# THE ADEQUACY OF VITAMIN E AND VITAMIN C INTAKES BY RESIDENTS OF NEWFOUNDLAND AND LABRADOR AND ITS POSSIBLE RELATIONSHIP TO DIABETES STATUS: SECONDARY ANALYSIS OF DATA COLLECTED BY THE NUTRITION NEWFOUNDLAND AND LABRADOR SURVEY

MADONNA MURPHY

# THE ADEQUACY OF VITAMIN E AND VITAMIN C INTAKES BY RESIDENTS OF NEWFOUNDLAND AND LABRADOR AND ITS POSSIBLE RELATIONSHIP TO DIABETES STATUS: SECONDARY ANALYSIS OF DATA COLLECTED BY THE NUTRITION NEWFOUNDLAND AND LABRADOR SURVEY


by

MADONNA MURPHY


A thesis submitted to the

School of Graduate Studies

in partial fulfillment of the

requirements for the degree of

Master of Science


Division of Community Health and Humanities
Faculty of Medicine
Memorial University of Newfoundland


2007

St. John's Newfoundland and Labrador

*Your file Votre référence*
*ISBN: 978-0-494-31271-1*
*Our file Notre référence*
*ISBN: 978-0-494-31271-1*

**ABSTRACT**

This study is a secondary analysis of data collected by 'Nutrition Newfoundland and Labrador'. Its primary goal was to estimate the adequacy of total vitamin E and total vitamin C intakes, by residents of this province. A secondary goal of this study was to look for a possible relationship between dietary intakes and diabetes status. Participants included 1927 non-institutionalized residents aged 18-74 years for the vitamin C analysis and 1181 participants for the Vitamin E analysis. The results suggest 82.3% of residents are not consuming enough total vitamin E to meet their estimated needs. Considering intake of total vitamin C, 48.3% of male non-smokers, 45.3% of female non-smokers, 78.8% of male smokers and 73.6% of female smokers have inadequate intakes. The intake of no nutrient studied was found to be associated with diabetes status. Residents of the province should be encouraged to consume diets of higher micronutrient density.

**ACKNOWLEDGEMENTS**

I would like to thank my supervisor Dr. Barbara Roebothan for her support, guidance, patience and encouragement throughout my Masters program. I would also like to thank my committee members, Dr. David Allison and Dr. Maria Mathews for providing excellent input and advice. Special thanks to Dr. Maria Mathews for her assistance with the statistical analysis.

I would like to thank Alison Edwards for help with the NNL data files and Dr. Veeresh Gadag for help and advice with the statistical analysis. As well I would like to acknowledge Julia Roebothan and Leah Crane who helped with some of the data entry in the early part of my research.

I would also like to thank my wonderful parents for their love, unwavering support and encouragement through my university career.

## TABLE OF CONTENTS

## LIST OF FIGURES

## LIST OF TABLES

## ABBREVIATIONS

| | |
|---|---|
| **NNL** | Nutrition Newfoundland and Labrador |
| **WHO** | World Health Organization |
| **NPHS** | National Population Health Survey |
| **DRI** | Dietary Reference Intake |
| **EAR** | Estimated Average Requirement |
| **RDA** | Recommended Dietary Allowance |
| **CSFII** | Continuing Survey of Food Intakes by Individuals |
| **NHANES** | National Health and Nutrition Examination Survey |
| **IDDM** | Insulin Dependent Diabetes Mellitus |
| **NIDDM** | Non-Insulin Dependent Diabetes Mellitus |
| **BMI** | Body Mass Index |
| **CCHS** | Canadian Community Health Survey |
| **NHIF** | Newfoundland Health Insurance File |
| **MCP** | Medical Care Plan |
| **DIN** | Drug Identification Number |

## LIST OF APPENDICES

# CHAPTER I

# INTRODUCTION

## 1.1 Rationale

The adequacy of vitamin E intakes by residents of Newfoundland and Labrador has not been explored prior to this study, yet the importance of vitamin E to health has clearly been established. It is thought to function mostly as a chain-breaking antioxidant that prevents the spread of free-radical reactions (Institute of Medicine, 2000) and protects polyunsaturated fats and other cellular components and their membranes from destruction (Sizer & Whitney, 2003). In this study, the researcher will make estimations of vitamin E intake through food and nutritional supplements from data collected from the respondents of a provincial nutrition survey, Nutrition Newfoundland and Labrador (NNL). This will be the first estimate of total vitamin E intake conducted on the population of the province. By comparing population intakes of this nutrient to the appropriate values of mean population requirements, the adequacy of intake pertaining to this nutrient can be estimated for residents of this province.

Data pertaining to the intake of vitamin C through food were also collected by NNL and has been reported elsewhere (Roebothan, 2003). Nevertheless total vitamin C intake by the adult population of Newfoundland and Labrador has not been calculated. Vitamin C is essential to health as it assists enzymes in the formation of the tissue protein collagen and it is an important antioxidant (Sizer & Whitney, 2003). A severe deficiency of this vitamin is known to cause the disease scurvy. In this study the researcher will also estimate total vitamin C intake and its adequacy in Newfoundland and Labrador.

Diabetes is the seventh leading cause of death in Canada (Health Canada, 1999) and as the incidence and prevalence rates rise, it becomes a growing public health concern and a major economic burden. Research suggests that dietary antioxidants such as vitamin E and vitamin C may be beneficial to people with diabetes (Colditz, Manson, Stampfer, Rosner, Willett & Speizer, 1992; Feskens, Virtanen, Rasanen, Tuomilehto, Stengard, Pekkanen, Nissinen & Kromhout, 1995; Ford, 2001). There is also evidence that oxidative stress plays a major role in the development of diabetes and its complications (Oberley, 1988). Diabetes is often associated with increased free radical production and reduced antioxidant defences (Baynes, 1991). Antioxidants scavenge free radicals and reduce oxidative stress. Consequently, it has been recommended that people with diabetes keep up their antioxidant defences in an attempt to control diabetes complications. One source of antioxidants is the diet. Since the rates of diabetes in Newfoundland and Labrador are above the national average is consumption of antioxidant vitamins such as vitamin E and vitamin C associated with diabetes in residents of this province? Newfoundland and Labrador has the highest prevalence of this disease at 5.8%, which is higher than the Canadian average of 4.1% (Statistics Canada, 2001). Not only are the rates of diabetes more prevalent in Newfoundland and Labrador but they are also increasing, especially among the young (Canadian Diabetes Association, 2001).

Nutritional epidemiology is relatively new and a number of limitations have been identified. Diet is very difficult to measure as an exposure and there are considerable measurement errors involved. For example, people eat various different foods and often forget what they have eaten and the ingredients of a lot of meals are unknown. Also, confounding is a problem as people who eat a healthy diet often lead a healthy active lifestyle so it is often hard to determine the effect of diet from other lifestyle components (Michels, 2003). Since rates of diabetes are high in this province and the literature suggests a possible link between diabetes and the intake of such antioxidant nutrients as vitamin E and vitamin C, are there any associations that exist between dietary antioxidants and diabetes status? The information obtained from this study will help contribute to our knowledge of nutrient intakes in Newfoundland and Labrador and their possible relationship to diabetes. Also, the results of this study may provide evidence to support health promotion activities related to diabetes prevention. For example, evidence suggests that fruit and vegetable consumption may lower the risk of developing diabetes (Colditz et al, 1992; Feskens et al, 1995; Ford, 2001) and that people at risk for developing diabetes have lower serum concentrations of several antioxidants, such as vitamin C which is found in these foods (Ford, Mokdad, Giles & Brown, 2003). Fruit and vegetable consumption appears to be inadequate in Newfoundland and Labrador (Statistics Canada, 2001). Since fruit and vegetable consumption may be beneficial to diabetes prevention, findings suggesting inadequate intakes of total vitamin C would support a recommendation to promote higher intakes of some fruits and vegetables.

## 1.2 Goals

Nutrition Newfoundland and Labrador found that intakes of certain nutrients were less than what is recommended to maintain health in a large percentage of Newfoundland and Labrador residents. At the time that NNL was conducted software was not available to analyze the diets of NNL participants to obtain vitamin E intake. As a result it was not possible to determine the adequacy of vitamin E intakes for the population of Newfoundland and Labrador. The primary goal of this project is to use data collected by NNL to estimate the intakes of vitamin E by the non-institutionalized adult population of Newfoundland and Labrador and to assess the adequacy of these intakes by comparing them to adult requirements for this nutrient. Estimates of vitamin E will include that consumed through food plus nutrient supplements. Vitamin C intakes from dietary supplements will also be calculated in this study and added to the intakes of vitamin C from food to provide more complete data on the total intake of vitamin C and how adequate it is in the residents of Newfoundland and Labrador. Once vitamin E and vitamin C intakes have been estimated, the data will be used to address a secondary goal of this study, which is to look for a possible relationship between intakes of vitamin E and vitamin C and diabetes mellitus. As Nutrition Newfoundland and Labrador did collect data on the intake of a number of micronutrients through food a possible association between the dietary intake of one or more of these other nutrients with diabetes status will also be investigated.

### 3.3 Objectives

The specific objectives of the study are:

1. To analyze 24-hour recall data of Nutrition Newfoundland and Labrador respondents aged 35-74 years to estimate their daily intakes of vitamin E as contributed by food.

2. To estimate the contribution of supplements to the intakes of vitamin E and vitamin C in order to calculate total intakes of these vitamins by residents of Newfoundland and Labrador.

3. To estimate the proportion of the Newfoundland and Labrador population aged 35-74 years who are consuming inadequate levels of total vitamin E (from food and supplements) and to estimate the proportion of the population aged 18-74 years who are consuming inadequate levels of total vitamin C (from food and supplements) to meet their needs.

4. To present intakes of vitamin E, vitamin C, vitamin B6, vitamin B12, magnesium, iron, zinc, thiamin and riboflavin from food by a subgroup of Newfoundland and Labrador residents as less than the recommended dietary amount and greater than or equal to the recommended dietary amount. Those consuming less than recommended will then be compared to those consuming greater than or equal to the recommended amount to determine if this is associated with the presence of pre-diagnosed diabetes.

5. To present total intakes of vitamin E and vitamin C (food plus supplements) as less than the recommended dietary amount and greater than or equal to the recommended dietary amount. Those consuming less than recommended will then be compared to those

consuming greater than or equal to the recommended to see whether or not this is associated with pre-diagnosed diabetes.

# CHAPTER II

# LITERATURE REVIEW

## 2.1 Population Health and Health Promotion

Population health aims to improve the health of the whole population and to reduce health inequities among certain groups within the population. Health promotion is one way to apply this approach to health and it is defined as the process of helping people to increase control over, and to improve their health. To reach a state of complete physical, mental and social well-being, an individual must be able to identify goals, satisfy needs and to change or cope with the environment (World Health Organization, 1986). In order to reach this state, population health and health promotion concentrate on a broad range of factors that have a large impact on our health (Health Canada, 2002).

### 2.1.1 Determinants of Health

Our health is affected by many factors, which include income and social status, social support and networks, education and literacy, employment/working conditions, social environments, physical environments, healthy child development, biology and genetic endowment, health services, gender, culture, personal health practices and coping skills. These factors have a substantial effect on determining our health status (Health Canada, 2004).

Health status improves with a higher income and a higher social status. The relative distribution of wealth in a population is important in determining the health of a large group since the greater the income inequality the higher the mortality (Le Grand, 1987; Evans, Barer & Marmor, 1994). People earning low incomes are more likely to die earlier than people earning higher incomes, regardless of age, sex, race and place of residence (Kaplan, Pamuk, Lynch, Cohen & Balfour, (1996b). Also, as income increases people have less sickness, longer life expectancies and improved health (Wilkinson, 1992).

Social support and social networks also have an impact on health. Support received from family, friends and communities is related to improved health. This support is important as it helps people deal with difficult situations and it provides a sense of control over life circumstances. Social support therefore seems to 'buffer' or protect people from the negative effects of stress (Cohen & Wills, 1985). A low level of social support is a risk factor for a number of health problems and even early death (Wilkins & Park, 1998). In 1996/97 the National Population Health Survey (NPHS) reported that 83.4% of Canadians had a high level of social support (Statistics Canada, 1996/97).

Education and literacy are also very important factors associated with health. Education is closely related to socio-economic status and thus health status improves with higher levels of formal education (Millar & Stephens, 1993). Having higher education enables enhanced access to healthy environments and enables people to better prepare their children for school than people who are less educated (Ross, Scott & Kelly, 1996).

Literacy skills are very important, as lower literacy skills are associated with unemployment, poverty, and poor health. Populations with lower literacy skills are more likely to have poorer health and to die earlier than populations with high literacy levels (Weiss, Hart, McGee & D'Estelle, 1992).

Health status is associated with employment and working conditions. People who are employed have better physical well being than those who are unemployed, retired or homemakers (Kessler, House & Turner, 1987). Meaningful employment, economic stability and a healthy work environment are associated with improved health. Employment not only provides income but status, power, sense of self and purpose, social interactions and personal growth (Bird & Fremont, 1991; Bird & Ross, 1993).

Social environments are also associated with health. Societal conditions such as social institutions and surroundings can affect health. Communities with fewer social resources have poorer health than communities with strong social networks (Health Canada, 2004). Physical environments strongly influence our ability to remain healthy. Factors such as air and water quality, the type of housing and the safety of the community can have a considerable impact on physical and psychological health. Poor air quality has a large effect on health outcomes as exposure to air pollution has been found to be associated with premature mortality (Burnett, Cakmak & Brook, 1998).

Healthy child development is vital to sustainable health in any population. Positive prenatal and early childhood experiences have a large impact on health in later years. Young children's development is also affected by the other determinants of health, including housing, family income, level of parental education, access to healthy foods, physical activity, genetic makeup and access to dental and medical care (Health Canada, 2004).

Health status is associated with biology and genetic predisposition. Although socio-economic and environmental factors are very important, genetic endowment predisposes certain people to particular diseases or health problems (Health Canada, 2004).

Access to health services constitutes yet another important determinant of health. Services that maintain and promote health, prevent disease, and restore health contribute to the health of the population. Availability of preventive and primary care services are associated with improved health (Health Canada, 2004).

Gender refers to the various society-determined roles, personality traits, attitudes, behaviours, values, relative power and influence that society assigns to the two sexes. Gender is also associated with health. Many health issues are a function of gender based social status or roles. Some health conditions affect one gender more than the other (Health Canada, 2004). For example, men have higher rates of heart disease and are more likely than women to die prematurely due to this condition (Verbrugge, 1985; Wingard, 1982). Even though women live longer than men, they are more likely to suffer from depression, stress overload, chronic conditions such as arthritis and allergies, and injuries and death related to family violence (Gove & Tudor, 1973; Kessler & McRae, 1982; Ross & Mirowsky, 1989).

