUMBPRB ≥1	CVD	HYPERTENS -DIS	DB	CONSULT -HPROF	CONSULT -GPSP	SELF-HEALTH
COUNTRY											
Canada (ref.)											
USA	0.06	0.10	0.05	0.01	0.22	0.02	0.01	0.07	0.01	0.03	0.04
Germany	0.03	0.04	0.14	0.05	0.02	0.09	0.09	0.01	0.01	0.01	0.02
Netherlands	0.01	0.01	0.01	0.21	0.04	0.08	0.07	0.01	0.04	0.04	0.09
UK	0.19	0.16	0.14	0.02	0.38	**0.87**	0.46	0.02	0.10	0.02	0.00
Italy	**0.97**	**1.00**	**0.96**	0.48	0.01	**0.99**	**0.93**	**0.82**	0.23	**0.95**	**1.00**
Portugal	0.02	0.06	0.01	0.07	0.05	.	.	.	0.01	0.04	0.76
Yugoslavia	0.36	0.06	0.33	0.01	0.02	0.03	0.01	0.09	0.04	0.01	0.75
Greece	0.01	0.01	0.01	0.06	0.14	0.03	0.02	.	0.02	0.04	0.07
Poland	0.03	0.02	0.08	0.09	0.03	**0.90**	0.69	0.01	0.04	0.07	**0.83**
Hungary				.	0.12	0.09	0.01	0.05	0.11	0.03	0.27
Other Europe	0.02	0.01	0.01	0.07	0.02	0.20	0.02	0.01	0.02	0.02	0.31
Asia	0.72	0.58	0.12	0.21	0.11	0.01	0.04	0.02	0.03	0.01	0.53
Caribbean	0.01	0.03	0.01	0.01	0.72	0.08	0.25		0.04	0.01	0.11
Africa/CS Am	0.24	0.34	0.21	0.01	0.02	0.01	0.01		0.05	0.01	0.02
Caribb./Afr./Cs Am.	.	.	.	.			.	0.02	.		

[1] BMI: BMI (kg/m^2); OVERWT: likelihood of overweight (BMI>25 kg/m^2), OBESITY: likelihood of obesity (BMI>27 kg/m^2); LOW-BMI: likelihood of low BMI (BMI<20 kg/m^2), NUMBPRB≥1: likelihood of having at least one health problem; CVD: likelihood of having a cardiovascular disease; HYPERTENS-DIS: likelihood of having a hypertensive disease, DB: likelihood of having diabetes mellitus; CONSULT-HPROF: number of consultations with all health professionals during the past twelve months; CONSULT-GPSP: number of consultations with general practitioners or specialists during the past twelve months, SELF-HEALTH: self-perceived health

APPENDIX H

Correspondence

APPENDIX I

Exposure variables and covariates: bivariate results

Table 11 Place of birth of the OHS and QHHNS study groups respondents.

Place of birth	OHS n[1]	OHS effn[1]	QHHNS n[1]	QHHNS effn[1]
ALL	**43,292**	**9,171**	**2,316**	**1,164**
CANADA	**34,444**	**6,535**	**2,184**	**1,075**
EUROPE	**6,340**	**1,661**	**72**	**46**
NORTHERN	**2,193**	**516**	**7**	**5**
United Kingdom	2,164	508	7	5
Ireland	29	8		
SOUTHERN	**1,696**	**578**	**21**	**15**
Italy	891	301	17	13
Portugal	339	134	4	2
Yugoslavia	262	75		
Greece	145	50		
Malta	33	7		
Spain	13	4		
Cyprus	10	3		
Albania	2	2		
Gibraltar	1	~0		
WESTERN	**1,410**	**228**	**19**	**11**
Netherland	657	105		
Germany	520	118		
Austria	74	19		
Belgium	69	15	6	3
France	44	11	13	8
Switzerland	45	20		
Luxembourg	1	~0		
EASTERN	**912**	**248**	**5**	**3**
Poland	395	112	5	3
Ukraine	74	21		
Estonia	35	9		
Russia	34	8		
Lithuania	29	11		
Latvia	22	7		
USSR (general)	10	3		
Hungary	154	40		
Czecholovakia	98	22		
Romania	55	14		
Bulgaria	6	2		
SCANDINAVIA	**128**	**30**		
Finland	60	11		
Denmark	44	12		
Sweden	17	6		
Norway	7	1		
EUROPE (general)	**1**	**~0**	**20[2]**	**12[2]**

/continued...

(continued) Table 11. Place of birth of the OHS and QHHNS study groups respondents

Place of birth	OHS n[1]	OHS effn[1]	QHHNS n[1]	QHHNS effn[1]
ASIA	**1,030**	**470**	**24**	**18**
SOUTH-EAST	**335**	**163**	**6**	**5**
Phillipines	144	74	1	2
Vietnam	118	59	5	3 (Vietnam,
Laos	24	7		Laos,
Kampuchea	16	7		Kampuchea)
Malaysia	11	3		
Indonesia	10	3		
Singapore	8	6		
Burma	3	4		
Thailand	1	~0		
EAST	**318**	**147**	**3**[3]	**2**[3]
Hong Kong	151	66		
China	104	53		
Korea	23	6		
Taiwan	22	17		
Japan	15	3		
Macao	3	1		
SOUTH	**265**	**115**	**5**	**4**
India	201	85	5	4
Pakistan	32	16		
Sri Lanka	29	14		
Bangladesh	3	1		
MIDDLE-EAST	**99**	**40**	**10**	**7**
Lebanon	40	12	5	4
Iran	21	6	5	3
Israel	20	11		(Iran, Syria)
Syria	7	3		
Jordania	5	3		
Saudi Arabia	2	1		
United Arab Emirates	2	2		
Bahrein	1	2		
Irak	1	~2		
WESTERN	**13**	**3**		
Turkey	12	3		
Afghanistan	1	~0		

/continued

(continued) Table II Place of birth of the OHS and QHHNS study groups respondents

Place of birth	OHS n[1]	OHS effn[1]	QHHNS n[1]	QHHNS effn[1]
UNITED STATES	**566**	**118**	**6**	**4**
CARIBBEAN	**384**	**159**	**9**	**6**
Jamaica	192	75		
Trinidad	111	57		
Barbados	21	6		
Grenada	8	2		
Bermuda	6	1		
Antigua	6	2		
St-Vincent	4	2		
Nevis	4	3		
St-Kitts	4	2		
Bahamas	2	~0		
Dominican Republic	2	~0		
Dominica	2	~0		
Haiti	2	1	3	2
Ste-Lucia	2	2		
Aruba	1	~0		
Guadeloupe	1	~0		
West-Indies (general)	16	5	6[4]	5[4]
CENTRAL-SOUTH AMERICA	**355**	**155**	**5**	**5**
SOUTH	**245**	**121**	**2**	**2**
Guyana	132	62		
Argentina	22	8		
Equador	18	10		
Chile	18	8		
Brazil	13	6		
Perou	13	10		
Columbia	10	3		
Uruguay	8	4		
Venezuela	2	2		
South America (general)	9	9	2	2
CENTRAL	**110**	**34**	**3**	**2**
El Salvador	49	20	2	2
Mexico	43	~0	1	~0
Guatemala	8	4		
Nicaragua	5	2		
Hondural	2	~0		
Belize	2	1		
Central America (gen.)	1	~0		

/continued...

(continued) Table II. Place of birth of the OHS and QHHNS study groups respondents

Place of birth	OHS n[1]	OHS effn[1]	QHHNS n[1]	QHHNS effn[1]
AFRICA	**173**	**73**	**16**	**11**
EASTERN	**80**	**34**		
Tanzania	19	9		
Ethiopia	12	5		
Kenya	13	7		
Maurice	11	3		
Ouganda	11	5		
Somalia	3	1		
Zimbabwe	3	1		
Zambia	2	1		
Madagascar	1	1		
East Africa (general)	5	2		
SOUTHERN	**36**	**14**		
South Africa	36	14		
NORTHERN	**27**	**12**	**11**[5]	**9**[5]
Egypt	15	7		
Morocco	9	4		
Tunisia	2	~0		
Libya	1	~0		
WESTERN	**11**	**4**		
Ghana	6	3		
Nigeria	5	2		
CENTRAL	**9**	**4**		
Angola	6	2		
Zaire	3	3		
AFRICA (general)	**10**	**4**		
BLACK AFRICA			5[6]	2[6]

[1] n=crude sample size; effn=effective sample size.
[2] Croatia, Hungary, Norway, Romania, Greece, Germany
[3] Hong Kong, China
[4] Barbados, Trinidad
[5] Maroc, Tunisia, Algeria, Egypt
[6] Mauricius, Rwanda

Table 12 Acculturation characteristics of the OHS study group respondents born outside of Canada.

Variable	Result
ACCETHNI (effn[1]=2,612, n[1]=8,794)	
No acculturation for ethnicity	72.6%
Medium acculturation for ethnicity	19.8%
High acculturation for ethnicity	7.6%
ACCLANG (effn[1]=2,598; n[1]=8,749)	
No acculturation for language spoken at home	29.0%
Some acculturation for language spoken at home	25.8%
Not applicable	45.2%
TIME (effn[1]=2,578; n[1]=8,635)	
Time since migration (mean $\pm$ SD)	24 $\pm$ 20 years Range: 0 - 89 years

[1] effn= effective sample size; n= crude sample size.

Table 13 Description of the covariates that are not also outcomes of interest in the OHS

Variable	Place of birth		
	All (effn[1] , n[1])	Canada (effn[1] ; n[1])	Other (effn[1] , n[1])
GENDER	(9,171;43,292)	(6,535,34,444)	(2,636,8,848)
Male	49 0%	48.9%	49 2%
Female	51.0%	51 1%	50 8%
AGE (years)	(9,171,43,292)	(6,535,34,444)	(2,636,8,848)
Mean±SD	44 ± 18	42 ± 17	47 ± 20
Range	18 - 98	18 - 98	18 - 98
18-39	46.9%	51 5%	35.5%
40-64	37.4%	33.9%	46 3%
65+	15.7%	14 6%	18 2%
MARITAL STATUS	(9,130,43,170)	(6,507,34,348)	(2,624,8,826)
Married	69.1%	66 8%	74 8%
Single	20.0%	22 4%	14 2%
Separated/divorced/widow(er)	10.9%	10.8%	11.0%
STRATUM	(9,171,43,292)	(6,535;34,444)	(2,636,8,822)
Rural	12.8%	15 9%	5 0%
Urban	87 2%	84 1%	95 0%
ETHNICITY	(9,134;43,186)	(6,523;34,392)	(2,612,8,794)
Canadian	48.9%	65 4%	7 6%
Canadian+other ethnicity	13 5%	11.0%	19 8%
Other ethnicity(ies)	37 7%	23 7%	72 6%
EDUCATION	(9,148,43,221)	(6,529,34,420)	(2,620,8,801)
Primary/less than primary	5.8%	4 4%	9 2%
Some secondary	14.6%	15.4%	12 5%
Completed secondary	23 4%	24 4%	21 0%
Some post-secondary	18 6%	18 8%	18 0%
Completed post-secondary	37.7%	37.0%	39 3%
INCOME	(7,825,36,884)	(5,639,29,502)	(2,187,7,382)
Low income	13.4%	11 9%	17 2%
Not low income but < $50,000	40 0%	41 0%	37 6%
≥ $50,000	46 6%	47 1%	45 2%

/continued

(continued) Table 13. Description of the covariates that are not also outcomes of interest in the OHS.