Culture is associated with health status. Some individuals or groups face health risks associated with their specific cultural values. These cultural values can contribute directly to conditions such as marginalization, stigmatization, loss or devaluation of language and culture and indirectly to poor health through lack of access to culturally appropriate health care and services (Health Canada, 2004). In 1994, infant mortality rates in First Nations communities were twice as high as among the Canadian population as a whole. Also, chronic diseases including diabetes, heart problems, cancer, hypertension and arthritis/rheumatism were significantly more prevalent in aboriginal communities as compared to non-aboriginal communities and these differences appear to be increasing (Health Canada, 1999).

Personal health practices and coping skills constitute yet another important determinant of health. Personal health practices are the actions people take to prevent diseases and promote well being. Effective coping strategies help people to deal with challenges.

In 1996/97 the National Population Health Survey (NPHS) reported that 30% of Canadian men and 25% of women aged 12 and over were daily or occasional smokers (Statistics Canada, 1996/97). Inadequate physical activity and poor dietary habits are also putting many Canadians at an elevated risk of ill health. The 1996/97 NPHS reported that 41.9 % of Canadians aged 12 and over were physically active or moderately active during leisure time (Statistics Canada, 1996/97). Also, 33.4% of Canadians aged 12 and over reported consuming fruits and vegetables less than five times per day (Statistics Canada, 2001).

## 2.2 Nutrition

The determinants of health have a significant influence on the health of the population. Many of these factors however are difficult to modify. One way to apply health promotion strategies while considering the many determinants of health is to focus on lifestyles and personal health practices. Dietary intake is one practice that is personally modifiable and can be used to promote wellness but also to delay and even prevent some illness (Eyre, Kahn & Robertson, 2004). Traditionally, food and nutrition research has focused on identifying essential nutrients and ensuring nutritional adequacy. NNL found that a number of vitamins and minerals are still being consumed in inadequate amounts. Folate intake was found to inadequate in 97% of the population. Likewise, 20.8% of the adult residents of Newfoundland and Labrador had inadequate intakes of thiamin, 29.3% had inadequate intakes of vitamin B6 and 22% of the population were not consuming adequate vitamin B12. Vitamin C intakes were also found to be inadequate in 52.7% of the population. Mineral intakes were also found to be inadequate as 82.7% of the population were not consuming adequate magnesium and 45.8% had inadequate zinc intakes. These numbers however represent the overall intakes and as a result certain subgroups within the population may have lower intakes than the population as a whole. For example, 20.8% of the population had inadequate intakes of thiamin. However, the intakes of females appeared to be much lower than the intakes of males with 38% of females aged 19 to 30 years having inadequate intakes of thiamin (Roebothan, 2003). Since nutrition is a new science assessment of intake of some nutrients, like vitamin E in the Newfoundland and Labrador population, has not yet been studied.

Although inadequate supplies of some nutrients are still a problem for some communities, the focus of many nutrition researchers is moving away from concerns of the inadequate diet and more towards the concerns of the over-consumption of certain dietary components by populations. Nutrition research exploring the associations between nutrition factors and chronic illness is growing. Nutritional factors have been associated with diseases such as cancer, diabetes, cardiovascular disease and osteoporosis and as a result, dietary recommendations have been set in an attempt to reduce or delay mortality and morbidity from these diseases and others (Webb, 2002).

Most nutrition research has been conducted since 1900. Nutrition is a growing field; however as it is a young science many of the scientific findings seem to contradict one another. Research questions are answered by many different kinds of experiments. One experiment alone confirms little and it is only when findings have been supported by several different kinds of experiments and by several studies that they can be considered valid (Sizer & Whitney, 2003). As human nutrition research has been focused on recent decades, much of the repeated experimentation which is required to provide sound support to research findings is not yet available.

The diet provides the body with nutrients, which are compounds that are essential to support life. Macronutrients such as carbohydrates, proteins and fats are required in large amounts (grams). However, micronutrients such as vitamins and minerals are required by the body in smaller amounts (milligrams and micrograms). Vitamins can be organized into two classes: fat-soluble and water-soluble. Fat-soluble vitamins, such as vitamin E, are absorbed, travel in the bloodstream and can be stored in the liver and fatty tissues. As a result of the human body's considerable capacity to store these nutrients, fat-soluble vitamins can reach toxic concentrations if they are consumed in excess. Water-soluble vitamins, such as vitamin C, are absorbed directly into the bloodstream. These vitamins are only stored in the body in limited amounts and so rarely reach toxic concentrations because excesses tend to be excreted in the urine (Sizer & Whitney, 2003).

Both fat-soluble and water-soluble vitamins are very important for the protection of cells in the body. They perform a variety of functions including a supply of antioxidant capacity. The inside of the cell and the fluid between the cells are composed mostly of water while the cell membrane is composed primarily of lipid. Free radicals can attack and damage either the fatty or aqueous components of the cell. Both fat-soluble and water-soluble antioxidants are required to minimize such damage (Smythies, 1998).

### 2.2.1 Dietary Antioxidants

The oxygen molecule found in the body can be turned into oxidizing agents called reactive oxygen species with great ease. When oxidizing agents lose an electron they will try to gain back this electron from other nearby molecules in the body. This stealing of electrons causes great damage to the nearby molecules. Reactive oxygen species are not always harmful; in fact many have specific roles in the body. However, a surplus of these very reactive species can be harmful, as they can attack and damage such molecules in the body as lipids, proteins and DNA (Smythies, 1998).

Compounds with one or more unpaired electrons are called free radicals (Roberfroid & Calderon, 1995). Reactive oxygen species include two types of compounds, oxygen-derived free radicals and compounds that are not free radicals themselves but can easily create them (Smythies, 1998). Therefore, any free radical involving oxygen can be referred to as a reactive oxygen species (Samson, 1999). Free radicals are short-lived in that they only exist for a brief period of time, usually nanoseconds or less, and then react with other molecules in the body in order to gain or lose an electron in an attempt to become stable. The molecule that is attacked then becomes a free radical itself and this causes a chain reaction (Bender, 2002). The free radical theory of aging proposes that oxygen-derived free radicals react with and cause damage to certain cellular components leading to the death of vital cells and either cause various diseases or add to their pathogenesis (Knight, 1999).

Oxidative stress occurs when cells are damaged due to the overproduction of free radicals and/or the failure of antioxidant defences. If oxidative stress continues then circulating antioxidants may be lacking. This impairment of the antioxidant defences can be extremely harmful and if oxidative stress persists and antioxidants are used up without being replaced then cells may die and this may lead to the occurrence of disease (Smythies, 1998).

Maintaining an adequate supply of antioxidants should help control oxidative stress and decrease the risk of illness and disease. Antioxidants act in a number of ways to protect cells from the effects of free radicals such as reducing the energy of the free radical, preventing free radicals from forming and/or interrupting the oxidizing chain reaction (Ames, Shigenaga & Hagen, 1993). They can also repair oxidative damage, eliminate damaged molecules and they promote the death of cells that have badly damaged DNA (Ozben, 1998).

The diet supplies a number of antioxidants. The antioxidant vitamins are vitamin E, vitamin C and vitamin A/beta-carotene (Sizer & Whitney, 2003), each with different specific functions that help to protect the body's cells.

#### 2.2.1.1 Vitamin E

Vitamin E is a fat-soluble vitamin that exists in eight different forms. Four of these are tocopherols, four are tocotrienols and they are labelled alpha ($\alpha$), beta ($\beta$), gamma ($\gamma$) or delta (δ) (Mann & Truswell, 1999). Tocopherols and tocotrienols are oils that are found in plants and they range from colourless to pale yellow. Alpha-tocopherol is the most active or usable form of vitamin E (Mino, Nakamura, Diplock & Kayden, 1993) and it is the only form that is maintained in human plasma. The other naturally occurring forms are usually not included in the estimation of human vitamin E requirements because, although they are absorbed, they are not converted to alpha-tocopherol by humans and they are not recognized efficiently by the alpha-tocopherol transfer protein in the liver. This implies that alpha-tocopherol is required by the body for some unknown need that the other forms of vitamin E do not fulfil (Institute of Medicine, 2000).

Vitamin E is contributed to the human diet primarily by fats and oils with wheat germ oil being the richest source. Nuts, such as almonds and peanuts, and green leafy vegetables are also good sources of vitamin E. Oils from plant based foods are the best sources of vitamin E whereas animal fats have very limited amounts (Mann & Truswell, 1999).

Vitamin E is considered the most abundant fat-soluble dietary antioxidant and it plays an important role in protecting the cell membrane and its lipoproteins from free radical damage (Mann & Truswell, 1999). It is thought to function mostly as a chain-breaking antioxidant that prevents the spread of lipid peroxidation (Institute of Medicine, 2000). Most vitamin E in the body is found in the cell membrane where it protects polyunsaturated fatty acids from free radical damage. If polyunsaturated fatty acids are attacked then they themselves become free radicals. Vitamin E stabilizes the newly formed free radicals and inhibits their attack of neighbouring polyunsaturated fatty acids. Thus vitamin E helps to prevent the initiation of a chain reaction of cellular damage (Mann & Truswell, 1999).

In Canada and the United States, a Dietary Reference Intake (DRI) is set for many nutrients and is composed of a set of standards which can be used to assess the adequacy of daily intakes of the major nutrients by healthy people. The Estimated Average Requirement (EAR) is one component of the DRI. The EAR has been set for many nutrients and it represents a nutrient intake value that is estimated to meet the requirements of half of the healthy people in a life stage and gender group. Group intakes are usually compared to the EAR for a nutrient to estimate the adequacy/inadequacy of that nutrient's intake by the group. The EAR for vitamin E has been set at 12 mg/day for both adult males and females (Institute of Medicine, 2000). Another component of the DRI is the Recommended Dietary Allowance (RDA). The RDA exceeds the minimum nutrient requirement of most healthy people and is the daily nutrient intake level often recommended for an individual. The RDA for vitamin E has been set at 15 mg/day for both adult males and females (Sizer & Whitney, 2003).

Vitamin E consumption has been shown to be low among certain populations. The Continuing Survey of Food Intakes by Individuals (CSFII) compared alpha-tocopherol intake of the US population to the current Dietary Reference Intakes (DRI) for vitamin E and found that only 8% of men and 2.4% of women met the Estimated Average

Requirements (EAR) for vitamin E intake from foods alone (Maras, Bermudez, Qiao, Bakun, Boody-Alter & Tucker, 2004). Results from the Second National Health and Nutrition Examination Survey (NHANES II) found that although mean intakes of vitamin E were close to the Recommended Dietary Allowance (RDA), median intakes were much lower (Murphy, Subar & Block, 1990). The Third National Health and Nutrition Examination Survey (NHANES III 1988-94) also found that the diets of many Americans do not provide enough vitamin E to meet the recommended intake (Bialostosky, Wright, Kennedy-Stephens, McDowell & Johnson, 2002).

When assessing vitamin E intakes valid estimates are needed. All foods consumed and specific fats and oils need to be identified when approximating vitamin E intake because vitamin E is distributed widely in many foods (Institute of Medicine, 2000) and vitamin E content is different in various fats and oils. Total energy and fat are often underreported by respondents to nutrition/diet surveys (Institute of Medicine, 2000; Horner, Patterson, Neuhouser, Lampe, Beresford & Prentice, 2002; Tooze, Subar, Thompson, Troiano, Schatzkin & Kipnis, 2004). Specific information regarding the amount and type of fat consumed is not always known by research participants and most foods consumed account for less than one percent of the daily intake of alpha-tocopherol. As a result of these challenges in methodology, special care must be taken in estimating vitamin E intake from dietary intake data.

#### 2.2.1.2 Vitamin C

Ascorbic acid/ascorbate is an active form of vitamin C and the terms vitamin C and ascorbic acid are often used interchangeably (Sizer & Whitney, 2003). Vitamin C plays many roles in the human body. One important role of vitamin C is that of a water soluble antioxidant. In this capacity it acts mostly in the intracellular fluid. It has a very high reducing power and as a result of this, vitamin C can reduce reactive oxygen species (Institute of Medicine, 2000). Another important function of vitamin C is its role in the production of collagen, the connective tissue protein found in tendons, arteries, bone, skin and muscle (Mann & Truswell, 1999).

There is an interaction between vitamin E and vitamin C in the human body. When vitamin E encounters a free radical it attempts to stabilize the free radical by giving up one of its own electrons and as a result of this vitamin E is converted into a free radical itself as it now has an unpaired electron. When the vitamin E radical interacts with vitamin C, the vitamin C will regenerate the vitamin E back to its useable form (Mann & Truswell, 1999).

The EAR for Vitamin C has been set at 75 mg/day for adult males and 60 mg/day for adult females. People who smoke need an additional 35 mg/day of vitamin C to meet their requirements. As a result, the EAR for vitamin C for smokers has been set at 110 mg/day for adult males and 95 mg/day for adult females. The RDA for vitamin C for smokers is set at 125 mg/day for adult males and 110 mg/day for adult females. These higher intakes should allow smokers to maintain vitamin C blood levels similar to non-smokers (Institute of Medicine, 2000).

Intakes of vitamin C have been shown to be inadequate in certain populations. NNL found that over 50% of the population had inadequate intakes of vitamin C and males had even higher rates of inadequacy (Roebothan, 2003). The British Columbia Nutrition Survey: Report on Supplements also found that 32% of the population had inadequate intakes of vitamin C from food to meet their estimated needs. When total vitamin C (food and supplements) was considered, 23% of the population still had inadequate intakes (Barr, 2004). Results from the Third National Health and Nutrition Examination Survey (NHANES III) found that mean intakes of vitamin C in the overall population were normal but that deficiency and vitamin C depletion were common in many individuals (Hampl, Taylor & Johnston, 2004).

Fresh fruits and vegetables are good dietary sources of vitamin C. Citrus fruits, strawberries, melons, cauliflower and broccoli are all excellent sources (Mann & Truswell, 1999). Vegetables lose much of their vitamin C when they wilt or are cut and large amounts of vitamin C are also lost when foods are cooked especially in large amounts of water (Bender, 2002). As a result it is best to eat vitamin C rich foods when they are raw and not chopped. Some foods and beverages are fortified with vitamin C, including ready to eat cereals and many fruit juices and fruit drinks (Government of Canada, 2003).

## 2.3 Diabetes Mellitus

Diabetes mellitus, commonly referred to as diabetes, is a chronic disease in which the body cannot properly process glucose, a sugar used for energy. The hormone insulin is needed to take glucose from the blood and move it into the body's cells. Insulin is produced by the beta (β) cells found in the islets of Langerhans of the pancreas, which are discrete clusters of endocrine cells that are dispersed throughout the organ but are most abundant in the tail of the pancreas. Insulin production by the beta cells is stimulated by increases in the blood glucose level. As blood glucose increases the beta cells produce insulin to restore a normal plasma glucose level of approximately 5.0 mmol/L. Insulin lowers blood glucose levels by reducing hepatic glucose production and by stimulating glucose uptake in the skeletal muscle and to a lesser degree in the adipocytes and heart muscle (Porte, Sherwin & Baron, 2003).

Figure 1 shows the prevalence of diabetes in Canada by province for people aged 12 and over. The Atlantic Provinces have higher rates of diabetes than other regions of the country. Newfoundland and Labrador has the highest prevalence at 5.8%, which is higher than the Canadian average of 4.1%. Not only are rates of diabetes more prevalent in Newfoundland and Labrador but they are also increasing, especially among the young (Canadian Diabetes Association, 2001). In 1994/95 there was no difference in the prevalence of diabetes between Canadian men and women. However, by 2000/01 the rate of diabetes was higher in men. The proportion of men who had been diagnosed increased

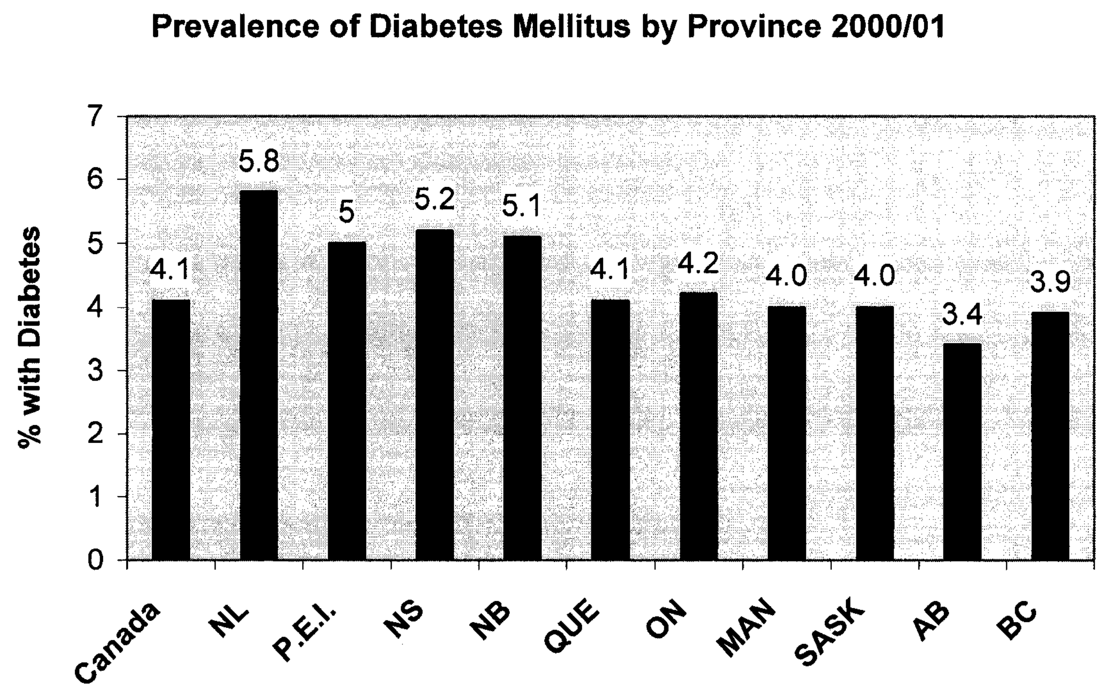


**Figure 1: Prevalence of Diabetes Mellitus in Canada by Province for 2000/01**

(Source: Statistics Canada, 2001)

from 3.1% to 4.4%, while among women the increase rose from 3.0% to 3.9% (Statistics Canada, 2001). As these numbers show, diabetes is on the rise in Canada, especially among men.

The National Population Health Survey 1996/97 longitudinal file reported an estimated 60,000 cases of diabetes every year in Canada. This is an incidence rate of 2.6 new cases per 1,000 people aged 12 and over each year (95% confidence interval [CI] 2.0-3.2 per 1,000 each year) (Health Canada, 1999).

As the rates of diabetes rise it becomes a growing public health concern and a major economic burden. Not only are the costs of diabetes a problem, but the economic costs associated with diabetes complications, such as cardiovascular disease and renal failure, are also a huge problem. The economic burden of diabetes and its related complications in Canada is estimated to be $9 billion (US) each year, which includes direct health care costs and indirect costs, such as premature death and lost productivity (Health Canada, 1999).

In people without diabetes the blood sugar level is maintained within a fairly constant range of 5.0 to 7.0 mmol/L. If the fasting blood sugar is below 5.5 mmol/L there is likely no diabetes. Borderline cases have fasting blood sugar values between 5.5 and 7.0 mmol/L. In 1999 the World Health Organization (WHO) reported that a positive diagnosis of diabetes could be made when the fasting blood sugar level is greater than or equal to 7.0 mmol/L and/or a plasma glucose level at or exceeding 11.1 mmol/L two hours after a 75-g oral glucose tolerance test. For an accurate diagnosis both tests should be used and this result should be seen on two separate occasions (Pickup & Williams, 2003).

There are two types of diabetes, insulin dependent diabetes mellitus (IDDM) and non-insulin dependent diabetes mellitus (NIDDM). IDDM is primarily the result of damaged beta cells in the pancreas whereas NIDDM tends to be associated with insulin resistance in which the body cannot use insulin efficiently. As a result glucose builds in the blood to above normal levels (Pickup & Williams, 2003).

### 2.3.1 Insulin Dependent Diabetes Mellitus (IDDM)

IDDM is an autoimmune disease in which the body produces little or no insulin. Due to an immune dysfunction the body actually mistakes the beta cells as foreign and attempts to destroy them (Smythies, 1998). This type of diabetes is more common in children and young adults and is often referred to as juvenile-onset diabetes or Type 1 diabetes. This form of diabetes is not the most frequent, representing only 10% of cases (Porte, Sherwin & Baron, 2003) and the peak age of onset is 10 to 14 years of age (Pickup & Williams, 2003).

When diagnosed with IDDM patients display symptoms of rapid weight loss; blurred vision; increased urine production, especially during the night; sugar in the urine; intense thirst and fatigue, yet the patient's appetite is good and may even be increased. These symptoms appear as a result of high blood sugar. In an attempt to keep the concentration of glucose in the urine low, the kidneys produce a high volume of urine. This along with the high osmotic pressure caused by the elevated circulating glucose levels increases the body's need for water and drives the person with diabetes to drink great amounts of fluids. If a diagnosis is not made at the presence of these symptoms then lack of appetite, nausea, vomiting, abdominal pain, muscular cramps, dehydration and signs of acidosis may develop (Pickup & Williams, 2003).

The treatment of IDDM involves insulin therapy, diet therapy and physical activity. Insulin therapy is considered by many to be the most important part of the treatment with replacement based on the non-diabetic insulin secretion pattern. However, people with this type of diabetes do need to inject insulin prior to their meals. Physical exercise, like meal planning, is suggested for overall physical and mental health. It is important to remember, especially when dealing with children, that meals and physical activity are fun activities and should not be viewed as a form of therapy. Since blood glucose levels vary greatly throughout the day, frequent blood glucose monitoring helps with the control of IDDM. This involves pricking the finger about three to six times per day, or more frequently, to determine the blood glucose level. Keeping blood glucose under control is also the best way to prevent or reduce the risk of complications (Pickup & Williams, 2003).

Some of the late complications of IDDM include retinopathy, renal failure, neuropathy, and cardiovascular complications such as atherosclerosis, coronary heart disease, and stroke. In general, these complications are more frequent the longer the patient has had IDDM. As a result of these complications life expectancy is often reduced for these patients. The cause of mortality in those with IDDM is usually due to renal complications. When the patient has had diabetes for more than 30 years the cause of mortality is usually cardiovascular in nature (Pickup & Williams, 2003).

### 2.3.2 Non-Insulin Dependent Diabetes Mellitus (NIDDM)

The natural history of NIDDM usually begins with insulin resistance, which is a condition in which the pancreas produces enough insulin but the body cannot use the insulin efficiently. As a result, the sugar in the blood is not moved into the cells and the pancreas produces more and more insulin in an attempt to compensate for the rising sugar levels. This helps keep blood sugar levels within a normal range for some time but eventually the stressed pancreas is no longer able to compensate and produce these large amounts of insulin. The condition at this point is characterized by impaired glucose tolerance with blood glucose levels higher than normal but usually lower than in those with insulin dependent diabetes. If untreated this condition often progresses to NIDDM (Matthews, 2003). This condition is usually more common in older adults and is often referred to as adult-onset diabetes or type 2 diabetes. This is the most common form of diabetes accounting for 90% of all cases (Porte, Sherwin & Baron, 2003), with the peak age of onset being between the ages of 60 and 70 years. However, in recent years there have been large increases in the number of adolescents and children who have developed NIDDM. Rates of NIDDM are also increasing in adults. Some of the risk factors associated with NIDDM include obesity, lifestyle factors and genetic predisposition (Pickup & Williams, 2003).

An elevated Body Mass Index (BMI) is an indicator of obesity and is calculated using measurements of standing height and total body weight. BMI equals body weight in kilograms divided by standing height in meters$^2$ ($kg/m^2$). BMI correlates well with total body fatness and degree of disease risk. A high BMI is a major risk factor for NIDDM (Health Canada, 2003). As the BMI increases the risk of disease also increases. Table 1 shows the health risk associated with BMI range, which are in accordance with the WHO standards. The combined effect of the aging population and the rising prevalence of obesity in adults and children may be contributing to the increasing rates of diabetes. The National Population Health Survey 1996/97 found that 10.4% of people aged 65 and over had diabetes compared with 3.2% in people aged 35 to 64 (Health Canada, 1999).

Overweight and obese adults in Canada are at a 1.5 to 10 times greater risk of developing diabetes when compared to healthy weight adults (Canadian Population Health Initiative, 2004). The National Population Health Survey found that 29.2% of the Canadian population were overweight. The survey also found that 58.7% of people with diabetes were overweight compared to 32.2% of people without diabetes (Health Canada, 1999). In 2000/01, 31.9% of Canadian adults were classified as overweight and the numbers

**Table 1: Health Risk According to Weight and Body Mass Index (BMI) Range**

| Weight Range | BMI ($kg/m^2$)[a] | Disease Risk |
|---|---|---|
| Underweight | < 18.5 | Increased |
| Normal | 18.5 – 24.9 | Least |
| Overweight | 25.0 – 29.9 | Increased |
| Obese: Class I | 30.0 – 34.9 | High |
| Obese: Class II | 35.0 – 39.9 | Very High |
| Obese: Class III | ≥ 40.0 | Extremely High |

Source: Health Canada, 2003

[a] Body Mass Index (BMI) is an indicator of obesity and is calculated using measurements of standing height and total body weight. BMI equals weight (kg) divided by height ($m^2$).

were higher in Newfoundland and Labrador with 42.8% of adults classified as overweight (Statistics Canada, 2002). In 2004 the Canadian Community Health Survey (CCHS) found that 36.1% of Canadians 18 years and older were overweight and 23.1% were obese. Forty per cent of males and 30.2% of females were found to be overweight, whereas 22.9% of males and 23.2% of females were obese. Again the rates in Newfoundland and Labrador were higher with 33.3% of men and 23.2% of women being obese (Tjepkema, 2005). It has been estimated that every kilogram of weight gain over 10 years increases a person's risk of developing diabetes by 4.5% (Ford, Williamson & Liu, 1997).

Individuals who have an apple shaped figure or who carry most of their weight above the hips are at a greater risk for diabetes as compared to those with a pear shaped figure and carry excess weight in the hips and thighs. A waist circumference of more than 102 cm (40 inches) in men and 88 cm (35 inches) in women would suggest increased risk (Health Canada, 2003). Wang, Rimm, Stampfer, Willett & Hu (2005) found that men with a waist circumference that exceeds 100 cm (40 inches) have a 12 times greater risk of developing diabetes as compared to those with a waist size of 86 cm (34 inches) or less. When determining disease risk it is useful to take into account both the BMI and waist circumference measures. Lifestyle factors such as physical inactivity, high fat/low carbohydrate diet, high alcohol consumption and smoking are also associated with an increased risk of developing NIDDM. Having a first-degree relative with NIDDM also increases the risk (Pickup & Williams, 2003). This type of diabetes often goes undiagnosed for many years because the high blood sugar (hyperglycemia) is not serious enough to cause noticeable symptoms. Many people with NIDDM have blood glucose levels that are only slightly raised (Pickup & Williams, 2003).

The treatment of NIDDM is similar to the treatment of IDDM as it involves diet, physical activity and sometimes insulin therapy. Most emphasis however is placed on improving diet and exercise. The diet should consist of complex carbohydrates as opposed to refined carbohydrates in an attempt to properly manage blood sugar levels (Pickup & Williams, 2003). The glycemic index is a way of ranking carbohydrates based on their immediate effect on blood sugar levels. Carbohydrates that break down quickly during digestion, such as refined carbohydrates, have the highest glycemic indices. When these types of carbohydrates are consumed the blood sugar levels rise at a fast rate. Carbohydrates that break down slowly, such as complex carbohydrates, release glucose gradually into the bloodstream thus these types of carbohydrates have low glycemic indices. It has been suggested that eating more foods with a low glycemic index should help to control blood sugar levels. These foods tend to be higher in fibre and lower in fat as compared to high glycemic index foods (Whitham & Hamilton, 2002).

It is recommended that fat intake be maintained at 20-35% of total energy for optimal health. Also, the consumption of dietary fibre should be increased to 21-38 grams per day for healthy adults depending upon the age-sex subgroup (Institute of Medicine, 2002). Soluble fibre may also help control blood sugar by delaying the emptying of the stomach, slowing the entry of glucose into the bloodstream and reducing the post-meal rise in blood sugar since it slows the digestion of food (Whitham & Hamilton, 2002).