Variable	Place of birth		
	All (effn[1] ; n[1])	Canada (effn[1] ; n[1])	Other (effn[1] ; n[1])
STRESS (life is...)	(8,993;42,458)	(6,431;33,862)	(2,563;8,596)
Not at all stressful	9.0%	7.9%	11.8%
Not very stressful	37.9%	38.3%	36.9%
Fairly stressful	44.4%	45.7%	41.4%
Very stressful	8.7%	8.2%	10.0%
SATISFACTION WITH SOCIAL LIFE	(8,581;40,757)	(6,174;32,578)	(2,408;8,179)
Very unsatisfied	3.2%	3.2%	3.3%
Somewhat unsatisfied	11.8%	12.1%	11.2%
Somewhat satisfied	48.4%	48.0%	49.4%
Very Satisfied	36.6%	36.8%	36.0%
CHEWING PROBLEMS	(8,848;41,933)	(6,338;33,451)	(2,510;8,482)
No chewing problem	91.9%	92.8%	89.8%
Some chewing problem	8.1%	7.3%	10.2%
THINK (think could improve health by changing eating habits)	(8,565;40,674)	(6,175;32,556)	(2,390;8,118)
Yes	61.6%	63.9%	55.8%
No/Don't know	38.4%	36.2%	44.2%
SMOKING	(8,300;39,146)	(5,996;31,417)	(2,304;7,729)
Never smoker	45.9%	36.3%	56.5%
Past smoker	21.1%	21.9%	18.8%
Current smoker	33.0%	41.8%	24.6%
ENERGY EXPENDITURE FROM EXERCISE (kcal/kg/day)	(7,405;34,846)	(5,412;28,144)	(1,994;6,702)
Mean±SD	1.3 ± 2.3	1.5 ± 2.3	1.0 ± 2.1
Range	0 - 20.0	0 - 20.0	0 - 20
Inactive	71.8%	68.9%	79.7%
Moderate	16.3%	17.6%	12.8%
Active	11.9%	13.5%	7.5%

[1] effn= effective sample size; n= crude sample size.

Table 14. Description of the covariates that are not also outcomes of interest in the QHHNS.

Variable	Place of birth		
	All (effn[1] ; n[1])	Canada (effn[1] ; n[1])	Other (effn[1] ; n[1])
GENDER	(1,164;2,316)	(1,075;2,184)	(89;132)
Male	49.9%	49.4%	55.5%
Female	50.1%	50.6%	45.5%
AGE (years)	(1,164;2,316)	(1,075;2,184)	(89,132)
Mean±SD	41±15	41±15	45±16
Range	18 - 74	18 - 74	18 - 74
18-39	51.2%	52.4%	36.5%
40-64	39.6%	38.4%	54.2%
65+	9.2%	9.2%	9.3%
MARITAL STATUS	(1,164,2,316)	(1,075,2,184)	(89;132)
Married	66.2%	65.2%	77.4%
Single	23.4%	24.2%	13.1%
Separated/divorced/widow(er)	10.5%	10.5%	9.5%
STRATUM	(1,164;2,316)	([illegible]75;2,184)	(89,132)
Rural	20.5%	21.8%	4.5%
Urban	79.5%	78.1%	95.5%
ETHNICITY	(1,161;2,309)	(1,072;2,177)	(89;132)
Canadian	90.0%	96.0%	17.6%
Canadian+other ethnicity	2.0%	1.0%	14.3%
Other ethnicity(ies)	8.0%	3.0%	68.1%
EDUCATION	(1,162;2,313)	(1,075,2,182)	(87,131)
Primary	14.0%	13.6%	18.6%
Some secondary	10.3%	19.3%	10.3%
Completed secondary	19.2%	22.9%	19.2%
Some college	8.2%	12.0%	8.2%
Complete college	17.8%	15.5%	17.8%
Some university	7.1%	4.4%	7.1%
Completed university	18.9%	12.4%	18.9%
INCOME	(1,033;2,055)	(955;1,941)	(77;114)
Low income	17.6%	17.3%	20.9%
Not low income but < $50,000	49.5%	49.9%	44.5%
≥ $50,000	33.0%	32.8%	34.6%

/continued

(continued) Table I4. Description of the covariates that are not also outcomes of interest in the QIHNS.

Variable	Place of birth		
	All (effn[1] ; n[1])	Canada (effn[1] ; n[1])	Other (effn[1] ; n[1])
SATISFACTION WITH SOCIAL LIFE	(1,161;2,311)	(1,072;2,179)	(89;132)
Very unsatisfied	2.0%	2.1%	0.8%
Somewhat unsatisfied	6.7%	6.2%	12.5%
Somewhat satisfied	50.6%	50.8%	48.0%
Very Satisfied	40.7%	40.9%	38.7%
SMOKING	(1,136;2,258)	(1,048;2,127)	(88;131)
Never smoker	31.6%	30.7%	42.1%
Past smoker	31.0%	31.1%	30.4%
Current smoker	37.4%	38.2%	27.5%
EXERCISE (frequency of participation in physical activities of 20-30 minutes during the past 4 months)	(1,159;2,309)	(1,072;2,177)	(88;132)
Not at all	22.9%	22.2%	31.6%
Less than once a month	3.6%	3.5%	4.5%
About once a month	4.9%	5.0%	4.4%
About 2 or 3 times a month	8.9%	8.5%	13.2%
About 1 or 2 times a week	24.9%	25.2%	21.5%
3 or more times a week	34.9%	35.7%	24.8%
FAMILY HISTORY OF CARDIOVASCULAR DISEASE	(1,151;2,288)	(1,063;2,158)	(88;130)
No	62.7%	61.2%	81.6%
Yes	37.3%	38.8%	18.4%

[1] effn= effective sample size; n= crude sample size.

APPENDIX J

Nutritional outcomes: bivariate results for the OHS

Table J1. Unadjusted mean number of Canada Food Guide recommendations met (CFG) by the OHS respondents, and proportion of respondents *not* meeting all four recommendations of the Guide (CFGALL), and proportions *not* meeting the recommendations for "Cereals and Breads" (BREADS), "Fruits and Vegetables" (VEG-FRUITS), "Milk Products" (MILK), and "Meats and Alternates" (MEATS), by place of birth.

Place of birth	effn[1] (n[1])	CFG # groups[2]	CFGALL %	BREADS %	VEG-FRUITS %	MILK %	MEATS %
ALL	7,726 (36,616)	2.5±1.2	79.2	41.6	63.7	68.8	71.2
IMM							
Canada	5,640 (29,458)	2.5±1.1	79.6	39.2	62.8	71.6	71.8
Others	2,086 (7,158)	2.5±1.4	78.2	48.0	66.4	61.3	69.7
REGION							
Canada	5,640 (29,458)	2.5±1.1	79.6	39.2	62.8	71.6	71.8
USA	103 (483)	2.5±1.2	74.6	41.6	63.1	74.7	73.1
Europe	1,331 (5,181)	2.5±1.3	76.9	48.2	67.7	64.5	69.7
Asia	373 (820)	2.3±1.8	83.4	51.8	60.3	46.5	68.0
Caribbean	107 (270)	2.3±1.7	84.4	41.5	67.6	58.2	62.0
Africa	62 (142)	2.6±1.6	76.5	46.9	73.7	62.8	72.8
CS America	111 (262)	2.5±1.7	73.9	46.2	68.5	61.8	78.3
SUB-REGION							
Canada	5,640 (29,458)	2.5±1.1	79.6	39.2	62.8	71.6	71.8
USA	103 (483)	2.5±1.2	74.6	41.6	63.1	74.7	73.1
West Europe	241 (1,184)	2.6±1.1	72.9	48.2	72.2	69.9	73.7
North Europe	442 (1,907)	2.6±1.2	78.4	42.9	67.2	76.6	69.1
Scandinavia	25 (102)	2.5±1.2	76.7	47.5	70.2	70.1	63.2
South Europe	433 (1,278)	2.3±1.6	80.4	49.3	63.7	46.0	66.9
East Europe	190 (709)	2.7±1.3	70.7	58.0	72.0	70.9	73.1
East Asia	127 (273)	2.3±1.7	86.7	58.4	59.6	30.0	79.0
SE Asia	123 (247)	2.3±2.0	79.7	55.9	55.0	48.1	71.9
South Asia	89 (211)	2.2±1.7	84.4	39.1	67.5	63.9	47.8
Middle East	31 (77)	2.3±1.7	82.6	45.3	60.9	54.2	65.1
Caribbean	107 (270)	2.3±1.7	84.4	41.5	67.6	58.2	62.0
East Africa	28 (65)	2.4±1.8	76.8	39.1	72.2	60.3	72.4
Other Africa	30 (70)	2.6±1.5	79.3	49.4	76.9	62.2	75.6
Central America	26 (81)	2.8±1.2	75.7	45.3	83.2	58.9	90.8
South America	85 (181)	2.5±1.8	73.3	46.5	64.1	62.6	74.5

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(continued) Table J1. Unadjusted mean number of Canada Food Guide recommendations met (CFG) by OHS respondents and proportion of respondents *not* meeting all four recommendations of the Guide (CFGALL), and proportions *not* meeting the recommendations for "Cereals and Breads" (BREADS), "Fruits and Vegetables" (VEG-FRUITS), "Milk Products" (MILK), and "Meats and Alternates" (MEATS), by place of birth.

Place of birth	effn[1] (n[1])	CFG # groups[2]	CFGALL %	BREADS %	VEG-FRUITS %	MILK %	MEATS %
COUNTRY							
Canada	5,640 (29,458)	2.5±1.1	79.6	39.2	62.8	71.6	71.8
USA	103 (483)	2 5±1.2	74.6	41.6	63.1	74.7	73.1
Germany	100 (437)	2.5±1.2	76.5	44.8	70.0	65.4	72.1
Netherlands	86 (558)	2.7±0.9	74.5	47.0	70.2	74.3	77.4
UK	434 (1,881)	2.6±1.2	78.5	42.6	67.1	766	69.0
Italy	240 (705)	2.2±1.6	82.5	51.4	63.9	40.8	65 7
Portugal	92 (233)	2.2±1.8	79.4	41.7	57.9	51.0	67.4
Yugoslavia	52 (190)	2.7±1.4	68.7	58.0	74.4	55.5	77 1
Greece	39 (109)	2.1±1.7	84.2	43.7	63.1	48.6	56 6
Poland	81 (297)	2.9±1.1	67.7	59.3	72.6	77.4	82.3
Hungary	33 (125)	2.8±1.2	69.2	66.2	76.5	65.9	75.7
Other Europe	173 (646)	2.6±1.4	72.1	53.2	72.1	68.7	66.5
Hong Kong	59 (132)	2.3±1.6	85.1	57.8	61.1	30.6	85.3
China	43 (88)	2.2±1.8	90.2	55.2	52.3	25.6	81.8
Philippines	56 (104)	2.5±2.0	77.7	62.4	62.7	49.0	73.7
Vietnam	45 (85)	2.3±2.1	80 1	56.8	47.1	50.5	71.6
India	69 (163)	2.1±1.8	82.6	36.3	71.2	62.8	44.3
Other Asia	101 (248)	2.2±1.7	84.7	49.4	59.0	50.6	63.3
Jamaica	52 (133)	2.2±1.6	85.6	43.8	61.2	57.3	62.3
Trinidad	34 (79)	2.4±1 7	85.0	35.7	74 3	61.1	66 7
Other Caribbean	21 (58)	2.3±1.9	80.6	45.4	72.3	55.4	54.0
Africa	62 (142)	2.6±1.6	76.5	46.9	73.7	62 8	72.8
Guyana	42 (88)	2.3±2.0	76.6	36 4	61.6	63 8	66 2
Other CS American	69 (174)	2 7±1.5	72.2	52.2	72.7	60.5	85.6

[1] effn= effective sample size, n= crude sample size.
[2] mean±standard deviation.

Table J2. Unadjusted mean fat and cholesterol intakes of the OHS respondents, and proportion of respondents with a high fat intake (>30% of dietary energy) or a high cholesterol intake (>300 mg/day), by place of birth.

Place of birth	effn[1] (n[1])	Fat[2] % energy	High fat %	Cholesterol[2] mg/d	High cholesterol %
ALL	7,726 (36,616)	37.1±6.6	86.9	345±212	50.4
IMM					
Canada	5,640 (29,458)	38.0±6.0	90.4	349±204	51.2
Others	2,086 (7,158)	34.7±8.0	77.5	335±244	48.4
REGION					
Canada	5,640 (29,458)	38.0±6.0	90.4	349±204	51.2
USA	103 (483)	36.4±6.7	84.2	334±218	44.3
Europe	1,331 (5,181)	35.7±7.1	82.9	340±225	50.5
Asia	373 (820)	31.8±10.4	61.5	317±308	43.7
Caribbean	107 (270)	33.0±9.0	69.4	316±300	39.8
Africa	62 (142)	33.1±10.7	67.5	312±223	50.7
CS America	111 (262)	33.1±9.7	73.8	362±350	49.6
SUB-REGION					
Canada	5,640 (29,458)	38.0±6.0	90.4	349±204	51.2
USA	103 (483)	36.4±6.7	84.2	334±218	44.3
West Europe	241 (1,184)	37.6±6.0	90.0	340±200	51.2
North Europe	442 (1,907)	36.4±6.1	88.1	335±198	48.5
Scandinavia	25 (102)	36.3±7.0	87.5	305±180	44.2
South Europe	433 (1,278)	33.7±8.2	73.3	341±268	50.4
East Europe	190 (709)	36.1±7.6	82.7	356±246	55.4
East Asia	127 (273)	31.8±10.8	61.4	319±261	45.6
SE Asia	123 (247)	30.7±10.8	54.4	342±388	46.8
South Asia	89 (211)	32.9±8.9	69.5	286±280	37.1
Middle East	31 (77)	32.3±11.0	64.1	295±241	43.2
Caribbean	107 (270)	33.0±9.0	69.4	316±300	39.8
East Africa	28 (65)	31.1±10.6	64.5	296±208	44.9
Other Africa	30 (70)	34.9±10.4	72.3	315±198	56.3
Central America	26 (81)	31.4±8.9	69.1	491±415	70.4
South America	85 (181)	33.6±10.0	75.2	323±294	43.3

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(continued) Table J2 Unadjusted mean fat and cholesterol intakes of the OHS respondents, and proportion of respondents with a high fat intake (>30% of dietary energy) or a high cholesterol intake (>300 mg/day), by place of birth.

Place of birth	effn[1] (n[1])	Fat[2] % energy	High fat %	Cholesterol[2] mg/d	High cholesterol %
COUNTRY					
Canada	5,640 (29,458)	38.0±6.0	90.4	349±204	51.2
USA	103 (483)	36.4±6.7	84.2	334±218	44.3
Germany	100 (437)	37.3±6.4	88.9	313±181	45.7
Netherlands	86 (558)	38.6±5.5	91.3	365±193	53.0
UK	434 (1,881)	36.4±6.2	88.0	334±198	48.1
Italy	240 (705)	33.0±8.2	68.0	343±246	53.7
Portugal	92 (233)	34.5±8.5	80.3	307±252	41.1
Yugoslavia	52 (190)	35.1±7.5	77.9	418±376	37.6
Greece	39 (109)	34.2±8.1	82.5	306±214	40.[illegible]
Poland	81 (297)	37.0±7.3	87.5	396±260	63.5
Hungary	33 (125)	35.5±7.3	78.9	346±240	56.7
Other Europe	173 (646)	35.9±7.0	84.6	331±223	51.6
Hong Kong	59 (132)	31.3±9.7	62.1	343±293	49.0
China	43 (88)	33.2±11.2	73.9	285±226	32.7
Philippines	56 (104)	30.1±11.4	55.2	343±387	45.2
Vietnam	45 (85)	30.9±10.9	53.8	336±408	44.7
India	69 (163)	32.8±9.3	68.6	287±300	36.3
Other Asia	101 (248)	32.1±10.1	57.8	312±260	49.0
Jamaica	52 (133)	33.4±8.5	70.2	333±290	43.0
Trinidad	34 (79)	32.8±9.4	71.0	312±320	38.3
Other Caribbean	21 (58)	32.5±9.7	64.7	281±292	34.2
Africa	62 (142)	33.1±10.7	67.5	312±223	50.7
Guyana	42 (88)	32.0±10.9	67.3	288±257	33.4
Other CS America	69 (174)	33.7±9.0	77.8	407±376	59.4

[1] effn= effective sample size, n= crude sample size.
[2] mean±standard deviation

Table J3 Unadjusted mean calcium and fibre intakes of the OHS respondents and proportions of respondents with an "inadequate" calcium intake (assessed using Canadian Recommended Nutritional Intakes (RNI) or World Health Organization (WHO) nutritional recommendations) or a low fibre intake (<3.0 g/kJ), by place of birth.

Place of birth	effn1[1] (n1[1])	Fibre[2] g/MJ	Low fibre %	Dietary calcium[2] mg/day	"Inadequate" calcium intake-RNI %	"Inadequate" calcium intake-WHO %
ALL	7,726 (36,616)	2.1±1.0	86.3	1,059±510	15.7	2.2
IMM						
Canada	5,640 (29,458)	2.1±1.0	86.8	1,088±489	14.0	1.5
Others	2,086 (7158)	2.2±1.2	85.0	980±579	20.5	4.1
REGION						
Canada	5,640 (29,458)	2.1±1.0	86.8	1,088±489	14.0	1.5
USA	103 (483)	2.2±1.0	83.7	1,069±490	13.9	1.4
Europe	1,331 (5,181)	2.2±1.1	84.6	1,032±545	16.3	2.3
Asia	373 (820)	2.1±1.7	88.3	799±681	34.7	11.3
Caribbean	107 (270)	2.4±1.4	79.8	892±601	26.1	6.6
Africa	62 (142)	2.4±1.7	79.3	1,011±658	21.6	2.3
CS America	111 (262)	2.1±2.0	86.9	953±663	23.2	2.5
SUB-REGION						
Canada	5,640 (29,458)	2.1±1.0	86.8	1,088±489	14.0	1.5
USA	103 (483)	2.2±1.0	83.7	1,069±490	13.9	1.4
West Europe	241 (1,184)	2.2±0.9	86.3	1,027±460	14.6	2.4
North Europe	442 (1,907)	2.3±1.1	82.7	1,126±526	11.1	1.2
Scandinavia	25 (102)	2.4±1.3	80.9	1,008±496	15.9	4.6
South Europe	433 (1,278)	2.2±1.2	85.1	936±627	22.9	3.2
East Europe	190 (709)	2.3±1.1	86.6	1,040±526	16.1	2.1
East Asia	127 (273)	2.2±1.7	87.6	683±629	46.9	16.4
SE Asia	123 (247)	1.8±1.5	82.4	772±684	36.7	14.3
South Asia	89 (211)	2.2±1.7	84.7	952±685	20.3	2.5
Middle East	31 (77)	2.2±1.7	84.6	905±644	20.2	4.3
Caribbean	107 (270)	2.4±1.4	79.8	892±601	26.1	6.6
East Africa	28 (65)	2.1±1.5	84.7	983±697	29.2	2.5
Other Africa	30 (70)	2.5±1.8	81.6	1,003±582	15.8	2.5
Central America	26 (81)	2.4±1.7	82.4	997±550	13.9	2.2
South America	85 (181)	2.0±2.0	88.3	940±708	26.0	2.6

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(continued) Table J3. Unadjusted mean calcium and fibre intakes of the OHS respondents and proportions of respondents with an "inadequate" calcium intake (assessed using Canadian Recommended Nutritional Intakes (RNI) or World Health Organization (WHO) nutritional recommendations) or a low fibre intake (<3.0 g/kJ), by place of birth.

Place of birth	effn1[1] (n1[1])	Fibre[2] g/MJ	Low fibre %	Dietary calcium[2] mg/day	"Inadequate" calcium intake-RNI %	"Inadequate" calcium intake-WHO %
COUNTRY						
Canada	5,640 (29,458)	2.1±1.0	86.8	1,088±489	14.0	1.5
USA	103 (483)	2.2±1.0	83.7	1,069±490	13.9	1.4
Germany	100 (437)	2.3±0.9	84.2	963±454	17.8	3.5
Netherlands	86 (558)	2.1±0.7	86.6	1,092±390	11.7	1.0
UK	434 (1,881)	2.3±1.1	82.5	1,125±527	11.2	1.2
Italy	240 (705)	2.2±1.2	86.4	932±584	21.3	1.3
Portugal	92 (233)	2.1±1.1	89.6	906±691	28.7	6.5
Yugoslavia	52 (190)	2.3±1.1	77.8	1,079±746	18.7	3.3
Greece	39 (109)	2.3±1.4	75.7	840±542	28.1	8.2
Poland	81 (297)	2.2±1.2	89.1	1,122±529	10.6	0.3
Hungary	33 (125)	2.4±1.0	81.8	974±524	19.5	4.2
Other Europe	173 (646)	2.3±1.1	86.8	1,011±538	16.3	3.0
Hong Kong	59 (132)	1.9±1.3	92.3	716±653	44.0	12.2
China	43 (88)	2.1±1.2	90.7	602±635	61.9	25.5
Philippines	56 (104)	1.8±1.3	91.6	823±730	27.7	9.2
Vietnam	45 (85)	1.7±1.3	94.5	744±703	43.2	19.0
India	69 (163)	2.2±1.8	85.6	977±743	21.6	3.2
Other Asia	101 (248)	2.3±2.0	82.1	820±572	26.4	7.8
Jamaica	52 (133)	2.3±1.4	81.0	878±603	27.1	6.5
Trinidad	34 (79)	2.3±1.3	82.5	901±550	19.4	3.1
Other Caribbean	21 (58)	2.6±1.7	72.4	911±667	34.2	12.4
Africa	62 (142)	2.4±1.7	79.3	1,011±658	21.6	2.3
Guyana	42 (88)	2.1±2.2	89.1	902±691	35.8	5.0
Other CS America	69 (174)	2.0±1.8	85.6	935±647	15.6	1.0

[1] effn1= effective sample size for dietary calcium; n1= crude sample size for dietary calcium; eff2= effective sample size for total calcium; n2=crude sample size for total calcium.
[2] mean±standard deviation.