People with NIDDM also need to control body weight. Lowering a high BMI to one within the recommended range of 18.5 to 24.9 would be ideal but is very difficult for many to achieve. As a starting point it is recommended that body weight be reduced by 5-10%, which should improve insulin sensitivity. Also, light to moderate exercise such as a walk four times a week for no less than 40 minutes should help to control blood sugar levels (Pickup & Williams, 2003).

Some of the complications associated with NIDDM include retinopathy, nephropathy and coronary heart disease. Retinopathy and cataracts affect about 15% of NIDDM patients and these complications may be present when the patient is diagnosed. The risk of developing nephropathy and end-stage renal disease is lower for NIDDM patients as compared to IDDM patients because the former are usually older when they develop diabetes and thus have had less exposure to hyperglycemia. On the other hand, the risk of developing coronary heart disease is high with 60-75% of NIDDM patients dying from this condition. Complications are common among patients with NIDDM and are potentially severe. As a result, life expectancy can be reduced by 5-10 years for middle-aged patients with NIDDM (Pickup & Williams, 2003).

### 2.3.3 Diet and Diabetic Complications

Evidence suggests that oxidative stress plays a major role in the development of diabetes and its complications (Oberley, 1988). Diabetes is usually associated with increased free radical production and reduced antioxidant defences (Baynes, 1991, Giugliano, Ceriello & Paolisso, 1996). Dietary antioxidants can help to scavenge free radicals, reduce oxidative stress and are safe and inexpensive when compared to insulin therapy. As a result, dietary antioxidants such as vitamin E and vitamin C could offer a potential treatment and/or prevention method for diabetes and its resulting complications.

Good dietary practices can be used to help control chronic diseases such as diabetes and its complications. Modification of diet and lifestyle has been shown to be effective in preventing and delaying diabetes in high-risk populations (Pan, Li, Hu, Wang, Yang & An, 1997; Tuomilehto, Lindstrom, Eriksson, Valle, Hamalainen, Ilanne-Parikka et al, 2001; Knowler, Barrett-Connor, Fowler, Hamman, Lachin, Walker & Nathan, 2002). Eating complex carbohydrates like whole grains, breads, rice, pasta, vegetables and beans should help to control blood sugar which is important since evidence suggests that free radical formation is associated with hyperglycemia or high blood sugar (Wolff, 1993). Thus controlling blood sugar should in turn help to control diabetic complications.

Evidence suggests that fruit and vegetable consumption may lower the risk of developing diabetes (Colditz et al, 1992; Feskens et al, 1995; Ford, 2001). Evidence from Ford, Mokdad, Giles & Brown (2003) also suggests that people at risk for developing diabetes have lower circulating concentrations of several antioxidants, including vitamins E and C. Participants with the metabolic syndrome in this study also consumed less fruits and vegetables than those without this syndrome (Ford et al, 2003). Metabolic syndrome is a condition characterized by excess weight, hyperglycemia, high blood pressure, low HDL cholesterol and hypertriglycemia. People with this syndrome are often at a higher risk for developing diabetes. Fruit and vegetables are good sources of dietary antioxidants such as vitamin C. As their consumption may be beneficial to diabetes prevention, it would be a good personal health practice to increase fruit and vegetable intake.

Canada's Food Guide recommends five to ten servings of fruit and vegetables per day (Health Canada, 1992). In 2001 the Canadian Community Health Survey reported that only 33.4% of the Canadian population aged 12 and over were consuming fruit and vegetables five to ten times a day. In Newfoundland and Labrador, 26.5% where consuming this amount (Statistics Canada, 2001). According to these numbers, more people need to increase their consumption of fruits and vegetables. However, when asked about changes to their diets 62% of Canadians reported that they have made some changes in the past year to improve their eating habits. Of the people making changes to their diets, 26% claim to be increasing vegetable and fruit consumption (Health Canada, 2002).

### 2.4 Summary of Literature Review

Population health is an approach that aims to improve the health of the whole population and to reduce health inequities among certain groups within the population. Health promotion can be applied to an entire population. To promote health at this level a broad range of factors and conditions should be considered simultaneously. Many such factors have now been identified which have a strong influence on maintaining health, promoting wellness and preventing illness (Health Canada, 2002). One way to apply health promotion strategies while considering the many determinants of health might be to focus on personal health practices. Dietary intake is one practice that is personally modifiable and can be used to maintain wellness. Some nutrients are essential to life meaning that the human body cannot make them and they must be obtained from food otherwise deficiencies will develop. Water, some forms of carbohydrate, lipids, proteins, vitamins and minerals are classified as essential nutrients (Sizer & Whitney, 2003). Over-consumption and under-consumption of these nutrients are both problems and both exist in Canada today. Both may increase the risk of ill health. However, a balanced diet with an adequate supply of nutrients may be useful in preventing such chronic illness as diabetes.

Oxidative stress is defined as damage that results from the overproduction of free radicals and/or the failure of antioxidant defences (Smythies, 1998). Evidence suggests that oxidative stress plays a major role in the development of diabetes and its complications (Oberley, 1988). Diabetes is often associated with increased free radical production and reduced antioxidant defences (Baynes, 1991, Giugliano, Ceriello & Paolisso, 1996). It has been suggested that one way to control oxidative stress is to maintain an adequate intake of antioxidants like vitamin E and vitamin C (Ames, Shigenaga & Hagen, 1993). Good dietary sources of vitamin E are nuts and vegetable oils. Vitamin C is prevalent in many plant foods including fruits and vegetables.

# Chapter III

# METHODOLOGY

## 3.1 Nutrition Newfoundland and Labrador Survey

This study is a secondary analysis of some of the data collected by the Nutrition Newfoundland and Labrador (NNL) survey in 1996 (Roebothan, 2003). Roebothan (2003) describes the response rate of the NNL survey at the time of data collection as being 51.4%. The sample design selected independent samples for both the spring and fall seasons.

NNL was part of a nation-wide effort to collect nutritional data, which can be used to improve the health of Canadians. Data was collected mainly by questionnaires. The Non-Response Questionnaire (Appendix A) was given to people who refused to take part in the survey. This was administered to assess if the people who refused to participate were different from the people who did participate. Information relating to dietary consumption patterns of Newfoundland and Labrador residents and related data were collected using two questionnaires. The 24-hour food recall form (Appendix B) allowed for the gathering of all the foods and beverages the participant consumed during the previous day including detailed descriptions of each food and the amounts eaten. The consumption of nutritional supplements was also recorded. A Food Frequency Questionnaire (Appendix C) explored how often the participant consumed various foods during the previous month. Information relating to general health and demographics were also collected using two questionnaires. A Nutrition and Health Questionnaire (Appendix D) posed questions pertaining to the participant's general health and his/her attitude towards nutrition and health. Finally, a Demographic Profile Questionnaire, Form E (Appendix E) was used to gather specific demographic information pertaining to education, marital status and income. Also, recorded on this form were measurements of total body weight, standing height, waist circumference and hip circumference.

### 3.1.1 Sample Design

A stratified probability sample design that was developed by Statistics Canada was used to select the participants for the NNL survey. Urban and rural areas of the province were represented in the survey and data were collected on weekdays as well as weekends. The sample design also selected independent samples for both the spring and fall seasons (Roebothan, 2003).

## 3.2 Study Sample

NNL is representative of the population of Newfoundland and Labrador (Roebothan, 2003). Potential participants for NNL were chosen from the Newfoundland Health Insurance File (NHIRF) which contains the names of all the participants registered with the provincial Medical Care Plan (MCP). This file was used to draw a stratified random sample of names of Newfoundland and Labrador residents for the survey. Potential participants were contacted originally by mail and then by telephone. If they agreed, participants were interviewed in-person by trained interviewers. Data collection was conducted in eleven areas throughout the province (Appendix F) and was conducted on 1927 participants aged 18-74 years. Institutionalized individuals, those living on military reserves and pregnant or lactating women were excluded from the survey.

### 3.3 Ethics Approval

The NNL survey obtained ethics approval from the Committee for Research with Human Subjects, Faculty of Science, Memorial University of Newfoundland, prior to selecting participants and administering the questionnaires. Ethics approval for the present study, a secondary analysis of data collected by NNL, was obtained from the Memorial University of Newfoundland, Faculty of Medicine, Human Investigation Committee (Appendix G).

All NNL files are kept in a locked storage cabinet in a locked room at Memorial University of Newfoundland. All computer files are password protected. For the present study, the researcher completed an oath of confidentiality in the presence of a Notary of the Public and a witness to access and use copies of the original data (Appendix H).

### 3.4 Research Protocol

This study is a secondary analysis of some of the data collected by the Nutrition Newfoundland and Labrador (NNL) survey in 1996 (Roebothan, 2003) with two main foci. One is to estimate the proportion of the Newfoundland and Labrador population who are consuming inadequate levels of total vitamin E and vitamin C (from food and supplements) to meet their needs and the other is to determine if nutrient intake are associated with the presence of pre-diagnosed diabetes.

### 3.4.1 Adequacy of Nutrient Intakes

The adequacy of vitamin E intake from food and total vitamin E and C intakes (food and supplements) were estimated in this study.

#### 3.4.1.1 Sub-Study Sample

For the present study data on 1927 participants aged 18-74 years were included, with the exception of analyses on vitamin E data which pertains to 1181 participants aged 35-74 years. The ages were restricted to this group due to the fact that the 24-hour recall data had to be entered by the researcher into the software to determine the vitamin E intake. This was very time consuming and since diabetes rates increase with age, the decision was made to include only the older two-thirds of the sample. Participants who did not consume any foods that contain vitamin E were included in the analysis. Both males and females were also included in all of the analyses as were smokers.

#### 3.4.1.2 Vitamin E Intake from Food

For the purpose of this study the alpha-tocopherol form of vitamin E only was calculated, as it is the most active or usable form of vitamin E (Mino, Nakamura, Diplock & Kayden, 1993). Prior to this study vitamin E intakes had not been analyzed for the residents of Newfoundland and Labrador. Food Processor Software (ESHA Food Processor SQL

Edition Version 9.0.1) was used to analyze dietary intake data of NNL participants. When the vitamin E content of pre-made foods was not available on the Food Processor Software, recipes were referred to and the vitamin E content of all ingredients was determined manually. The recipes were obtained from the respondent who consumed the food or from the venue that prepared/packaged the food, at the time of the original NNL survey. When the dietary intake file, prepared by NNL interviewers, reported volumes of food but the software required weights for analysis, then the weights of food were determined from food densities found in the literature (American Home Economics Association, 1980; Fogt, 2002). Even though the latest available version (9.0.1) of the Food Processor was used, vitamin E values of some foods were not available on the software. When vitamin E values were not included in the software, they were found in the literature or on the Internet and entered manually (Bowes & Church, 1998; Traber & Blumberg, 2000).

Available data were very limited on the vitamin E content of local foods such as seal and seabirds. According to professional dietitian M. Villeneuve (personal communication, July 8, 2004), these game foods contained trace amounts of vitamin E only and so 0 mg was used for these foods. In general, animal foods tend to contain only trace amounts of vitamin E (National Research Council, 1989). This may slightly underestimate the vitamin E intakes for these foods; however the number of participants and the volumes of these foods that were consumed on the days in question were very low.

### 3.4.1.3 Total Vitamin Intakes of Vitamins E and C

Total vitamin intakes refer to intake values from food and supplements combined. Intakes for vitamin C from food did not need to be calculated as they were analyzed by the 24-hour recall form and obtained from the existing database of the NNL survey. Total intakes of vitamin E and vitamin C were obtained by adding the intake value from food and the intake value from supplements for each of these vitamins. The researcher calculated supplement intakes for vitamins E and C using the data indicated in the 24-hour food recall form of the NNL survey (Appendix B). Participants were asked "Did you take any vitamin or mineral supplements in the last month?" If participants answered "Yes" they were then asked to tell the interviewer all vitamin and mineral supplements taken during the last month with the DIN (drug identification number) of each. When the interview was conducted in the participant's home this information was recorded directly from the supplement label. When the interview was conducted elsewhere, this information was not always available. Participants were also asked, "How often was each of these supplements taken during the last month?" (Number of times per day, per week or per month) and "How many pills (capsules, etc.) were usually taken on each occasion?" Finally, participants were asked "Yesterday, how many pills were taken?"

Vitamin E and vitamin C supplement intakes reported in this study are limited to those consumed on the day prior to the NNL interview. Since the vitamin E and C intakes from food were obtained using the 24-hour recall and since the supplement intakes of vitamin E and C would be later grouped with the intakes from food, the nutrient intakes from supplements were expressed in this study solely as the intake from the previous day. Health Canada's Drug Product Database was used to determine the amount of vitamins C and E obtained from supplements (Health Canada, 2004). When the supplement DIN was not found on this database, the Compendium of Non-prescription Products (CNP, 1996) and the Compendium of Pharmaceuticals and Specialties (CPS, 1996) were then consulted. Only if the supplement could not be found in either of these sources was <www.drugstore.com> then consulted (Drugstore.com Inc, 2004). When the content of vitamin E and/or vitamin C in a supplement was not available from any of these sources then the intake of the supplement was excluded from the analysis (23 participants). Supplement intakes for vitamin E were analyzed only for participants aged 35-74 years due to the fact that analysis of food intake for vitamin E content was performed on this age group only.

#### 3.4.1.4 Assessing Adequacy of Vitamin E Intake

Vitamin E intakes from food alone and total vitamin E intakes (food and supplements) were compared to population intakes recommended to maintain health. The EAR for vitamin E has been set at 12 mg/day for adults (Institute of Medicine, 2000). Vitamin E intakes were analyzed by grouping participants into two categories: those consuming less than the appropriate EAR and those consuming greater than or equal to the appropriate EAR set for that particular nutrient. The proportion of the population consuming inadequate levels of these nutrients was then estimated. An individual was deemed to be consuming an inadequate amount of a nutrient if the individual consumed less than the appropriate EAR on the day that they were interviewed. Intakes less than the EAR were coded as (0) and intakes greater than or equal to the EAR were coded as (1).

### 3.4.1.5 Assessing Adequacy of Vitamin C Intake

Total vitamin C intakes (food and supplements) were compared to population intakes recommended to maintain health. Non-smokers and smokers were assessed separately. The EAR for vitamin C has been set at 75 mg/day for adult male non-smokers and 60 mg/day for adult female non-smokers. Smokers need an extra 35 mg/day to meet their requirement so the EAR for vitamin C has been set at 110 mg/day for adult male smokers and 95 mg/day for adult female smokers (Institute of Medicine, 2000). Vitamin C intakes were analyzed by grouping participants into two categories: those consuming less than the appropriate EAR and those consuming greater than or equal to the appropriate EAR set for that particular nutrient. The proportion of the population consuming inadequate levels of these nutrients was then estimated. Intakes less than the EAR were coded as (0) and intakes greater than or equal to the EAR were coded as (1).