Table J4. Unadjusted mean energy, carbohydrate, and protein intakes of the OHS respondents, number of alcoholic drinks consumed during the past week, and proportion of respondents with a low carbohydrate intake (<50% of energy), an "inadequate" protein intake, or a high consumption of alcoholic drinks (>14 drinks during past week), by place of birth

Place of birth	effn1[1] (n1[1])	Energy[2] kJ/day	Carbohydrate[2] % energy	Low carbohydrate %	Protein[2] % energy	"Inadequate" protein intake %	effn2[2] (n2[2])	Number of alcoholic drinks[2]	High # drinks %
ALL	7,726 (36,616)	9,246±3,985	49.2± 8.0	57.4	16.3±3.3	7.0	8,242 (38,946)	6±9	10.5
IMM									
Canada	5,640 (29,458)	9,335±3,837	48.2±7.3	62.7	16.4±3.1	6.2	5,950 (31,243)	6±9	11.9
Others	2,086 (7,158)	9,006±4,529	51.8±9.8	43.3	16.1±4.0	9.4	2,292 (7,703)	4±9	7.0
REGION									
Canada	5,640 (29,458)	9,335±3,837	48.2±7.3	62.7	15.4±3.1	6.2	5,950 (31,243)	6±9	11.9
USA	103 (483)	9,028±3,979	49.6±7.3	53.0	16.7±2.9	8.6	110 (522)	5±8	7.9
Europe	1,331 (5,181)	9,225±4,235	50.8±8.6	47.2	16.2±3.8	6.9	1,443 (5,514)	5±9	9.0
Asia	373 (820)	8,258±5,538	54.5±13.1	31.6	15.8±5.1	17.2	417 (914)	1±6	1.6
Caribbean	107 (270)	8,346±4,855	54.0±12.1	32.7	15.9±4.9	14.0	132 (313)	4±19	5.4
Africa	62 (142)	9,286±5,078	54.0±13.0	40.2	16.0±4.7	12.4	65 (153)	2±7	2.6
CS America	111 (262)	9,352±6,041	53.3±13.2	38.2	15.9±4.8	7.6	124 (287)	3±9	4.9
SUB-REGION									
Canada	5,640 (29,458)	9,335±3,837	48.2±7.3	62.7	16.4±3.1	6.2	5,950 (31,243)	6±9	11.9
USA	103 (483)	9,028±3,979	49.6±7.3	53.0	16.7±2.9	8.6	110 (522)	5±8	7.9
West Europe	241 (1,184)	9,419±3,714	49.9±7.4	51.7	15.5±3.2	6.8	253 (1,217)	4±7	7.5
North Europe	442 (1,907)	9,087±3,610	49.9±7.5	52.1	16.4±3.4	4.6	476 (2,004)	6±9	11.4
Scandinavia	25 (102)	8,346±2,910	50.7±8.5	52.8	16.0±3.2	11.8	27 (111)	5±8	9.2
South Europe	433 (1,278)	9,001±5,119	51.9±10.3	40.4	16.7±4.5	9.1	477 (1,412)	5±11	9.2
East Europe	190 (709)	9,924±4,856	51.1±9.4	44.8	15.7±4.3	6.5	209 (769)	3±6	4.6
East Asia	127 (273)	8,142±5,703	53.5±13.7	37.8	16.5±5.2	12.0	140 (291)	1±4	0.2
SE Asia	123 (247)	8,412±6,010	54.9±13.3	28.1	15.9±5.6	17.5	141 (288)	1±5	1.0
South Asia	89 (211)	8,256±5,110	55.2±12.0	27.6	14.8±4.1	25.8	99 (235)	2±9	3.8
Middle East	31 (77)	8,115±4,838	55.1±13.2	29.1	15.5±4.0	12.9	35 (89)	2±5	3.0
Caribbean	107 (270)	8,346±4,855	54.0±12.1	32.7	15.9±4.9	14.0	132 (313)	4±19	5.4
East Africa	28 (65)	9,051±5,246	55.7±13.4	35.5	15.8±4.7	18.0	31 (68)	2±8	2.6
Other Africa	30 (70)	9,341±4,468	52.3±12.4	43.5	16.1±4.7	7.3	32 (77)	2±7	2.5
Central America	26 (81)	10,792±6,104	55.3±12.2	26.8	15.8±4.3	3.2	28 (90)	4±8	5.9
South America	85 (181)	8,920±5,869	52.7±13.5	41.6	15.9±5.0	9.0	96 (197)	3±9	4.5

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(continued) Table J4. Unadjusted mean energy, carbohydrate, and protein intakes of the OHS respondents, number of alcoholic drinks consumed during the past week, and proportion of respondents with a low carbohydrate intake (<50% of dietary energy), an "inadequate" protein intake, or a high consumption of alcoholic drinks (>14 drinks during past week), by place of birth.

Place of birth	effn1[1] (n1[1])	Energy[2] kJ/day	Carbohydrate[2] % energy	Low carbohydrate %	Protein[2] % energy	"Inadequate" protein intake %	effn2[2] (n2[2])	Number of alcoholic drinks[2]	High # drinks %
COUNTRY									
Canada	5,640 (29,458)	9,335±3,837	48.2±7.3	62.7	16.4±3.1	6.2	5,950 (31,243)	6±9	11.9
USA	103 (483)	9,028±3,979	49.6±7.3	53.0	16.7±2.9	8.6	110 (522)	5±8	7.9
Germany	100 (437)	8,925±3,677	50.2±8.1	52.2	15.5±3.8	8.1	105 (446)	5±9	8.3
Netherlands	86 (558)	9,798±3,369	48.6±6,3	57.3	15.7±2.5	5.3	92 (572)	4±5	4.6
UK	434 (1,881)	9,079±3,611	49.9±7.5	52.3	16.4±3.4	4.6	468 (1,976)	6±9	11.3
Italy	240 (705)	8,968±4,950	52.2±10.2	38.5	17.0±4.2	7.1	256 (758)	5±10	8.3
Portugal	92 (233)	9,037±6,014	52.0±10.3	38.3	15.9±4.9	12.9	108 (278)	6±15	13.1
Yugoslavia	52 (190)	9,871±4,901	51.3±10.1	46.6	16.4±5.0	9.0	59 (212)	5±10	11.9
Greece	39 (109)	8,090±4,664	51.4±11.5	44.7	17.0±4.3	13.0	43 (121)	2±7	3.3
Poland	81 (297)	10,963±5,286	50.5±9.1	47.8	15.5±3.9	5.0	92 (325)	2±4	1.4
Hungary	33 (125)	9,393±4,478	50.6±10.6	48.3	16.8±5.5	2.6	35 (134)	5±8	13.8
Other Europe	173 (646)	9,161±4,129	51.6±8.5	43.8	15.6±3.7	8.6	184 (692)	4±8	7.3
Hong Kong	59 (132)	8,783±6,204	53.6±11.5	31.7	16.4±4.8	11.4	62 (136)	1±4	0.0
China	43 (88)	7,656±5,683	51.8±14.2	51.0	16.9±6.0	15.8	52 (99)	1±6	0.5
Philippines	56 (104)	9,401±5,957	56.5±14.3	18.4	14.9±5.0	14.0	65 (130)	1±3	0.0
Vietnam	4[illegible] (85)	7,661±6,327	54.1±12.8	31.5	16.3±5.6	23.4	48 (91)	0±2	0.3
India	69 (163)	8,196±5,371	55.4±12.2	25.3	14.6±4.1	30.6	76 (179)	1±6	2.4
Other Asia	101 (248)	7[illegible]87±4,456	54.5±13.2	34.8	16.1±4.9	11.1	114 (279)	2±9	4.0
Jamaica	52 (133)	8,[illegible]±4,488	53.4±12.3	35.0	15.9±5.3	11.1	65 (162)	2±8	2.9
Trinidad	34 (79)	8,402±5,378	53.9±11.1	26.5	15.9±4.7	15.8	47 (95)	6±32	7.5
Other Caribbean	21 (58)	8,502±4,993	55.3±12.8	37.2	15.8±4.4	18.2	20 (56)	3±7	8.3
Africa	62 (142)	9,286±5,078	54.0±13.0	40.2	16.0±4.7	12.4	65 (153)	2±7	2.6
Guyana	42 (88)	8,130±5,282	55.0±15.6	31.6	15.5±5.3	15.5	50 (106)	3±10	5.4
Other CS Amer.	69 (174)	10,092±6,176	52.2±11.6	42.2	16.2±4.5	2.8	74 (181)	3±8	4.5

[1] effn1= effective sample size for energy, carbohydrate, and protein; n1= crude sample size for energy, carbohydrate, and protein; eff2= effective sample size for the number of drinks; n2=crude sample size for the number of drinks2.

[2] mean±standard deviation.

Table J5. Unadjusted mean iron and vitamin C intake of the OHS respondents, and proportion of respondents with an "inadequate" intake of iron or vitamin C, by place of birth.

Place of birth	effn[1] (n[1])	Iron[2] mg/d	"Inadequate" iron intake %	Vitamin C[2] mg/day	"Inadequate" vitamin C intake %
ALL	7,726 (36,616)	13±6	10.2	141±36	3.6
IMM					
Canada	5,640 (29,458)	13±6	9.9	138±97	3.5
Others	2,086 (7,158)	13±8	11.0	149±134	3.7
REGION					
Canada	5,640 (29,458)	13±6	9.9	138±97	3.5
USA	103 (483)	14±6	9.4	134±97	3.3
Europe	1,331 (5,181)	14±7	7.1	146±122	3.4
Asia	373 (820)	11±9	24.3	143±16[illegible]	5.7
Caribbean	107 (270)	13±10	10.6	173±176	2.6
Africa	62 (142)	14±11	6.7	162±161	3.2
CS America	111 (262)	13±10	7.5	195±213	1.5
SUB-REGION					
Canada	5,640 (29,458)	13±6	9.9	[illegible]8±97	3.5
USA	103 (483)	14±6	9.4	134±97	3.3
West Europe	241 (1,184)	13±6	8.6	139±94	2.6
North Europe	442 (1,907)	13±6	5.8	134±108	3.0
Scandinavia	25 (102)	12±5	11.8	142±110	5.3
South Europe	433 (1,278)	14±9	8.8	161±158	3.9
East Europe	190 (709)	14±8	4.1	146±117	4.1
East Asia	127 (273)	11±9	23.4	134±141	6.4
SE Asia	123 (247)	11±10	28.1	144±185	6.8
South Asia	89 (211)	11±9	22.9	153±164	3.7
Middle East	31 (77)	11±7	17.3	147±177	3.2
Caribbean	107 (270)	13±10	19.6	173±176	2.6
East Africa	28 (65)	14±10	9.2	148±16[illegible]	6.4
Other Africa	30 (70)	15±8	3.9	177±158	0.6
Central America	26 (81)	17±12	4.9	235±231	2.5
South America	85 (181)	12±9	8.3	183±201	1.2

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(continued) Table J5. Unadjusted mean iron and vitamin C intake of the OHS respondents, and proportion of respondents with an "inadequate" intake of iron or vitamin C, by place of birth.

Place of birth	effn[1] (n[1])	Iron[2] mg/d	"Inadequate" iron intake %	Vitamin C[2] mg/day	"Inadequate" vitamin C intake %
COUNTRY					
Canada	5,640 (29,458)	13±6	9.9	138±97	3.5
USA	103 (483)	14±6	9.4	134±97	3.3
Germany	100 (437)	13±6	8.4	140±110	3.1
Netherlands	86 (558)	13±5	5.6	131±76	3.6
UK	434 (1,881)	13±6	5.9	134±109	3.0
Italy	240 (705)	15±9	4.9	163±168	2.4
Portugal	92 (233)	13±8	15.3	160±166	9.4
Yugoslavia	52 (190)	15±9	9.4	154±105	3.0
Greece	39 (109)	13±7	17.3	167±160	2.1
Poland	81 (297)	15±8	2.8	153±118	2.3
Hungary	33 (125)	14±7	4.5	139±124	4.4
Other Europe	173 (646)	13±7	8.7	144±109	3.6
Hong Kong	59 (132)	11±9	22.9	148±145	4.3
China	43 (88)	10±8	24.9	117±144	10.8
Philippines	56 (104)	12±11	19.3	161±206	6.0
Vietnam	45 (85)	10±10	35.0	134±192	5.9
India	69 (163)	11±10	25.9	158±169	3.0
Other Asia	101 (248)	11±8	21.7	136±144	5.8
Jamaica	52 (133)	12±9	17.3	180±181	1.1
Trinidad	34 (79)	12±10	23.9	164±162	4.0
Other Caribbean	21 (58)	14±12	18.3	170±183	3.9
Africa	62 (142)	14±11	6.7	162±161	3.2
Guyana	42 (88)	11±9	14.0	164±199	1.2
Other CS America	69 (174)	15±10	3.6	214±216	1.7

[1] effn=effective sample size; n= crude sample size.
[2] mean±standard deviation

Table J6. Unadjusted mean thiamin, riboflavin, and niacin intakes of the OHS respondents, and proportion of respondents with an "inadequate" intake of thiamin, riboflavin, or niacin, by place of birth.

Place of birth	effn[1] (n[1])	Thiamin[2] mg/5MJ	"Inadequate" thiamin intake %	Riboflavin[2] mg/5MJ	"Inadequate" riboflavin intake %	Niacin[2] mg/5MJ	"Inadequate" niacin intake %
ALL	7,726 (36,616)	0.82±0.28	4.8	1.2±0.4	2.4	20.1±4.5	1.0
IMM							
Canada	5,640 (29,458)	0.82±0.27	4.3	1.2±0.4	2.1	20.2±4.2	0.7
Others	2,086 (7,158)	0.82±0.33	6.1	1.2±0.5	3.3	20.0±5.5	1.7
REGION							
Canada	5,640 (29,458)	0.82±0.27	4.3	1.2±0.4	2.1	20.2±4.2	0.7
USA	103 (483)	0.83±0.30	5.6	1.3±0.4	0.6	20.6±4.3	1.0
Europe	1,331 (5,181)	0.83±0.29	4.5	1.3±0.4	2.0	20.0±4.9	1.0
Asia	373 (820)	0.79±0.47	11.1	1.1±0.5	8.7	19.6±7.5	4.1
Caribbean	107 (270)	0.82±0.37	10.3	1.3±0.7	5.0	20.3±7.3	1.4
Africa	62 (142)	0.81±0.48	5.2	1.2±0.5	3.1	19.9±7.2	2.0
CS America	111 (262)	0.82±0.54	5.6	1.1±0.7	2.3	19.7±7.0	2.3
SUB-REGION							
Canada	5,640 (29,458)	0.82±0.27	4.3	1.2±0.4	2.1	20.2±4.2	0.7
USA	103 (483)	0.83±0.30	5.6	1.3±0.4	0.6	20.6±4.3	1.0
West Europe	241 (1,184)	0.78±0.23	5.3	1.3±0.3	3.2	18.9±4.1	1.8
North Europe	442 (1,907)	0.85±0.30	2.6	1.3±0.4	0.7	20.2±4.5	0.8
Scandinavia	25 (102)	0.85±0.48	8.5	1.2±0.3	1.9	20.0±5.1	1.1
South Europe	433 (1,278)	0.84±0.30	5.8	1.2±0.6	3.0	20.7±5.7	0.6
East Europe	190 (709)	0.80±0.30	4.3	1.3±0.4	0.8	19.4±5.5	1.2
East Asia	127 (273)	0.82±0.48	10.6	1.1±0.4	8.1	21.0±7.3	1.9
SE Asia	123 (247)	0.79±0.51	11.7	1.1±0.6	13.3	19.7±8.3	3.5
South Asia	89 (211)	0.79±0.43	9.6	1.3±0.5	3.5	17.6±6.5	8.0
Middle East	31 (77)	0.73±0.37	14.4	1.2±0.6	8.8	18.8±5.5	4.5
Caribbean	107 (270)	0.82±0.37	10.3	1.3±0.7	5.0	20.3±7.3	1.4
East Africa	28 (65)	0.73±0.36	6.5	1.2±0.4	3.3	18.9±6.5	4.4
Other Africa	30 (70)	0.85±0.54	4.6	1.2±0.4	2.1	20.5±7.0	0.0
Central America	26 (81)	0.83±0.46	2.3	1.2±0.9	1.1	19.8±6.9	1.2
South America	85 (181)	0.81±0.57	6.5	1.1±0.5	2.7	19.7±7.1	2.7

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(continued) Table J6. Unadjusted mean thiamin, riboflavin, and niacin intakes of the OHS respondents, and proportion of respondents with an "inadequate" intake of thiamin, riboflavin, or niacin.

Place of birth	effn[1] (n[1])	Thiamin[2] mg/5MJ	"Inadequate" thiamin intake %	Riboflavin[2] mg/5MJ	"Inadequate" riboflavin intake %	Niacin[2] mg/5MJ	"Inadequate" niacin intake %
COUNTRY							
Canada	5,640 (29,458)	0.82±0.27	4.3	1.2±0.4	2.1	20.2±4.2	0.7
USA	103 (483)	0.83±0.30	5.6	1.3±0.4	0.6	20.6±4.3	1.0
Germany	100 (437)	0.77±0.25	6.2	1.2±0.4	3.8	18.9±4.8	2.4
Netherlands	86 (558)	0.77±0.18	5.0	1.3±0.3	2.1	19.1±3.1	0.7
UK	434 (1,881)	0.85±0.30	2.6	1.3±0.4	0.7	20.2±4.5	0.8
Italy	240 (705)	0.84±0.30	5.0	1.2±0.6	2.2	21.1±5.7	0.2
Portugal	92 (233)	0.82±0.31	6.7	1.2±0.6	4.9	20.0±6.0	1.5
Yugoslavia	52 (190)	0.86±0.30	4.1	1.4±0.7	1.7	20.1±5.2	1.2
Greece	39 (109)	0.84±0.30	11.8	1.2±0.5	5.7	21.4±5.9	0.0
Poland	81 (297)	0.80±0.34	3.8	1.3±0.5	0.2	19.1±5.6	1.7
Hungary	33 (125)	0.81±0.28	5.2	1.3±0.4	0.2	20.8±6.6	0.0
Other Europe	173 (646)	0.81±0.29	4.6	1.3±0.4	2.3	19.1±4.8	1.5
Hong Kong	59 (132)	0.80±0.38	7.4	1.0±0.4	6.9	20.4±6.6	2.1
China	43 (88)	0.76±0.34	14.4	1.1±0.5	9.6	21.7±7.8	2.9
Philippines	56 (104)	0.71±0.44	11.1	1.1±0.6	8.7	18.4±7.3	3.4
Vietnam	45 (85)	0.85±0.42	11.4	1.1±0.5	18.3	20.0±7.5	5.4
India	69 (163)	0.81±0.46	11.6	1.2±0.5	4.5	17.4±6.6	8.7
Other Asia	101 (248)	0.81±0.56	11.3	1.2±0.6	8.0	20.1±7.6	2.5
Jamaica	52 (133)	0.83±0.37	5.9	1.3±0.6	3.3	20.3±7.5	0.0
Trinidad	34 (79)	0.78±0.37	15.3	1.2±0.4	5.2	19.9±7.0	3.1
Other Caribbean	21 (58)	0.85±0.37	13.2	1.3±1.0	8.6	20.9±7.2	2.3
Africa	62 (142)	0.81±0.48	5.2	1.2±0.5	3.1	19.9±7.2	2.0
Guyana	42 (88)	0.81±0.63	11.7	1.1±0.6	4.6	19.6±7.6	5.4
Other CS America	69 (174)	0.82±0.49	1.8	1.1±0.7	1.0	19.8±6.7	0.4

[1] effn= effective sample size; n= crude sample size.
[2] mean±standard deviation

Table J7. Unadjusted mean BMI of the OHS respondents, and proportion of respondents with overweight (BMI>25kg/m²), obesity (BMI>27kg/m²), or low BMI (BMI<20kg/m²), by place of birth.

Place of birth	effn[1] (n[1])	BMI[2] kg/m²	Overweight %	Obesity %	Low BMI %
ALL	6,703 (31,805)	24.9±4.4	43.5	26.7	9.1
IMM					
Canada	4,866 (25,732)	25.0±4.1	44.3	27.0	8.7
Others	1,837 (6,073)	24.7±5.2	41.3	26.0	10.3
REGION					
Canada	4,866 (25,732)	25.0±4.1	44.3	27.0	8.7
USA	83 (389)	24.5±4.1	34.4	18.7	8.6
Europe	1,108 (4,192)	25.2±4.6	47.2	29.8	6.6
Asia	355 (792)	23.1±6.1	24.8	14.2	21.7
Caribbean	122 (304)	25.0±7.2	41.3	26.9	13.3
Africa	60 (140)	24.1±5.8	40.2	23.8	9.3
CS America	109 (256)	25.1±6.8	40.9	31.5	9.3
SUB-REGION					
Canada	4,866 (25,732)	25.0±4.1	44.3	27.0	8.7
USA	83 (389)	24.5±4.1	34.4	18.7	8.6
West Europe	211 (1,019)	24.8±3.9	41.4	25.8	6.2
North Europe	340 (1,405)	24.4±4.0	37.4	19.7	8.9
Scandinavia	22 (75)	24.3±5.1	30.7	18.1	9.0
South Europe	402 (1,199)	26.1±5.2	59.3	40.6	5.3
East Europe	134 (494)	25.7±5.1	47.4	31.2	4.4
East Asia	119 (262)	22.2±5.3	15.2	9.6	27.6
SE Asia	112 (241)	22.8±6.9	21.7	13.7	23.9
South Asia	91 (204)	23.9±5.6	33.6	14.5	13.9
Middle East	31 (79)	25.1±6.2	47.8	33.0	14.0
Caribbean	122 (304)	25.0±7.2	41.3	26.9	13.3
East Africa	29 (65)	23.5±6.3	38.3	23.3	14.2
Other Africa	28 (67)	24.5±5.2	39.1	19.8	4.8
Central America	23 (71)	23.5±5.6	25.8	18.1	10.4
South America	87 (185)	25.4±7.2	44.9	35.0	9.0

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(continued) Table J7. Unadjusted mean BMI of OHS respondents, and proportion of respondents with overweight (BMI>25kg/m²), obesity (BMI>27kg/m²), or low BMI (BMI<20kg/m²), by place of birth.