### 3.4.1.6 Data Analysis

For research objectives one and two, the daily intake of vitamin E as contributed by food and total intakes of vitamin E and vitamin C from food and supplements were estimated. Mean, standard deviations and median daily intakes were analyzed along with percentiles. These intakes were then compared to intakes recommended to maintain health (Institute of Medicine, 2000). For research objective three, the proportion of the population consuming inadequate levels of these nutrients was estimated. For the purpose of this study, a person consuming an inadequate level of a nutrient is one consuming less than the recommended intake of that nutrient (Estimated Average Requirement) for the appropriate population subgroup. Outliers were included in the data analysis.

### 3.4.2 Nutrient Intakes and Diabetes Mellitus Status

Since this province has the highest prevalence of diabetes (Statistics Canada, 2001) and that the rates are also increasing, especially among the young (Canadian Diabetes Association, 2001), another objective of this study was to investigate whether nutrients intakes are associated with diabetes status. Statistical analyses such as Chi-Square tests and logistic regression were performed on unweighted data to examine whether people with diabetes had higher or lower intakes than people not previously diagnosed with diabetes.

#### 3.4.2.1 Variables Studied

A number of variables were investigated including dietary intake of various nutrients, age, sex and anthropometric factors.

##### 3.4.2.1.1 Nutrient Intakes from Food

The possible relationship between the intake of certain nutrients and the self-reported diagnosis of diabetes mellitus by a health professional was explored. The value of vitamin E intake from food was obtained from the calculations made in this study.

Intakes of vitamin C, vitamin B6, vitamin B12, thiamin, riboflavin, magnesium, iron and zinc intakes did not need to be calculated as they were analyzed by the 24-hour recall form and obtained from the existing database of the NNL survey. Intakes of these nutrients were analyzed by grouping participants into two categories for each nutrient: those consuming less than the appropriate EAR and those consuming greater than or equal to the appropriate EAR set for that particular nutrient. This was done to suggest what proportion of each subgroup studied was meeting its requirements for each of these specific nutrients. EAR values vary with nutrients and may vary with age-sex subgroups for the same nutrient. Table 2 shows the EAR values for each nutrient investigated. Nutrient intakes less than the EAR were coded as (0) and intakes greater than or equal to the EAR were coded as (1).

The possible relationship between the intake of total vitamin E and total vitamin C and the self-reported diagnosis of diabetes mellitus by a health professional was also explored in this study. The EAR for vitamin E and vitamin C were previously mentioned. Again, nutrient intakes less than the EAR were coded as (0) and intakes greater than or equal to the EAR were coded as (1).

#### 3.4.2.1.2 Predictor Variables

A number of predictor variables were examined including age, sex and anthropometric factors. Age was calculated using the participant's MCP number and the interview date. MCP numbers are 12 digits in length and include the person's date and year of birth.

**Table 2: Estimated Average Requirements (EAR) by Nutrient and Age/Sex Groupings**

| Nutrient | Gender | Age | EAR |
|---|---|---|---|
| Vitamin B6 | Both Sexes | 19-50 | 1.1 mg/day |
| | Males | 51+ | 1.4 mg/day |
| | Females | 51+ | 1.3 mg/day |
| Vitamin B12 | Both Sexes | 19+ | 2.0 μg/day |
| Thiamin | Males | 19+ | 1.0 mg/day |
| | Females | 19+ | 0.9 mg/day |
| Riboflavin | Males | 19+ | 1.1 mg/day |
| | Females | 19+ | 0.9 mg/day |
| Magnesium | Males | 19-30 | 330 mg/day |
| | | 31+ | 350 mg/day |
| | Females | 19-30 | 255 mg/day |
| | | 31+ | 265 mg/day |
| Iron | Males | 19+ | 6.0 mg/day |
| | Females | 19-50 | 8.1 mg/day |
| | | 51+ | 5.0 mg/day |
| Zinc | Males | 19+ | 9.4 mg/day |
| | Females | 19+ | 6.8 mg/day |

Source: Institute of Medicine (1997), Institute of Medicine (1998), Institute of Medicine (2001).

Comparing interview date and date of birth derived from the participant's MCP number allowed for age calculation.

Vitamin E analysis included participants aged 35-74 years whereas all other nutrient analysis included participants aged 18-74 years. Because EAR values vary with age and sex, various nutrients were grouped differently for the Chi-Square analysis. Since the EAR for Vitamin B6 is different for younger and older adults, analyses of intake for this nutrient were performed on two groups, 19-50 years and 51+ years. Likewise, analyses of participants' intakes of magnesium were performed on two separate groups, 19-30 years and 31+ years. The EAR for iron is different for males and females, and even varies by age for adult females. Analysis of intake for males aged 18-74 years was conducted. Analyses of iron intake pertaining to females were performed separately on those aged 19-50 years and 51+ years. Sex was another predictor variable that was explored and it was coded as either male (0) or female (1).

Body Mass Index (BMI) is an indicator of overweight/obesity and is calculated using measurements of standing height and total body weight (BMI = weight in kilograms/height in meters$^2$) (Health Canada, 2003). In this study, the interviewers directly measured total body weight and standing height of all willing participants. BMI was calculated from weight and height data and mean BMI for people without diabetes was compared to mean BMI of those previously diagnosed with diabetes. Chi-Square analysis was used to examine associations between nutrient intakes and diabetes status.

For this analysis, only participants with a BMI less than 27 were included. This was done to compensate for the fact that overweight/obesity is a major risk factor for diabetes. A BMI of greater than 25 is used by many at present as an indicator of overweight (Health Canada, 2003). However, it has been suggested that using 25 as the cut off for the overweight category is too strict and that some people will be labelled as overweight when they are actually normal weight for their body type (Lemieux, Mongeau, Paquette, Laberge & Lachance, 2004). It is still somewhat controversial as to whether Canadians with a BMI between 25 and 27 are at a significantly higher risk of ill health than those with a BMI between 20 and 25 (Health and Welfare Canada, 1988; Lemieux, Mongeau, Paquette, Laberge & Lachance, 2004). Also, if participants with an acceptable body weight (body weights associated with the lowest risk of ill-health) in the present study were restricted to those with a BMI less than 25 the number of participants would be very small, especially when considering the number in the diabetic subgroup. As a result, it was decided to use the past Health Canada cut-off value of BMI less than 27 for analysis (Health and Welfare Canada, 1988) to limit the influence of overweight/obesity on our findings. For the logistic regression analysis, all BMI's were included.

#### 3.4.2.1.3 Diabetes Status

All variables specified were considered for participants previously diagnosed with diabetes versus those not previously diagnosed with diabetes. For the NNL survey diabetes status was self-reported. The sample used for this study was divided into two groups based on whether or not participants had been told by a doctor or other health care worker that they had diabetes/high blood sugar (except during pregnancy) (Question 26, Part II, Form D, Appendix D). The responses were coded as 'YES' if they had been told by a doctor or other health care worker that they had diabetes, or high blood sugar (except during pregnancy) or 'NO' if they had not been told by a doctor or other health care worker that they had diabetes, or high blood sugar (except during pregnancy). Any respondent who refused to answer this question was excluded from the analysis (2 cases). No indication of type of diabetes (NIDDM versus IDDM) could be made as the question did not ask about type of diabetes only whether or not participants had been told by a doctor or other health care worker that they had diabetes/high blood sugar (except during pregnancy).

**3.4.2.2 Data Analysis**

This study is a secondary analysis of some of the data collected by the Nutrition Newfoundland and Labrador (NNL) survey. Data used in this subsection of the study were obtained from the pre-existing NNL database. These data were originally stored in SAS format, however these files were converted to the Statistical Package for the Social Sciences (SPSS) format. The data from this study were analyzed using SPSS Version 11. Descriptive analyses were carried out on weighted data to account for the overall population of the province (Weston & Laffey, 2001). Chi-Square tests and logistic regression were performed on unweighted data. Unweighted data were used when conducting these analyses because weighted data counts some people more than once so that the sample is representative of the population and this will affect standard error and variances.

For research objectives four and five, the possible relationship between the intake of certain nutrients and the self-reported diagnosis of diabetes mellitus was investigated. People with diabetes were compared to people without diabetes on a number of factors to determine if there were any significant differences. These factors include anthropometric and dietary factors. The sample was divided into groups based on whether or not they had been told by a doctor or other health care worker that they had diabetes. Chi-Square tests were used to identify differences between diabetes status and whether the respondent did or did not meet the appropriate recommended nutrient intakes (Estimated Average Requirement).

A t-test for independent means was used to compare mean BMI's of people not previously diagnosed with diabetes to those previously diagnosed with diabetes. Binary logistic regression was also used to determine whether associations existed between intakes of vitamin E (from food and total), vitamin C (from food and total) and vitamin B6, vitamin B12, thiamin, riboflavin, magnesium, iron and zinc from food alone and self-reported diabetes status. Logistic regression is used to predict a discrete outcome from a set of variables that may be continuous, discrete, dichotomous or a mix (Tabachnick & Fidell, 2001). The Wald statistic and the –2 log likelihood ratio were used to evaluate the model. The Wald statistic was used to determine if the variable was significant and if it was significant ($p < 0.05$) the –2 log likelihood was considered. If the change in the –2 log likelihood was significant ($p < 0.05$) then the variable was included in the model. This process was used to determine if the model was improved when certain variables were included.

The odds ratio is defined as the ratio of the odds that an event will occur in one group divided by the odds of the event occurring in another group (Kleinbaum, Kupper, Muller & Nizam, 1998). An odds ratio of 1 implies that the event is equally likely in people with diabetes and people without diabetes. An odds ratio greater than 1.0 implies that the event is more likely in the first group and an odds ratio of less than 1.0 implies that the event is less likely in the first group (Tabachnick & Fidell, 2001). For this study the level of significance was set at $p < 0.05$.

# CHAPTER IV

# RESULTS

## 4.1 Introduction

The results from this secondary analysis of some of the data collected by the NNL survey are presented. Although this survey was conducted on 1927 residents of Newfoundland and Labrador, all data were not available on all participants. The number of participants under consideration is reported with each corresponding table. This study analyzed data that explored the daily intakes of vitamin E from food and the contribution of supplements to the intakes of vitamin E and vitamin C. The total intakes of vitamin E and vitamin C were used to estimate the proportion of the population consuming inadequate levels of these nutrients to meet their needs. This study also explored the possible relationship between a number of variables, both nutritional and non-nutritional, and a past diagnosis of diabetes mellitus.

## 4.2 Adequacy of Nutrient Intakes

An attempt was made to determine the adequacy of vitamin E intake from food and total vitamin E and C intakes (food and supplements) in this study.

### 4.2.1 Study Population

Our sample included 1927 participants; however for the vitamin E analysis 746 were excluded for being under 35 years of age. This left a total of 1181 participants. When assessing the total vitamin intakes (food plus supplements) for vitamin E and C occasionally the content of vitamin E and/or vitamin C in a supplement could not be found so then the intake of the supplement was excluded from the analysis (23 participants).

Table 3 shows the characteristics of the complete study sample, ages 18-74 years (n = 1927). Data from all these participants were used for analysis of vitamin C intakes. There were almost equal numbers of males and females (50.3% vs. 49.7%), the majority of who were between 35-64 years of age (71.7%). Less than half of the respondents completed secondary education and two-thirds were married. The majority of the respondents had not been diagnosed with diabetes (93.0%) and about one-third were smokers.

Table 3 also shows the characteristics of the participant sub-sample used for the analysis of vitamin E, ages 35-74 years (n = 1181). The number of males and females were equal with 50.1% of the population being male and 49.9% being female. The majority of the respondents were 35-64 years of age (84.0%) while less than half had completed secondary education and the majority were married. Most of the respondents had not been diagnosed with diabetes (90.8%) and about one-third were smokers.

### 4.2.2 Intakes of Vitamin E and Vitamin C

Tables 4 and 5 present data collected on the vitamin E intakes of the study sample. Although statistical analysis was not conducted to compare intake of vitamin E by age,

**Table 3: Characteristics of the Study Sample**

| Characteristics of the Sample | Total NNL Sample (Ages 18-74) | NNL Sub-sample[a] (Ages 35-74) |
|---|---|---|
| **Sex** | (n = 1927) | (n = 1181) |
| Male | 970[b] (50.3%)[c, d] | 591 (50.1%) |
| Female | 957 (49.7%) | 590 (49.9%) |
| **Age** | (n = 1927) | (n=1181) |
| 18-34 | 356 (18.5%) | |
| 35-64 | 1382 (71.7%) | 992 (84.0%) |
| 65-74 | 189 (9.8%) | 189 (16.0%) |
| **Education Level** | (n=1902) | (n=1162) |
| No Formal Schooling | 14 (0.7%) | 14 (1.2%) |
| Some or Completed Elementary | 86 (4.5%) | 85 (7.3%) |
| Some or Completed Secondary | 870 (45.8%) | 577 (49.7%) |
| Some or Completed College | 466 (24.5%) | 247 (21.3%) |
| Some or Completed University | 466 (24.5%) | 239 (20.5%) |
| **Marital Status** | (n=1926) | (n=1180) |
| Single (Never Married) | 493 (25.6%) | 85 (7.2%) |
| Married | 1272 (66.0%) | 945 (80.0%) |
| Separated | 29 (1.5%) | 23 (1.9%) |
| Divorced | 60 (3.1%) | 57 (4.8%) |
| Widowed | 72 (3.7%) | 70 (6.0%) |
| **Diabetes Status** | (n = 1925) | (n = 1179) |
| Diabetic | 134 (7.0%) | 109 (9.2%) |
| Non-Diabetic | 1791 (93.0%) | 1070 (90.8%) |
| **Smoking Status** (n = 1927) | (n = 1927) | (n = 1181) |
| Smokers | 685 (35.5%) | 371 (31.4%) |
| Non-Smokers | 1242 (64.5%) | 810 (68.6%) |

[a] Used for study of vitamin E intakes only.

[b] # NNL respondents.

[c] % within age/sex group.

[d] Weighted NNL survey data was used to calculate percentages.