Place of birth	effn[1] (n[1])	BMI[2] kg/m²	Overweight %	Obesity %	Low BMI %
COUNTRY					
Canada	4,866 (25,732)	25.0±4.1	44.3	27.0	8.7
USA	83 (389)	24.5±4.1	34.4	18.7	8.6
Germany	88 (391)	25.1±4.4	47.5	32.0	7.6
Netherlands	76 (480)	24.8±3.1	40.3	24.5	5.0
UK	333 (1,383)	24.3±4.0	37.2	19.8	8.9
Italy	206 (633)	26.4±4.9	66.7	43.2	3.5
Portugal	93 (244)	25.8±5.0	53.5	40.3	5.0
Yugoslavia	50 (169)	25.5±5.5	47.3	37.4	10.8
Greece	42 (111)	25.7±6.8	51.2	33.6	8.4
Poland	61 (219)	25.0±4.4	41.6	25.6	3.9
Hungary	26 (99)	26.8±5.4	60.1	51.1	5.7
Other Europe	131 (463)	24.9±5.1	39.9	21.9	6.1
Hong Kong	60 (133)	21.4±4.8	14.2	7.4	37.8
China	34 (74)	23.4±6.2	18.2	13.6	17.3
Philippines	52 (105)	[illegible]	26.3	19.2	8.0
Vietnam	42 (87)	[illegible]	18.6	10.4	43.8
India	67 (150)	23.7±5.5	[illegible]	11.0	13.0
Other Asia	99 (243)	23.7±5.7	[illegible]	19.8	17.4
Jamaica	55 (151)	25.1±7.2	43.4	32.6	14.1
Trinidad	45 (90)	24.7±8.1	36.6	23.9	17.8
Other Caribbean	22 (63)	25.3±5.3	45.8	18.8	1.9
Africa	60 (140)	24.1±5.8	40.2	23.8	9.3
Guyana	43 (91)	24.7±6.8	36.8	28.1	12.3
Other CS America	66 (165)	25.3±6.9	43.6	33.7	7.4

1 effn=effective sample size; n= crude sample size.

2 mean±standard deviation.

APPENDIX K

Health outcomes: bivariate results for the OHS

Table K1. Unadjusted mean number of health problems of the OHS respondents, and proportion of respondents with at least health problem, or with cardiovascular diseases (CVD), hypertensive diseases (HYPERTENS-DIS), diabetes mellitus (DB), digestive diseases (DIGESTIVE), gastrointestinal ulcer (ULCER), or cancer (CANCER), by place of birth.

Place of birth	effn[1] (n[1])	Number of health problems[2]	≥1 health problem %	CVD %	HYPERTENS-DIS %	DB %	DIGESTIVE %	ULCER %	CANCER %
ALL	9,171 (43,292)	2±2	70.0	13.3	9.5	2.5	5.1	1.8	1.6
IMM									
Canada	6,535 (34,444)	2±2	71.0	12.7	8.9	2.5	5.1	1.7	1.6
Others	2,636 (8,848)	1±2	67.4	14.8	10.9	2.6	5.3	2.1	61.5
REGION									
Canada	6,535 (34,444)	2±2	71.0	12.7	8.9	2.5	5.1	1.7	1.6
USA	118 (566)	2±1	79.3	13.0	9.4	3.2	7.4	1.4	2.6
Europe	1,661 (6,340)	2±2	71.0	17.4	12.5	3.0	5.2	2.0	1.8
Asia	470 (1,030)	1±2	56.2	8.1	6.6	2.0	5.3	2.7	1.2
Caribbean	159 (384)	1±2	64.2	16.5	12.4	2.5	4.6	1.8	0.4
Africa	73 (173)	1±2	71.5	7.4	6.2	1.6	6.3	3.3	0.3
CS America	155 (355)	1±2	55.2	9.6	7.7	1.4	4.5	1.2	0.0
SUB-REGION									
Canada	6,535 (34,444)	2±2	71.0	12.7	8.9	2.5	5.1	1.7	1.6
USA	118 (566)	2±1	79.3	13.0	9.4	3.2	7.4	1.4	2.6
West Europe	288 (1,410)	2±2	70.4	15.7	10.9	2.2	3.7	1.2	1.9
North Europe	516 (2,193)	2±2	76.0	16.8	12.1	2.6	5.0	1.4	2.9
Scandinavia	30 (128)	2±2	72.1	18.8	8.8	2.8	4.3	0.0	1.1
South Europe	578 (1,696)	1±2	67.4	17.2	13.4	3.9	5.0	2.7	1.2
East Europe	248 (912)	2±2	69.3	20.9	13.6	2.4	7.8	2.5	1.1
East Asia	147 (318)	1±2	59.3	8.6	8.3	1.9	7.0	2.1	1.1
SE Asia	163 (335)	1±2	54.5	8.5	6.0	1.4	6.5	5.1	1.5
South Asia	115 (265)	1±2	55.1	7.3	4.9	2.2	2.0	0.8	1.1
Middle East	40 (99)	1±2	54.9	6.8	6.8	3.6	3.1	0.6	0.6
Caribbean	159 (384)	1±2	64.2	16.4	12.4	2.5	4.6	1.8	0.4
East Africa	34 (80)	1±2	77.4	9.1	8.0	1.9	7.3	6.2	0.3
Other Africa	35 (83)	1±2	67.3	6.7	5.2	1.5	6.2	0.9	0.3
Central America	34 (110)	1±2	50.0	9.9	9.0	0.9	5.9	2.6	0.0
South America	121 (245)	1±2	56.7	9.5	7.4	1.6	4.2	0.8	0.0

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(continued) Table K1. Unadjusted mean number of health problems of the OHS respondents, and proportion of respondents with at least health problem, or with cardiovascular diseases (CVD), hypertensive diseases (HYPERTENS-DIS), diabetes mellitus (DB), digestive diseases (DIGESTIVE), gastrointestinal ulcer (ULCER), or cancer (CANCER), by place of birth.

Place of birth	effn[1] (n[1])	Number of health problems[2]	≥1 health problem %	CVD %	HYPERTENS-DIS %	DB %	DIGESTIVE %	ULCER %	CANCER %
COUNTRY									
Canada	6,535 (34,444)	2±2	71.0	12.7	8.9	2.5	5.1	1.7	1.6
USA	118 (566)	2±1	79.3	13.0	9.4	3.2	7.4	1.4	2.6
Germany	118 (520)	2±2	71.2	16.7	12.5	2.1	4.1	1.3	2.5
Netherlands	105 (657)	2±1	73.5	17.3	12.0	2.8	4.3	1.2	2.4
UK	508 (2,164)	2±2	76.2	16.9	12.1	2.5	4.9	1.4	2.9
Italy	301 (891)	1±2	70.6	21.0	16.3	4.3	6.5	4.0	0.7
Portugal	134 (339)	1±2	63.8	14.9	12.1	4.5	3.6	1.7	2.6
Yugoslavia	75 (262)	1±2	70.0	13.5	10.6	4.4	1.6	0.7	0.2
Greece	50 (145)	1±2	56.0	9.8	6.7	0.4	6.4	1.5	2.1
Poland	112 (395)	1±2	63.1	18.4	13.6	1.7	7.2	3.1	1.4
Hungary	40 (154)	2±2	77.5	22.5	12.2	3.9	8.5	1.7	1.7
Other Europe	217 (813)	2±2	68.8	17.2	10.2	2.4	5.4	1.5	0.8
Hong Kong	66 (151)	1±2	54.9	8.1	7.6	3.1	5.6	2.3	0.0
China	53 (104)	1±2	55.0	9.0	9.0	1.3	3.8	2.5	2.9
Philippines	74 (144)	1±2	56.9	9.9	9.2	1.9	5.5	4.8	3.4
Vietnam	59 (118)	1±2	47.2	10.5	4.5	1.4	5.0	3.3	0.0
India	85 (201)	1±2	55.4	6.8	4.2	3.0	2.4	1.1	0.6
Other Asia	133 (312)	1±2	61.4	6.5	6.1	1.2	7.7	2.7	0.8
Jamaica	75 (192)	1±2	68.1	19.3	12.4	3.3	6.0	2.2	0.4
Trinidad	57 (111)	1±2	55.9	7.4	6.8	2.2	3.3	0.7	0.6
Other Caribbean	27 (81)	1±2	70.4	27.3	24.0	0.9	3.4	3.1	0.0
Africa	74 (173)	1±2	71.5	7.4	6.2	1.6	6.3	3.3	0.3
Guyana	62 (132)	1±2	54.0	11.1	9.4	2.3	4.1	1.3	0.0
Other CS America	93 (223)	1±2	56.1	8.6	6.6	0.8	4.8	1.1	0.0

[1] effn= effective sample size; n= crude sample size.
[2] mean±standard deviation

Table K2. Unadjusted mean number of consultations with all health professionals and with general practitioners/specialists (during the past 12 months) of the OHS respondents, mean number of cut-down day or bed-day during the two weeeks and proportion of respondents who had at least one cut-down day or bed-day, and mean self-perceived health score, by place of birth.