**Table 4: Daily Intakes[a] of Vitamin E [b] (mg) from Food and Total Vitamin E[c] (mg) (Food and Supplements)**

| **Vitamin E (mg) from Food** | | | |
|---|---|---|---|
| Age-Group (yrs.)[d] | Mean (SD) | Median | EAR[e] (mg/day) |
| 35-50 (n = 646) | 6.8 (4.2) | 6.0 | 12 |
| 51-70 (n = 455) | 6.7 (4.2) | 5.5 | |
| 71-74 (n = 76) | 7.2 (4.6) | 5.6 | |
| Overall (n = 1177) | 6.8 (4.3) | 5.7 | |
| **Vitamin E (mg) from Food and Supplements** | | | |
| Age-Group (yrs.) | Mean (SD) | Median | EAR (mg/day) |
| 35-50 (n = 640) | 24.7 (98.6) | 6.3 | 12 |
| 51-70 (n = 455) | 32.2 (135.6) | 6.0 | |
| 71-74 (n = 75) | 38.9 (104.7) | 7.1 | |
| Overall (n = 1170) | 28.5 (114.6) | 6.2 | |

[a] Weighted NNL Survey data used to calculate mean and median intakes.

[b] Vitamin E represents α-tocopherol.

[c] Represents supplements of vitamin E and/or vitamin-minerals.

[d] Age groupings were selected to correspond with DRI age groupings (Institute of Medicine, 2000).

[e] EAR = Estimated Average Requirement is the intake value that meets the nutrient needs of 50 percent of healthy individuals in a life stage or gender group. The EAR for Vitamin E has been set at 12 mg/day for all adults of both sexes (Institute of Medicine, 2000).

**Table 5: Percentiles[a] of Total Vitamin E Intakes (mg) from Food[b] and Supplements[c]**

| **Vitamin E Intake from Food[b]** | | **Vitamin E Intake from Food[b] and Supplements[c]** | |
|---|---|---|---|
| Percentile | mg consumed per day | Percentile | mg consumed per day |
| 35-50 yrs. (n = 646) | | 35-50 yrs. (n = 640) | |
| 25th | 3.8 | 25th | 3.9 |
| 50th | 6.0 | 50th | 6.3 |
| 75th | 9.1 | 75th | 10.1 |
| 51-70 yrs. (n = 455) | | 51-70 yrs. (n = 449) | |
| 25th | 3.7 | 25th | 3.8 |
| 50th | 5.5 | 50th | 6.0 |
| 75th | 8.7 | 75th | 10.3 |
| 71-74 yrs. (n = 76) | | 71-74 yrs. (n = 75) | |
| 25th | 4.2 | 25th | 4.3 |
| 50th | 5.6 | 50th | 7.1 |
| 75th | 9.0 | 75th | 13.1 |

[a] Weighted NNL survey data used to calculate percentiles.

[b] Represents total α-tocopherol content from food.

[c] Represents vitamin E supplement forms

the results suggest that total intakes may increase with age.

Although a mean and a median are both measures of central tendency of a group's intake, individuals may consume more than or less than the mean and the median. The difference in the mean and median values of vitamin E intake from food presented in Table 4 would suggest that intakes of vitamin E by the respondents are not normally distributed. The very large differences between mean and median values of total vitamin E would suggest that those consuming supplements substantially increased their intakes. In this study it was possible to calculate vitamin E and vitamin C intakes through supplement and thus total intakes of vitamin E and vitamin C. Our findings suggest that 8.2% of the population were consuming vitamin E and/or vitamin C supplements. One hundred and twenty-two (10.3%) respondents reported taking vitamin E through a supplement resulting in intakes ranging from 0.10 to 1625.97 mg per day. The wide variation in vitamin E consumed by food alone and especially by food and supplements is apparent in Table 5. The intakes of vitamin E by those of the 25$^{th}$ percentile are considerably less than those of the 75$^{th}$ percentile for each of the age-groups tested.

Tables 6 through 8 present data on the vitamin C intakes from food and supplements. Data pertaining to male and female intakes are presented separately due to the different estimated daily requirements of vitamin C by each group. Statistical analysis was not conducted to compare intake of vitamin C by age. As with vitamin E intakes, there were very large differences between mean and median values of total vitamin C suggesting

**Table 6: Daily Intakes[a] of Total Vitamin C (mg) from Food and Supplements[b] for Male Non-Smokers and Smokers**

| Vitamin C (mg) from Food and Supplements (Non-Smokers) | | | |
|---|---|---|---|
| Age-Group (yrs.)[c] | Mean (SD) | Median | EAR[d] (mg/day) |
| 18-34 (n = 213) | 142.3 (241.1) | 80.2 | 75 |
| 35-50 (n = 214) | 108.6 (104.3) | 76.6 | |
| 51-70 (n = 153) | 138.7 (250.7) | 76.2 | |
| 71-74 (n = 25) | 111.8 (113.6) | 87.0 | |
| Overall (n = 605) | 128.2 (202.1) | 78.1 | |
| **Vitamin C (mg) from Food and Supplements (Smokers)** | | | |
| Age-Group (yrs.) | Mean (SD) | Median | EAR (mg/day) |
| 18-34 (n = 163) | 87.4 (142.5) | 52.5 | 110 |
| 35-50 (n = 124) | 87.9 (123.5) | 56.5 | |
| 51-70 (n = 62) | 76.6 (98.0) | 56.2 | |
| 71-74 (n = 8) | 45.6 (26.6) | 35.5 | |
| Overall (n = 357) | 84.8 (127.3) | 52.9 | |

[a] Weighted NNL Survey data used to calculate mean and median intakes.

[b] Represents supplements of vitamin C and/or vitamin-minerals.

[c] Age groupings were selected to correspond with DRI age groupings (Institute of Medicine, 2000).

[d] EAR = Estimated Average Requirement is the intake value that meets the nutrient needs of 50 percent of healthy individuals in a life stage or gender group. The EAR for Vitamin C has been set at 75 mg/day for adult non-smoking males and 110 mg/day for adult male smokers (Institute of Medicine, 2000).

**Table 7: Daily Intakes[a] of Total Vitamin C (mg) from Food and Supplements[b] for Female Non-Smokers and Smokers**

| Vitamin C (mg) from Food and Supplements (Non-Smokers) | | | |
|---|---|---|---|
| Age-Group (yrs.)[c] | Mean (SD) | Median (mg) | EAR[d] (mg/day) |
| 18-34 (n = 216) | 106.9 (153.7) | 61.6 | 60 |
| 35-50 (n = 194) | 119.3 (136.8) | 82.7 | |
| 51-70 (n = 177) | 139.5 (238.7) | 98.2 | |
| 71-74 (n = 35) | 135.3 (151.3) | 92.5 | |
| Overall (n = 622) | 121.6 (177.7) | 79.9 | |
| **Vitamin C (mg) from Food and Supplements (Smokers)** | | | |
| Age-Group (yrs.) | Mean (SD) | Median (mg) | EAR (mg/day) |
| 18-34 (n = 149) | 92.5 (157.6) | 42.0 | 95 |
| 35-50 (n = 108) | 95.7 (143.9) | 54.5 | |
| 51-70 (n = 61) | 74.5 (100.1) | 42.3 | |
| 71-74 (n = 6) | 246.2 (300.4) | 275.5 | |
| Overall (n = 324) | 93.2 (148.7) | 46.1 | |

[a] Weighted NNL Survey data used to calculate mean and median intakes.

[b] Represents supplements of vitamin C and/or vitamin-minerals.

[c] Age groupings were selected to correspond with DRI age groupings (Institute of Medicine, 2000).

[d] EAR = Estimated Average Requirement is the intake value that meets the nutrient needs of 50 percent of healthy individuals in a life stage or gender group. The EAR for Vitamin C has been set at 60 mg/day for adult non-smoking females and 95 mg/day for female smokers (Institute of Medicine, 2000).

**Table 8: Percentiles[a] of Total Vitamin C Intakes from Food and Supplements[bc]**

| Vitamin C Intakes from Food and Supplements | | | |
|---|---|---|---|
| **Non-Smokers** | | **Smokers** | |
| Percentile | mg consumed per day | Percentile | mg consumed per day |
| 18-34 yrs. (n = 429) | | 18-34 yrs. (n = 313) | |
| 25th | 30.41 | 25th | 21.45 |
| 50th | 73.77 | 50th | 49.11 |
| 75th | 157.74 | 75th | 103.02 |
| 35-50 yrs. (n = 408) | | 35-50 yrs. (n = 232) | |
| 25th | 39.53 | 25th | 26.36 |
| 50th | 78.95 | 50th | 55.88 |
| 75th | 145.46 | 75th | 111.71 |
| 51-70 yrs. (n = 330) | | 51-70 yrs. (n = 123) | |
| 25th | 45.13 | 25th | 24.46 |
| 50th | 83.75 | 50th | 46.80 |
| 75th | 153.15 | 75th | 87.48 |
| 71-74 yrs. (n = 59) | | 71-74 yrs. (n = 15) | |
| 25th | 49.45 | 25th | 23.43 |
| 50th | 89.79 | 50th | 44.40 |
| 75th | 148.38 | 75th | 252.69 |

[a] Weighted NNL survey data used to calculate percentiles.

[b] Represents supplements of vitamin C and/or vitamin-minerals.

[c] Percentiles of vitamin C from food have already been reported (Roebothan, 2003).

that those taking supplements did increase their intakes to a large extent. The percentiles of total vitamin C intakes are displayed in Table 8 and the wide variation in vitamin C consumed from food and supplements is evident. The intakes of vitamin C by those of the $25^{th}$ percentile are considerably less than those of the $75^{th}$ percentile for each of the groups.

### 4.2.3 Adequacy of Vitamin E and C Intakes

Table 9 presents the prevalence of inadequate vitamin E intakes from food alone and from total vitamin E. An inadequate intake of vitamin E would be a daily intake that is less than the Estimated Average Requirement (EAR) for vitamin E (Roebothan, 2003), which is 12 mg/day for adults (Institute of Medicine, 2000). Generally intakes of this nutrient appear poor as over 88% of respondents were consuming an inadequate amount from their food to meet their estimated requirement. Even 82% of those taking a vitamin E supplement were not consuming enough to meet their EAR. Chi-Square analysis was used to measure the degree of association between total vitamin E intakes by those people who were consuming vitamin E from food alone and those who were consuming vitamin E from food and supplements. A significantly higher percentage of people meeting their vitamin E requirement were consuming vitamin E from food and supplements ($p < 0.001$) (Table 10), suggesting that taking vitamin E supplements makes a significant contribution to meeting vitamin E requirements in this group of people.

**Table 9: Prevalence[a] of Inadequate[b] Vitamin E (mg) Intakes from Food[c] and Supplements[d]**

| Age-Sex Group[e] | % of Population Subgroup Consuming less than the Appropriate EAR | |
|---|---|---|
| | Considering Intake of Vitamin E from Food Alone | Considering Intake of Total Vitamin E (Food and Supplements) |
| **MALE** | | |
| 35-50 | 84.5[f] | 80.0 |
| 51-70 | 88.4 | 85.4 |
| 71-74 | 82.4 | 75.8 |
| **FEMALE** | | |
| 35-50 | 89.9 | 85.7 |
| 51-70 | 92.1 | 80.7 |
| 71-74 | 90.5 | 76.2 |
| **OVERALL** | 88.4 (n = 1179) | 82.3 (n = 1167) |

[a] Weighted NNL survey data used to calculate prevalence of inadequate intakes.

[b] An inadequate intake of a vitamin would be a daily intake that is less than the Estimated Average Requirement (EAR) for that vitamin (Roebothan, 2003), which is 12 mg/day for vitamin E for adults (Institute of Medicine, 2000).

[c] Represents total α-tocopherol content from food.

[d] Represents supplements of vitamin E and/or vitamin-minerals.

[e] Age groupings were selected to correspond with DRI age groupings (Institute of Medicine, 2000).

[f] Refers to % within age-sex group.

**Table 10: Chi-Square Analysis by Source of Vitamin E Intake**

| Variable | Number of People consuming Vitamin E from Food[a] | Number of People consuming Vitamin E from Food and Supplements[b] | $\chi^2$ | df | p-value |
|---|---|---|---|---|---|
| Vitamin E Intake | | | | | |
| Under EAR | 1055 (87.6%) | 29 (18.7%) | 402.4 | 1 | <0.001[c] |
| Meeting/ exceeding EAR | 150 (12.4%) | 126 (81.3%) | | | |

[a] Represents total α-tocopherol content from food.

[b] Represents vitamin E supplement forms.

[c] A significantly higher percentage of people meeting their vitamin E requirement were consuming vitamin E from both food and supplements as compared to food alone.

Table 11 presents the prevalence of inadequate intakes of total vitamin C (food plus supplements). An inadequate intake of vitamin C would be a daily intake that is less than the Estimated Average Requirement (EAR) for vitamin C (Roebothan, 2003), which is 75 mg/day for adult males non-smokers, 110 mg/day for adult male smokers, 60 mg/day for adult female non-smokers and 95 mg/day for adult female smokers (Institute of Medicine, 2000). Even though the estimated requirement is greater for smokers more smokers appear to be consuming an inadequate amount of vitamin C from food and supplements when compared to non-smokers. Chi-Square analysis was used to measure the degree of association between total vitamin C intakes by smokers and non-smokers who were consuming vitamin C from food alone and those who were consuming vitamin C from food and supplements. A significantly higher percentage of non-smokers and smokers meeting their vitamin C requirement were consuming vitamin C from food and supplements ($p < 0.001$) (Table 12), suggesting that taking vitamin C supplements makes a significant contribution to meeting vitamin C requirements.

### 4.3 Nutrient Intakes and Diabetes Mellitus Status

The second focus of this study was to examine a number of nutritional factors to see if any were associated with the presence of pre-diagnosed diabetes.

#### 4.3.1 Study Population

Table 13 presents some of the characteristics of the study sample by diabetes status including sex, age, Body Mass Index (BMI), educational status, marital status and smoking status.

**Table 11: Prevalence[a] of Inadequate[b] Vitamin C (mg) Intakes from Food and Supplements[c] by Smoking Status**

| Age-Sex Group[d] | % of Population Consuming less than the EAR for Total Vitamin C (Food and Supplements[c]) | |
|---|---|---|
| | Non-Smokers | Smokers |
| **MALE** | | |
| 18-34 | 47.9[e] | 79.1 |
| 35-50 | 49.5 | 74.2 |
| 51-70 | 48.7 | 85.7 |
| 71-74 | 44.0 | 100.0 |
| Overall (n = 970) | 48.3 (n = 611) | 78.8 (n = 359) |
| **FEMALE** | | |
| 18-34 | 53.0 | 74.2 |
| 35-50 | 47.0 | 71.3 |
| 51-70 | 36.1 | 80.3 |
| 71-74 | 33.3 | 33.3 |
| Overall (n = 957) | 45.3 (n = 631) | 73.6 (n = 326) |

[a] Weighted NNL survey data used to calculate prevalence of inadequate intakes.