Place of birth	effn1[1] (n1[1])	CONSULT-HPROF[2]	effn2[1] (n2[1])	CONSULT-GPSP[2]	effn3[1] (n3[1])	# cut-down /bed-days[2]	≥1 cut-down /bed-days %	effn[1] (n[1])	Self-perceived health[2,3]
ALL	9,169 (43,286)	11±19	9,165 (43,271)	5±9	9,063 (42,841)	1±3	13.1	9,079 (42,906)	3.7±1.0
IMM									
Canada	6,533 (34,438)	11±18	6,531 (34,428)	5±8	6,463 (34,107)	1±3	13.6	6,478 (34,156)	3.7±0.9
Other	2,636 (8,848)	11±21	2,634 (8,843)	5±11	2,600 (8,734)	1±3	11.8	2,602 (8,750)	3.6±1.3
REGION									
Canada	6,533 (34,438)	11±18	6,531 (34,428)	5±8	6,463 (34,107)	1±3	13.7	6,478 (34,156)	3.7±0.9
USA	118 (566)	12±16	118 (566)	5±7	118 (561)	1±3	13.2	115 (555)	3.7±1.0
Europe	1,661 (6,340)	11±20	1,661 (6,338)	5±10	1,638 (6,262)	1±3	12.3	1,640 (6,277)	3.5±1.2
Asia	470 (1,030)	10±25	468 (1,028)	6±19	464 (1,012)	0±3	7.8	468 (1,025)	3.6±1.5
Caribbean	159 (384)	9±21	159 (384)	4±9	155 (375)	1±4	9.0	156 (376)	3.8±1.6
Africa	73 (173)	9±20	73 (173)	4±8	74 (173)	1±4	15.4	73 (172)	3.9±1.3
CS America	155 (355)	10±20	155 (354)	5±9	152 (351)	1±4	18.8	150 (345)	3.7±1.4
SUB-REGION									
Canada	6,533 (34,438)	11±18	6,531 (34,428)	5±8	6,463 (34,107)	1±3	13.7	6,478 (34,156)	3.7±0.9
USA	118 (566)	12±16	118 (566)	5±7	118 (561)	1±3	13.2	115 (555)	3.7±1.0
West Europe	288 (1,410)	10±17	288 (1,410)	4±8	284 (1,397)	1±2	10.7	286 (1,396)	3.7±1.0
North Europe	516 (2,193)	11±18	516 (2,191)	5±7	511 (2,174)	1±3	14.5	511 (2,178)	3.7±1.0
Scandinavia	30 (128)	12±17	30 (128)	7±12	30 (127)	1±3	9.5	30 (127)	3.6±1.1
South Europe	578 (1,696)	13±28	578 (1,696)	7±14	567 (1,665)	1±4	12.2	568 (1,675)	3.3±1.5
East Europe	248 (912)	11±16	248 (912)	5±8	245 (898)	1±3	10.2	245 (900)	3.3±1.2
East Asia	147 (318)	8±21	147 (318)	5±11	146 (311)	0±2	6.2	147 (317)	3.4±1.6
SE Asia	163 (335)	8±19	163 (335)	5±10	161 (331)	0±3	7.5	163 (334)	3.7±1.5
South Asia	115 (265)	15±35	115 (265)	11±32	114 (259)	0±2	6.6	114 (262)	3.7±1.4
Middle East	40 (99)	10±22	39 (97)	4±10	40 (98)	1±5	18.8	40 (99)	3.7±1.5
Caribbean	159 (384)	9±21	159 (384)	4±9	155 (375)	1±4	9.0	156 (376)	3.8±1.6
East Africa	34 (80)	10±23	34 (80)	4±7	34 (80)	1±3	14.6	34 (80)	4.0±1.3
Other Africa	35 (83)	9±16	35 (83)	4±10	35 (83)	1±4	12.3	35 (82)	3.9±1.4
Central America	34 (110)	11±16	33 (109)	6±10	34 (110)	1±2	13.3	33 (106)	3.7±1.2
South America	121 (245)	9±22	121 (245)	5±9	119 (241)	1±5	20.4	117 (239)	3.7±1.5

/continued...

(continued) Table K2. Unadjusted mean number of consultations with all health professionals and with general practitioners/specialists (during the past 12 months) of the OHS respondents, mean number of cut-down day or bed-day during the two weeeks and proportion of respondents who had at least one cut-down day or bed-day, and mean self-perceived health score, by place of birth.

Place of birth	effn1[1] (n1[1])	CONSULT-HPROF[2]	effn2[1] (n2[1])	CONSULT-GPSP[2]	effn3[1] (n3[1])	# cut-down /bed-days[2]	≥1 cut-down /bed-day %	effn[1] (n[1])	Self-perceived health[2,3]
COUNTRY									
Canada	6,533 (34,438)	11±8	6,531 (34,428)	5±8	6,463 (34,107)	1±3	13.7	6,478 (34,156)	3.7±0.9
USA	118 (566)	12±16	118 (566)	5±7	118 (561)	1±3	13.2	115 (555)	3.7±1.0
Germany	118 (520)	11±18	118 (520)	5±10	117 (517)	1±3	11.9	117 (515)	3.6±1.0
Netherlands	105 (657)	9±14	105 (657)	4±6	103 (649)	1±2	10.3	104 (649)	3.7±0.8
UK	508 (2,164)	11±18	507 (2,162)	5±7	503 (2,145)	1±3	14.4	502 (2,149)	3.7±1.0
Italy	301 (891)	13±24	301 (891)	7±13	295 (875)	1±4	12.3	299 (885)	3.3±1.4
Portugal	134 (339)	14±42	134 (339)	8±19	132 (333)	1±3	11.9	129 (331)	3.2±1.7
Yugoslavia	75 (262)	9±16	75 (262)	5±9	75 (258)	1±5	15.1	73 (255)	3.4±1.4
Greece	50 (145)	10±21	50 (145)	5±11	49 (142)	0±2	11.0	50 (145)	3.6±1.5
Poland	112 (395)	10±16	112 (395)	5±9	111 (389)	1±3	7.1	111 (388)	3.4±1.2
Hungary	40 (154)	14±21	40 (154)	6±7	39 (150)	1±3	10.4	39 (153)	3.2±1.1
Other Europe	217 (813)	11±17	217 (813)	5±8	215 (804)	1±3	11.3	216 (807)	3.4±1.2
Hong Kong	66 (151)	7±17	66 (151)	4±10	65 (146)	0±1	4.2	66 (150)	3.7±1.4
China	53 (104)	8±17	53 (104)	5±8	53 (102)	0±2	5.7	53 (104)	3.3±1.7
Philippines	74 (144)	8±16	74 (144)	4±10	73 (143)	1±4	10.7	74 (144)	3.9±1.5
Vietnam	59 (118)	10±23	59 (118)	6±12	57 (115)	0±2	3.2	58 (117)	3.4±1.5
India	85 (201)	11±23	85 (201)	8±19	83 (196)	0±2	7.1	84 (198)	3.7±1.4
Other Asia	133 (312)	13±33	131 (310)	8±27	132 (310)	1±4	11.4	133 (312)	3.6±1.5
Jamaica	75 (192)	11±25	75 (192)	5±9	73 (187)	1±4	11.6	72 (187)	3.6±1.6
Trinidad	57 (111)	7±17	57 (111)	4±9	56 (110)	0±3	5.9	57 (110)	4.1±1.7
Other Caribbean	27 (81)	9±14	27 (81)	5±9	26 (78)	0±3	8.4	27 (79)	4.0±1.3
Africa	73 (173)	9±20	73 (173)	4±8	73 (173)	0±4	15.4	73 (172)	3.9±1.3
Guyana	62 (132)	7±12	62 (132)	4±8	59 (128)	1±5	25.8	58 (128)	3.5±1.5
Other CS America	93 (223)	11±23	53 (222)	5±10	93 (223)	1±4	14.4	92 (217)	3.9±1.3

1 effn1= effective sample size for number of consultations with all health professionals; n1= crude sample size for number of consultations with all health professionals; n1= crude sample size for number of consultations with all health professionals; effn2= effective sample size for number of consultations with general practitioners/specialists; n2= crude sample size for number of consultations with general practitioners/specialists.

2 mean±standard deviation

3 Self-perceived health score: 1=poor; 2=fair; 3=good; 4=very good; 5=excellent.

APPENDIX L

Nutritional outcomes: bivariate results fro the QHHNS

Table L1. Unadjusted mean fat, saturated fat, polyunsaturated fat, and cholesterol intakes of QHHNS respondents, and proportion of respondents with a high fat intake (>30% of dietary energy), a high saturated fat intake (>10% of dietary energy), or a high cholesterol intake (>300 mg/day), by place of birth.

Place of birth	effn[1] (n[1])	Fat[2] % energy	High fat %	Saturated fat[2] % energy	High saturated fat %	Polyunsaturated fat[2] % energy	Cholesterol[2] mg/day	High cholesterol %
ALL	1,066 (2,109)	34.6±8.7	71.9	12.8±4.4	73.4	5.5±2.6	310±232	39.8
IMM								
Canada	987 (1,989)	34.8±8.4	72.6	12.9±4.3	74.4	5.5±2.6	308±229	39.5
Others	79 (120)	31.9±11.8	63.7	11.7±5.5	60.4	5.3±3.4	331±281	44.4
REGION								
Canada	987 (1,989)	34.8±8.4	72.6	12.9±4.3	74.4	5.5±2.6	308±229	39.5
Europe	40 (65)	33.2±9.9	66.4	12.2±4.9	68.7	5.7±3.9	298±248	35.7
Others	39 (5)	30.4±13.6	61.0	11.1±6.2	52.0	4.9±2.8	363±313	53.1

[1] effn= effective sample size; n= crude sample size.

[2] mean±standard deviation.

Table I.2. Unadjusted mean fibre and calcium intakes of the QHHNS respondents, and proportion of respondents with a low fibre intake (<3.0 g/MJ), or an "inadequate" calcium intake (assessed using Canadian Recommended Nutritional Intakes (RNI) or World Health Organization (WHO) recommendations, by place of birth.

Place of birth	effn[1] (n[1])	Fibre[1] g/MJ	Low fibre %	Calcium[1] mg/day	"Inadequate" calcium intake-RNI %	"Inadequate" calcium intake-WHO %
ALL	1,066 (2,109)	1.8±1.0	87.6	818±515	38.3	11.1
IMM						
Canada	987 (1,989)	1.8±1.0	87.4	820±553	38.1	11.1
Others	79 (120)	1.8±1.1	90.0	801±553	39.8	12.0
REGION						
Canada	987 (1,989)	1.8±1.0	87.4	820±513	38.1	11.1
Europe	40 (65)	1.9±1.0	88.4	745±481	45.5	14.5
Others	39 (55)	1.7±1.1	91.6	857±621	34.0	9.4

[1] effn= effective sample size; n= crude sample size.

[2] mean±standard deviation.

Table L3. Unadjusted mean energy, carbohydrate, and protein intakes of the QHHNS respondents number of alcoholic drinks consumed during the past week, and proportion of respondents with a low carbohydrate intake (<50% of dietary energy), an "inadequate" protein intake, or a high consumption of alcoholic drinks (>14 drinks during past week), by place of birth.

Place of birth	effn1[1] (n1[1])	Energy[2] kJ	Carbohydrate[2] % energy	Low carbohydrate %	Protein[2] % ene	"Inadequate" protein intake %	effn2[1] (n2[1])	Number of alcoholic drinks[2]	High # drinks %
ALL	1,066 (2,109)	8,843±3,784	49.7±10.5	51.0	17.0±5.1	9.6	1,163 (2,313)	4±8	6.4
IMM									
Canada	987 (1,989)	8,895±3,770	49.6±10.3	51.0	17.0±5.0	9.5	1,074 (2,182)	4±7	6.2
Others	79 (120)	8,196±3,947	51.2±13 6	50.6	17 9±5.8	10.6	89 (131)	5±13	9.0
REGION									
Canada	987 (1,989)	8.895±3,770	49.6±10.3	51.0	17.0±5.0	9.5	1,074 (2,182)	4±7	6.2
Europe	40 (65)	7,419±3,237	50.2±11.8	49.1	17.8_5.4	10.9	46 (72)	6±13	9.1
Others	39 (55)	8,976±4,488	52.3±15.5	52.0	18.0_6.4	10.3	43 (59)	5±13	8.9

[1] effn1= effective sample size for energy, carbohydrate, and protein; n= crude sample size for energy, carbohydrate, and protein; effn= effective sample size for alcohol; n= crude sample size for alcohol.