[b] An inadequate intake of a vitamin would be a daily intake that is less than the Estimated Average Requirement (EAR) for that vitamin (Roebothan, 2003), which for vitamin C is 75 mg/day for adult male non-smokers, 110 mg/day for adult male smokers, 60 mg/day for adult female non-smokers and 95 mg/day for adult female smokers (Institute of Medicine, 2000).

[c] Represents vitamin C supplement forms.

[d] Age groupings were selected to correspond with DRI age groupings (Institute of Medicine, 2000).

[e] Refers to % within age-sex group.

**Table 12: Chi-Square Analysis by Source of Vitamin C Intake and Smoking Status**

| Smoking Status | Number of People consuming Vitamin C from Food | Number of People consuming Vitamin C from Food and Supplements[a] | $\chi^2$ | df | p-value |
|---|---|---|---|---|---|
| Non-Smokers | | | | | |
| Vitamin C Intake | | | | | |
| Under EAR | 517 (42.6%) | 0 (0.0%) | 85.4 | 1 | <0.001[b] |
| Meeting/ exceeding EAR | 697 (57.4%) | 123 (100.0%) | | | |
| Smokers | | | | | |
| Vitamin C Intake | | | | | |
| Under EAR | 328 (61.5%) | 0 (0.0%) | 45.6 | 1 | <0.001[c] |
| Meeting/ exceeding EAR | 205 (38.5%) | 31 (100.0%) | | | |

[a] Represents vitamin C supplement forms.

[b] A significantly higher percentage of non-smokers meeting their vitamin C requirement were consuming vitamin C from both food and supplements as compared to food alone.

[c] A significantly higher percentage of smokers meeting their vitamin C requirement were consuming vitamin C from both food and supplements as compared to food alone.

**Table 13: Characteristics of the Study Sample by Diabetes Status[a]**

| | Non-Diabetic | Diabetic | p-value |
|---|---|---|---|
| **Sex** (n = 1925) | | | |
| Males | 910[b] (50.8%)[c] | 59[b] (44.0%)[c] | 0.130 |
| Females | 881 (49.2%) | 75 (56.0%) | |
| **Age** (n = 1925) | | | |
| 18-34 | 720 (40.2%) | 26 (19.3%) | |
| 35-64 | 925 (51.6%) | 66 (48.9%) | < 0.001 |
| 65-74 | 146 (8.2%) | 43 (31.9%) | |
| **Mean BMI[d]** (n = 1820) | 27.2 | 30.1 | 0.001* |
| **Education Level** (n = 1900) | | | |
| No Formal Schooling | 11 (0.6%) | 3 (2.3%) | |
| Some or Completed Elementary | 69 (3.9%) | 17 (13.0%) | |
| Some or Completed Secondary | 802 (45.3%) | 66 (50.4%) | 0.001* |
| Some or Completed College | 440 (24.9%) | 26 (19.8%) | |
| Some or Completed University | 447 (25.3%) | 19 (14.5%) | |
| **Marital Status** (n = 1923) | | | |
| Single (Never Married) | 475 (26.5%) | 17 (12.8%) | |
| Married | 1182 (66.0%) | 88 (66.2%) | |
| Separated | 26 (1.5%) | 3 (2.3%) | < 0.001* |
| Divorced | 56 (3.1%) | 4 (3.0%) | |
| Widowed | 51 (2.8%) | 21 (15.8%) | |
| **Smoking Status** (n = 1925) | | | |
| Smokers | 649 (36.2%) | 36 (26.9%) | |
| Non-Smokers | 1142 (63.8%) | 98 (73.1%) | 0.029* |

[a] Weighted NNL survey data used to calculate percentages.

[b] # NNL respondents.

[c] % within age/sex group.

[d] Body Mass Index (BMI) is an indicator of obesity and is calculated using measurements of standing height and total body weight. BMI equals weight (kg) divided by height ($m^2$).

For the Chi-Square analysis, 849 participants with a BMI greater than 27 were excluded from the total sample and 614 participants with a BMI greater than 27 were excluded from the vitamin E sample leaving 1078 and 567 participants respectively. Participants were divided into two groups for each nutrient under study, those with intakes that were less than the appropriate EAR and those with intakes that were greater than or equal to the same EAR. Chi-Square analysis suggested that diabetes is more prevalent in the 35-64 year age-group but that it did not vary with sex. Mean BMI ($kg/m^2$) for people without diabetes was compared to the mean BMI of those previously diagnosed with diabetes. Self reported data were not used to determine BMI. The results suggest that diabetes is positively associated with a higher BMI ($p < 0.001$). Education level, marital status and smoking status were also compared with diabetes status. It appears that diabetes is more prevalent in the less educated ($p < 0.001$), people who are widowed ($p < 0.001$) or non-smokers ($p < 0.001$).

### 4.3.2 Data Analysis

Data from NNL were available for vitamin C, vitamin B6, vitamin B12, thiamin, riboflavin, magnesium, iron and zinc from food and so these were studied. Intakes of vitamin E from food and total intakes of vitamin E and vitamin C as calculated in this study were also considered. Chi-Square analysis was used to measure the degree of association between these nutrient intakes and whether people had previously been diagnosed with diabetes or not. Participants were restricted to those with a Body Mass Index (BMI) of less than 27 for these particular analyses. The results are presented in

Table 14 and suggest that people with diabetes may differ from people not previously diagnosed with diabetes in their intake of magnesium, iron and zinc only (p values of 0.007, 0.021 and 0.036 respectively).

Multiple logistic regression was also used to further study a possible association between these nutrients and diabetes status. Many factors are associated with diabetes and since age and BMI have the strongest associations with diabetes these factors were controlled for in the analysis. The results are presented in Table 15. The odds ratio for magnesium, iron and zinc are among the highest of the nutrients studied, suggesting that intakes of people with diabetes could be higher than those not previously diagnosed with diabetes. However, none of the p values were $< 0.05$ so the intakes of none of the nutrients studied were shown to be significantly associated with diabetes status according to the regression analysis.

**Table 14: Chi-Square Analysis by Diabetes Status**

| Variable | Non-Diabetic | Diabetic | $\chi^2$ | df | p-value |
|---|---|---|---|---|---|
| Vitamin E Intake from Food[a] | | | | | |
| Under EAR | 461 (88.3%) | 37 (86.0%) | 0.195 | 1 | 0.658 |
| Meeting/exceeding EAR | 61 (11.7%) | 6 (14.0%) | | | |
| Total Vitamin E Intake (Food plus Supplements[b]) | | | | | |
| Under EAR | 403 (78.7%) | 35 (81.4%) | 0.172 | 1 | 0.679 |
| Meeting/exceeding EAR | 109 (21.3%) | 8 (18.6%) | | | |
| Vitamin C Intake from Food (Non-smokers) | | | | | |
| Under EAR | 228 (40.9%) | 11 (40.7%) | 0.000 | 1 | 0.990 |
| Meeting/exceeding EAR | 330 (59.1%) | 16 (59.3%) | | | |
| Vitamin C Intake from Food (Smokers) | | | | | |
| Under EAR | 283 (76.5%) | 12 (80.0%) | 0.099 | 1 | 0.753 |
| Meeting/exceeding EAR | 87 (23.5%) | 3 (20.0%) | | | |
| Total Vitamin C Intake (Food plus Supplements[c]) (Non-smokers) | | | | | |
| Under EAR | 205 (37.3%) | 10 (38.5%) | 0.013 | 1 | 0.908 |
| Meeting/exceeding EAR | 344 (62.7%) | 16 (61.5%) | | | |
| Total Vitamin C Intake (Food plus Supplements) (Smokers) | | | | | |
| Under EAR | 277 (75.1%) | 12 (80.0%) | 0.188 | 1 | 0.664 |
| Meeting/exceeding EAR | 92 (24.9%) | 3 (20.0%) | | | |
| Vitamin B6 Intake from Food | | | | | |
| Under EAR | 314 (37.5%) | 16 (30.2%) | 1.133 | 1 | 0.287 |
| Meeting/exceeding EAR | 524 (62.5%) | 37 (69.8%) | | | |
| Vitamin B12 Intake from Food | | | | | |
| Under EAR | 300 (35.8%) | 21 (39.6%) | 0.316 | 1 | 0.574 |
| Meeting/exceeding EAR | 538 (64.2%) | 32 (60.4%) | | | |
| Thiamin Intake from Food | | | | | |
| Under EAR | 246 (29.4%) | 10 (18.9%) | 2.678 | 1 | 0.102 |
| Meeting/exceeding EAR | 592 (70.6%) | 43 (81.1%) | | | |
| Riboflavin Intake from Food | | | | | |
| Under EAR | 148 (17.7%) | 7 (13.2%) | 0.688 | 1 | 0.407 |
| Meeting/exceeding EAR | 690 (82.3%) | 46 (86.8%) | | | |
| Magnesium Intake from Food | | | | | |
| Under EAR | 603 (72.0%) | 29 (54.7%) | 7.186 | 1 | 0.007[d] |
| Meeting/exceeding EAR | 235 (28.0%) | 24 (45.3%) | | | |

| | | | | | |
|---|---|---|---|---|---|
| Iron Intake from Food | | | | | |
| Under EAR | 129 (15.4%) | 2 (3.8%) | 5.367 | 1 | 0.021[e] |
| Meeting/exceeding EAR | 709 (84.6%) | 51 (96.2%) | | | |
| Zinc Intake from Food | | | | | |
| Under EAR | 360 (43.0%) | 15 (28.3%) | 4.394 | 1 | 0.036[f] |
| Meeting/exceeding EAR | 478 (57.0%) | 38 (71.7%) | | | |

[a] Represents total α-tocopherol content from food.

[b] Represents vitamin E supplement forms.

[c] Represents supplements of vitamin C and/or vitamin-minerals.

[d] A significantly higher percentage of people with diabetes are meeting their requirement for magnesium as compared to people without diabetes.

[e] A significantly higher percentage of people with diabetes are meeting their requirement for iron as compared to people without diabetes.

[f] A significantly higher percent of people with diabetes are meeting their requirement for zinc as compared to people without diabetes.

**Table 15: Predictors of Diabetes Status[a]**

| Variable | Odds Ratio | 95% Confidence Interval | p-value |
|---|---|---|---|
| Vitamin E Intake from Food[b] | 1.135 | 0.728-1.770 | 0.577 |
| Total Vitamin E Intake (Food plus Supplements[c]) | 0.847 | 0.538-1.336 | 0.475 |
| Vitamin C Intake from Food | 0.998 | 0.711-1.401 | 0.993 |
| Total Vitamin C Intake (Food plus Supplements[d]) | 1.005 | 0.712-1.417 | 0.979 |
| Vitamin B6 Intake from Food | 1.201 | 0.846-1.706 | 0.306 |
| Vitamin B12 Intake from Food | 0.855 | 0.604-1.211 | 0.378 |
| Thiamin Intake from Food | 1.235 | 0.838-1.819 | 0.286 |
| Riboflavin Intake from Food | 0.958 | 0.613-1.496 | 0.849 |
| Magnesium Intake from Food | 1.334 | 0.928-1.917 | 0.120 |
| Iron Intake from Food | 1.675 | 0.853-3.286 | 0.134 |
| Zinc Intake from Food | 1.205 | 0.858-1.692 | 0.281 |

[a] Controlled for age and Body Mass Index (BMI).

[b] Represents total α-tocopherol content from food.

[c] Represents vitamin E supplement forms.

[d] Represents supplements of vitamin C and/or vitamin-minerals.

# CHAPTER V

# DISCUSSION

## 5.1 Introduction

This discussion provides a possible explanation/interpretation of the results obtained in this study. How adequate are intakes of vitamin E and vitamin C by residents of Newfoundland and Labrador? Is there evidence to suggest that the intakes of specific nutrients are associated with diabetes status?

## 5.2 Representativeness of the Study Sample

The study sample for the NNL survey was representative of the residents of Newfoundland and Labrador. A comparison of the NNL data collected in 1996 with the 1996 census data revealed similar numbers. This study found that 50.3% of the population was male and 49.7% was female while the 1996 census suggests that for Newfoundland and Labrador in 1996, 49.4% of the population was male and 50.6% of the population was female (Statistics Canada, 2002). The educational attainment of the sample is somewhat consistent with the 1996 census data. The NNL sample appears to have had a higher percentage of people with university education when compared with the census data (24.2% vs. 19%). Findings on the marital status of the NNL sample are also comparable to the 1996 census data with the majority of respondents being married (Statistics Canada, 1996).

This study found that people with diabetes represent approximately 7.0% of the NNL population. The Canadian Community Health Survey (CCHS) 2001 which also asked people if they had been diagnosed with diabetes by a health professional found that 4.1% of the Canadian population aged 12 and over had diabetes. In Newfoundland and Labrador however, 5.8% of the population (5.4% for males and 6.1% for females) had reported that they had been diagnosed with diabetes by a health professional (Statistics Canada, 2002). This finding is lower than what was reported in NNL. This could be due to the fact that NNL was conducted in 1996 and rates of diabetes have been increasing in Atlantic Canada since that time (Canadian Diabetes Association, 2001). Also NNL included people aged 18-74 only whereas the CCHS included people aged 12 and over. By including participants at younger ages where diabetes is less prevalent (Health Canada, 1999) one would expect overall rates of diabetes to be lower in the CCHS than in the NNL.

The characteristics of the study sample were analyzed by diabetes status and although the findings suggest that more females may have diabetes as compared to males this was not statistically significant ($p > 0.05$). Findings of the National Population Health Surveys (NPHS) suggest that diabetes is more prevalent in females as compared to males. The NPHS 1994/95 found that 2.8% of the Newfoundland and Labrador population aged 12 and over reporting diabetes were male and 5.1% were female. Likewise, 4.0% of people in Newfoundland and Labrador with diabetes were male and 5.1% were female according to the 1996/97 NPHS. More Newfoundland and Labrador females were diagnosed with diabetes than males in the 1998/99 NPHS as well (5.8% vs. 4.5%) (Statistics Canada, 2001). The CCHS 2000/01 also found similar results with 6.1% of the diabetic population being female and 5.4 % being male in Newfoundland and Labrador (Statistics Canada, 2002).