[2] mean±standard deviation.

Table L4. Unadjusted mean iron and vitamin C intakes of the QHHNS respondents, and proportion of respondents with an "inadequate" intake of iron of vitamin C, by place of birth.

Place of birth	effn[1] (n[1])	Iron mg/day	"Inadequate" iron intake %	Vitamin C mg/day	"Inadequate" vitamin C intake %
ALL	1,066 (2,109)	14±7	13.3	100±88	17.4
IMM					
Canada	987 (1,989)	14±7	13.2	100±88	17.7
Others	79 (120)	14±10	14.6	100±92	14.1
REGION					
Canada	987 (1,989)	14±7	13.2	100±88	17.7
Europe	40 (65)	13±10	10.7	99±90	12.1
Others	39 (55)	14±9	18.4	101±96	16.2

[1] effn= effective sample size; n= crude sample size.

Table L5. Unadjusted mean thiamin, riboflavin, and niacin intakes of the QHHNS respondents, and proportion of respondents with an "inadequate" intake of thiamin, riboflavin, or niacin, by place of birth.

Place of birth	effn[1] (n[1])	Thiamin mg/5MJ	"Inadequate" thiamin intake %	Riboflavin mg/5MJ	"Inadequate" riboflavin intake %	Niacin mg/5MJ	"Inadequate" niacin intake %
ALL	1,066 (2,109)	0.87±0.37	10.9	1.1±0.4	9.2	22.5±7.3	2.2
IMM							
Canada	987 (1,989)	0.88±0.37	10.4	1.1±0.4	9.3	22.4±7.2	2.3
Others	79 (120)	1.12±0.38	16.7	1.1±0.4	7.1	23.5±8.8	1.4
REGION							
Canada	987 (1,989)	0.88±0.37	10.4	1.1±0.4	9.3	22.4±7.2	2.3
Europe	40 (65)	1.14±0.42	15.5	1.1±0.4	7.6	23.0±7.5	2.8
Others	39 (55)	0.85±0.50	17.9	1.1±0.4	6.6	24.0±10.1	0.0

[1] effn= effective sample size; n= crude sample size.

Table L6. Unadjusted mean BMI of the QIHNS respondents, and proportion of respondents with overweight ($BMI>25kg/m^2$), obesity ($BMI>27kg/m^2$, low BMI ($BMI<20kg/m^2$), or high waist-to-hip circumference ratio (WHR; >1.0 for males and >0.8 for females), and mean difference between reported and measured weight and height, by place of birth.

Place of birth	effn1[1] (n1[1])	BMI kg/m^2	Over-weight %	Obesity %	Low BMI %	effn2[1] (n2[1])	High WHR %	effn3[1] (n3[1])	Difference in weight[2] kg	effn4[1] (n4[1])	Difference in height[2] cm
ALL	886 (1,591)	24.9±4.7	42.7	28.3	10.8	1,035 (2,040)	20.7	1,007 (1,989)	-0.6±3.0	2,006 (1,018)	0.7±4.6
IMM											
Canada	820 (1,504)	24.9±4.6	42.5	27.7	10.9	957 (1,927)	20.7	934 (1,488)	-0.6±3.0	1,987 (943)	0.7±4.4
Others	66 (87)	25.7±5.6	45.3	35.4	9.2	78 (113)	20.5	72 (1,488)	-0.6±3.9	109 (74)	0.1±7.0
REGION											
Canada	820 (1,504)	24.9±4.6	42.5	42.5	19.0	957 (1,927)	20.7	934 (1,488)	-0.6±3.0	1,897 (943)	0.7±4.4
Europe	33 (44)	26.4±5.8	48.6	44.6	3.0	40 (62)	30.3	38 (59)	-1.4±3.3	61 (40)	0.4±5.9
Others	32 (43)	25.0±5.4	42.0	25.8	15.5	38 (51)	10.0	34 (47)	0.2±4.0	48 (35)	-0.2±8.2

[1] effn1= effective sample size for BMI, overweight, obesity, and low BMI; n1= crude sample size for BMI, overweight, obesity, and low BMI; effn2= effective sample size for High WHR; n2= crude sample size for High WHR; effn3= effective sample size for difference in weight; n3= crude sample size for different in weight; effn4= effective sample size for difference in height; n3= crude sample size for different in height.

[2] mean±standard deviation

Table L7. Unadjusted proportion of QHHNS respondents who *do not know* about the effect of fat (KNOW-FAT), salt (KNOW-SALT), and cholesterol (KNOW-CHOL) on health, by place of birth.

Place of birth	effn1[1] (n1[1])	KNOW-FAT	KNOW-SALT	effn2[1] (n2[1])	KNOW-CHOL
ALL	1,164 (2,316)	2.3	24.3	1,163 (2,314)	24.5
IMM					
Canada	1,075 (2,184)	2.3	24.5	1,075 (2,182)	24.8
Others	89 (132)	2.6	21.7	89 (132)	20.9
REGION					
Canada	1,075 (2,184)	2.3	24.5	1,075 (2,182)	24.8
Europe	46 (72)	1.9	21.3	46 (72)	22.2
Others	43 (60)	3.4	22.1	43 (60)	19.4

[1] effn1= effective sample size for KNOW-FAT and KNOW-SALT; n=1 crude sample size for KNOW-FAT and KNOW-SALT; effn2= effective sample size for KNOW-CHOL; n=2 crude sample size for KNOW-CHOL.

APPENDIX M

Health outcomes: bivariate results for the QHHNS

Table M1. Unadjusted proportion of QHHNS respondents with cardiovascular diseases, angina, intermittent claudication, infarction, or hypertension, and proportion of respondents who have hypertension without knowing it (HT-KNOW), by place of birth.

Place of birth	effn1[1] (n1[1])	Cardiovascular disease %	Angina %	Intermittent claudication %	Infarction %	effn2[1] (n2[1])	Hypertension %	effn3[1] (n3[1])	HT-KNOW %
ALL	1,164 (2,316)	9.6	8.4	0.4	1.4	1,164 (2,314)	14.0	1,158 (2,300)	4.4
IMM									
Canada	1,075 (2,184)	9.4	8.1	0.4	1.6	1,075 (2,182)	13.4	1,071 (2,169)	4.3
Others	89 (132)	12.3	11.8	0.6	0.0	89 (132)	21.1	88 (131)	5.9
REGION									
Canada	1,075 (2,184)	9.4	8.1	0.4	1.6	1,0' (2,182)	13.4	1,071 (2,169)	4.3
Europe	46 (72)	14.3	13.2	1.1	0.0	6 (72)	21.5	45 (71)	2.8
Others	43 (60)	10.3	10.3	0.0	0.0	43 (60)	20.7	43 (60)	9.1

[1] effn1= effective sample size for cardiovascular disease, angina, intermittent claudication, and infarction; n1= crude sample size for cardiovascular disease, angina, intermittent claudication, and infarction; effn2= effective sample size for hypertension; n2= crude sample size for hypertension; effn3= effective sample size for HT-KNOW; n2= crude sample size for HT-KNOW.

Table M2. Unadjusted proportion of QHHNS respondents with high blood total cholesterol (≥5.2 mmol/L and ≥6.2 mmol/L), high LDL-cholesterol (≥3.4 mmol/L), high total cholesterol-to-HDL-cholesterol ratio (CHL/HDL≥5.0), low HDL-cholesterol (≤0.9 mmol/L), or high triglycerides (≥2.3 mmol/L) levels, and proportion of respondents whose do not know that their blood total cholesterol is greater or equal to 5.2 mmol/L (CHOL5.2-KNOW), by place of birth.

Place of birth	effn1[1] (n1[1])	High chl (>5.2) %	High chl (>6.2) %	effn2[1] (n2[1])	CHOL5.2-KNOW %	effn3[1] (n3[1])	High LDL-chl %	effn4[1] (n4[1])	Low HDL-chl %	High CHL/HDL %	effn5[1] (n5[1])	High triglyc. %
ALL	1,026 (2,018)	48.6	19.3	985 (1,932)	36.0	981 (1,950)	39.6	1,000 (1,975)	7.9	27.6	1,010 (1,992)	17.1
IMM												
Canada	948 (1,905)	48.5	19.3	917 (1,829)	35.5	908 (1,841)	39.8	923 (1,863)	7.6	27.9	932 (1,879)	16.7
Others	78 (113)	50.8	19.5	68 (103)	42.6	73 (109)	36.2	77 (112)	11.1	24.0	78 (113)	21.0
REGION												
Canada	1,075 (1,905)	48.5	19.3	917 (1,829)	35.5	908 (1,841)	39.8	923 (1,863)	7.6	27.9	932 (1,879)	16.7
Europe	46 (62)	58.7	24.5	34 (57)	50.2	37 (59)	43.6	40 (61)	8.8	20.4	40 (62)	18.7
Others	43 (51)	42.4	14.2	33 (46)	34.8	36 (50)	28.7	37 (51)	13.6	27.8	37 (51)	23.5

[1] effn1= effective sample size for High chl (>5.2) and High chl (>6.2); n1= crude sample size for High chl (>5.2) and High chl (>6.2); effn2= effective sample size for CHOL5.2-KNOW; n2= crude sample size for CHOL5.2-KNOW; effn3= effective sample size for High LDL-chol; n3= crude sample size for High LDL-chl; effn4= effective sample size for Low HDL-chl and High CHL/HDL; n4= crude sample size for Low HDL-chl and High CHL/HDL; effn5= effective sample size for High triglycerides; n5= crude sample size for High triglycerides.

Table M3. Unadjusted proportions of QHHNS respondents with diabetes mellitus, and mean number of consultation with all health professionals (CONSULT-HPROF) or with a general practitioner or specialist (CONSULT-GPSP) during the past three months, and proportion of respondents who had at least one consultation with a health professional (CONSULT-HPROF≥1) or with a general practitioner or a specialist (CONSULT-GPSP≥1), by place of birth.

Place of birth	effn1[1] (n1[1])	Diabetes %	effn2 (n2)	CONSULT-HPROF[2]	CONSULT-HPROF≥1	CONSULT-GPSP[2]	CONSULT-GPSP≥1
ALL	1,162 (2,312)	5.0	1,159 (2,307)	2±5	59.5	1±2	52.4
IMM							
Canada	1,074 (2,181)	4.5	1,070 (2,175)	1±9	59.4	1±2	52.2
Others	89 (131)	10.5	89 (132)	2±6	60.9	1±2	54.8
REGION							
Canada	1,074 (2,181)	4.5	1,070 (2,175)	1±9	59.4	1±2	52.2
Europe	46 (72)	12.3	46 (72)	2±7	57.1	1±2	55.7
Others	43 (59)	8.7	43 (60)	2±3	64.9	1±2	53.9

[1] effn1= effective sample size for diabetes; n1= crude sample size for diabetes; effn2= effective sample size for CONSULT-HPROF, CONSULT-HPROF≥1, CONSULT-GPSP, and CONSULT-GPSP≥1; n2= crude sample size for CONSULT-HPROF, CONSULT-HPROF≥1, CONSULT-GPSP, and CONSULT-GPSP≥1.

[2] mean±standard deviation

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