The findings from this study also suggest that the prevalence of diabetes increase with age and is highest among adults over 65. The NPHS 1996/97 found that Canadians aged 65 years and over were found to have a prevalence rate three times higher than those aged 35 to 64 (10.4% vs. 3.2%).

People previously diagnosed with diabetes were found to have a higher BMI than people not previously diagnosed with diabetes ($p < 0.001$). This finding is consistent with previous research, which shows that overweight and obesity are risk factors for diabetes (Colditz, Willett, Stampfer, Mason, Hennekens, Arky & Speizer, 1990; Reeder, Angel, Ledoux, Rabkin, Young & Sweet, 1992; Colditz, Manson, Stampfer, Rosner, Willett & Speizer, 1992; Resnick, Valsania, Halter & Lin, 2000). The NPHS 1996/97 also found that in the 35 to 64 age group, a greater proportion of people with diabetes were overweight as compared to people without diabetes (59% vs. 32%) (Health Canada, 1999).

People with diabetes were found to be different than people not previously diagnosed with diabetes in educational attainment, marital status, and smoking status although not much literature is available to support or dispute these findings. A significantly higher percentage of people not previously diagnosed with diabetes had at least some college or university education as compared to people with diabetes. Robbins, Vaccarino & Kasl (2005) found that educational attainment was inversely associated with diabetes in women but not in men. The majority of the sample were married, however a significantly higher percentage of people not previously diagnosed with diabetes were single when compared to people with diabetes and a significantly higher percentage of people with diabetes were separated or widowed when compared to people not previously diagnosed with diabetes. Joung, Meer & Mackenbach (1995) found that the reason widowed and divorced people had a higher hospital utilisation of health services was that they suffer more from chronic conditions than married people. Marriage provides social support and as a result could buffer or protect people from the negative effects of stress (Cohen & Wills, 1985). Finally, a significantly higher percentage of people with diabetes are non-smokers when compared to people not previously diagnosed with diabetes. In contrast, Foy, Bell, Farmer, Goff & Wagenknecht (2005) found that smokers had a greater incidence of diabetes than non-smokers.

### 5.3 Nutrient Intakes

Statistical analysis was performed on intake data pertaining to a number of nutrients.

#### 5.3.1 Intakes of Vitamin E and C

NNL suggested that the intakes of many micronutrients are lower than recommended in the province and generally less adequate than those consumed by residents of other

Canadian provinces. This is supported by the findings of a number of nutrient surveys recently conducted in other provinces (Nova Scotia Heart Health Program, Nova Scotia Department of Health, Health and Welfare Canada 1993; University of Saskatchewan, 2001; Taylor, VanTil & MacLellan, 2002; Mendelson, Tarasuk, Chappell, Brown & Anderson, 2003; Balram, Villalon & Ericson, 2005). Intakes of vitamin E were not studied in NNL. Consequently, there is reason to believe that vitamin E intakes may be less than adequate. Although NNL did report on vitamin C intakes from food (Roebothan, 2003), it did not consider vitamin C intakes from supplements, as supplemental intakes were not available at that time. It is important to investigate the total intakes of vitamin E and vitamin C, as they are essential to health.

#### 5.3.1.1 Vitamin Intakes from Food and Supplements

The daily intakes of vitamin E from food were analyzed in this study. Mean intake from food was 6.7mg (SD = 4.3) and median intake was 5.7mg. Fogarty, Lewis, Weiss & Britton (2000) reported similar vitamin E intakes in a sample of 2633 adults aged 18-70 in the United Kingdom. A food frequency questionnaire was used to assess intakes and it was found that daily mean vitamin E intake was 6.2 mg (SD = 2.2). Morens, Grandinetti, Waslien, Park, Ross & White (1996) also used a food frequency questionnaire and a 24-hr recall form to determine vitamin E intake in 420 male subjects enrolled in the Honolulu Heart Study. Daily mean vitamin E intake was 9.4mg and median daily intake was 7 mg. These intakes are higher than those found in this study and by Fogarty, Lewis, Weiss & Britton (2000). This can be explained by the different samples in each study.

The present study investigated vitamin E intakes for Canadian (Newfoundland and Labrador) participants aged 35-74; Fogarty, Lewis, Weiss & Britton (2000) studied adults aged 18-70 from the United Kingdom; whereas Morens, Grandinetti, Waslien, Park, Ross & White (1996) included men of Japanese and Okinawan descent.

The daily intakes of total vitamin E (food and supplements) were also analyzed. Although those who took vitamin E supplements had increased total intakes as compared to those who did not take supplements, median intakes for both groups were less than the EAR. Mean values, which are affected by extreme values indicate intake exceeding the EAR. This finding suggests that those who take supplements have high vitamin E intakes. This can be partly explained by the fact that the small number of participants who reported taking a supplement on the day in question had very high intakes.

Mean and median intakes of vitamin C from food by residents of Newfoundland and Labrador have previously been reported. NNL found that the mean daily intake of vitamin C was 89.2 mg, representing intakes of both smokers and non-smokers (Roebothan, 2003). Luchsinger, Tang, Shea & Mayeux (2003) used a food frequency questionnaire to explore vitamin C intake in 980 US adults aged 65 years and older. The daily mean intakes were 141 mg (SD = 78). This intake is higher than what was reported in NNL.

The daily intakes of total vitamin C (food and supplements) for male non-smokers and smokers were investigated in this study. Male smokers were found to have lower intakes than non-smokers. The daily intakes of total vitamin C (food and supplements) for female non-smokers and smokers were also explored and female smokers also have lower intakes than non-smokers. This is not surprising as the Estimated Average Requirement (EAR) for vitamin C is higher for adult male smokers and adult female smokers (Institute of Medicine, 2000). Dallongeville, Marecaux, Fruchart & Amouye (1998) through a meta-analysis also found that dietary intake of vitamin C was lower among smokers than non-smokers.

Our findings suggested that intakes of vitamin E and C were not normally distributed (means varied from medians) and that they were very different from individual to individual. A high inter-individual variation in intake is characteristic of many nutrients (Beaton, Milner, McGuire, Feather & Little, 1983; Nelson, Black, Morris, & Cole, 1989) and was found for a variety of nutrients in a number of the provincial nutrition surveys (Nova Scotia Heart Health Program, Nova Scotia Department of Health, Health and Welfare Canada 1993; University of Saskatchewan, 2001; Taylor, VanTil & MacLellan, 2002; Mendelson, Tarasuk, Chappell, Brown & Anderson, 2003; Balram, Villalon & Ericson, 2005).

Although NNL did collect raw data on nutritional supplements, this data has not yet been analyzed and released in print. To get a true estimation of a nutrient's intake one must consider total intake, that from food and supplements. In this study it was possible to calculate vitamin E and vitamin C intakes through supplements and thus total intakes of vitamin E and vitamin C. Our findings suggest that 8.2% of the population were consuming vitamin E and/or vitamin C supplements. NNL found that 24% of the population consumed vitamin/mineral supplements on the previous day. The British Columbia Nutrition Survey: Report on Supplements found that 46% of participants had used one or more supplements on the day before the survey (Barr, 2004) and the Food Habits of Canadians study found that 41% of adults had taken one or more supplements on the previous day (Troppmann, Johns & Gray-Donald, 2002). The present study considered supplement intakes from vitamin E and/or vitamin C supplements only. This can partly explain the discrepancies between this study and the other nutrition surveys. Total intakes of vitamin E and vitamin C may be even more variable than food intakes suggesting that those people taking supplements increase their intakes of each of the vitamins considerably. Supplements are a good way to increase the intake of a nutrient however it has been suggested that normally consuming nutrients through food is best (Lichtenstein & Russell, 2005). Possible exceptions are the recommended intakes of supplemental folic acid by females of childbearing age, supplemental iron by pregnant females and supplemental vitamin D by seniors (Health Canada, 2007).

#### 5.3.1.2 Adequacy of Vitamin E and Vitamin C Intakes

Considering the intake of vitamin E from food alone, the data suggest that 88.4% of the population is not consuming adequate vitamin E to meet their estimated needs. Although taking vitamin E supplements does appear to make a significant contribution to meeting vitamin E requirements in this group, when considering intake of total vitamin E (food and supplements), the data suggest that 82.3% of the population is still not consuming adequate vitamin E to meet their needs. Supplement intakes have been shown by some researchers to be higher in seniors, especially senior females (Troppmann, Johns & Gray-Donald, 2002; Barr, 2004). This may help to explain why the oldest age group tested in each sex appeared to have a lower prevalence of inadequate intake of vitamin E when both food and supplemental vitamin E are considered together. Even when vitamin E from food and vitamin E from supplements are both considered and even when consideration is limited to seniors, over 75% of the population of Newfoundland and Labrador are below the appropriate EAR for this nutrient.

The fact that a high percentage of the population had intakes of vitamin E from food that were inadequate is not surprising considering that NNL found that a number of nutrients had low intake levels including folate, thiamin, vitamin B6, vitamin B12, vitamin C, magnesium and zinc (Roebothan, 2003). Also, Ahuja, Goldman & Moshfegh examined the current status of vitamin E intake in the US by analyzing dietary data from the National Health and Nutrition Examination Survey 1999-2000. They found that over 90% of adults had intakes below the Estimated Average Requirement (EAR) (Ahuja, Goldman & Moshfegh, 2004).

Considering the prevalence of inadequate vitamin C intakes from food and supplements together, taking vitamin C supplements does appear to make a significant contribution to meeting vitamin C requirements. However, male and female non-smokers are not consuming adequate vitamin C to meet their needs and smokers were more likely to have inadequate intakes of total vitamin C. These findings were not surprising as NNL found that the prevalence of inadequate vitamin C intake from food for non-smokers and smokers combined was 52.7% and since smokers require more vitamin C to meet their requirement (Institute of Medicine, 2000) the prevalence of inadequacy for vitamin C intake is likely higher than 52.7%. The British Columbia Nutrition Survey: Report on Supplements also found that 32% of the population had inadequate intakes of vitamin C from food. When total vitamin C (food and supplements) was considered, 23% of the population still had inadequate intakes (Barr, 2004).

### 5.3.2 Nutrient Intakes and Diabetes Mellitus Status

With this data available the possible associations between intakes of antioxidant vitamins, some vitamins of the B complex and some minerals and diabetes mellitus status were investigated.

#### 5.3.2.1 Dietary Antioxidants

Research suggests that dietary antioxidants such as vitamin E and vitamin C may be beneficial to people with diabetes (Colditz, Manson, Stampfer, Rosner, Willett & Speizer, 1992; Feskens, Virtanen, Rasanen, Tuomilehto, Stengard, Pekkanen, Nissinen & Kromhout, 1995; Ford, 2001). It has also been suggested that fruit and vegetable consumption may lower the risk of developing diabetes (Colditz et al, 1992; Feskens et al, 1995; Ford, 2001) and that people at high risk of diabetes have lower serum concentrations of several antioxidants, including vitamin C and Beta-carotene which are found in these foods (Ford, Mokdad, Giles & Brown, 2003).

In this study diabetes status was not found to be significantly associated with meeting one's requirement of the antioxidant alpha-tocopherol (vitamin E) in adults aged 35 to 74 with a BMI less than or equal to 27. Age and BMI were considered to be confounding variables so a logistic regression was conducted to see if these variables had an effect on diabetes status. Even after controlling for age and further controlling for BMI, vitamin E intakes from food were not found to be associated with diabetes status.

Unfortunately the only nutritional data available for analysis in this study were those pertaining to intakes after diagnosis and it is possible that some people change their diets when diagnosed with diabetes. However, there is evidence to suggest that many people retain their dietary habits for very long periods of time (Devine, Connors, Bisogni & Sobal, 1998; Devine, Bove & Olson, 1999; Paquette & Devine, 2000). Montonen, Knekt, Jarvinen & Reunanen (2004) did study vitamin E intakes in a group of Finnish people before and after diabetes diagnosis. They followed over 4000 people free of diabetes for 23 years. Then they compared the intakes of a number of nutrients including vitamin E, by those who did develop diabetes and those who did not. They found that α-tocopherol (vitamin E) intake was inversely associated with diabetes status, and controlling for confounding variables did not affect the association. In the United States, Mayer-Davis, Costacou, King, Zaccaro & Bell (2002) also assessed the intakes of a group of people over time, but in this care for only a period of five years. They found that the reported mean intake of vitamin E did not differ between people diagnosed with diabetes and people who did not develop diabetes. However, these researchers also compared plasma α-tocopherol levels of those people who developed diabetes and those who did not. Plasma α-tocopherol was inversely associated with diabetes status, even when confounding variables were controlled for. Therefore even when dietary intake data are available both pre and post diagnosis it is still not clear whether the intake of vitamin E is associated with the cause and/or presence of diabetes mellitus.

It appears that when data on dietary intakes and/or circulating levels of nutrients are available both pre and post diagnosis, research findings give support to an association between vitamin E and diabetes mellitus. Research, such as in the present study, where nutritional data is only available post diagnosis, does not appear to give the same support for this association. For example, Reunanen, Knekt, Aaran & Aromaa (1998) found no difference in the serum α-tocopherol levels of cases versus controls when nutritional data were collected post diagnosis. Although, Ford, Mokdad, Giles & Brown (2003) did find lower circulating levels of a number of antioxidants in cases versus controls post diagnosis, these researchers were actually studying people with the metabolic syndrome only and not actual diabetes mellitus.

Research with vitamin C suggests the same. Support is given for a possible association of vitamin C and diabetes when data on vitamin C intakes and/or status are available before diabetes develops but when the analysis of nutritional data is limited to that collected post diagnosis then the association is not apparent. Fesken, Virtanen, Rasanen, Tuomilehto, Stengard, Pekkanen, Nissinen & Kromhout (1995) found through a prospective cohort study that vitamin C intake prior to diagnosis was significantly lower among people previously diagnosed with NIDDM. Yet Will, Ford & Bowman (1999) tested both men and women who participated in the third National Health and Nutrition Examination Study in the United States. They used an oral glucose tolerance test (WHO criteria) to diagnose diabetes. These researchers compared both vitamin C intakes and serum vitamin C concentrations of those with diabetes and those without diabetes after diagnosis. Neither was shown to be associated with diabetes status. It appears that there is limited support that dietary intakes and serum levels of antioxidants after diagnosis are associated with diabetes status. Unfortunately access to blood samples of participants to study circulating levels of nutrients was unavailable.

Nutrients other than vitamin E and vitamin C were also analyzed in the present study. However, only intakes from food alone were available so total intakes of these nutrients could not be calculated. Nevertheless, as supplement usage appears to be limited in Newfoundland and Labrador (Roebothan, 2003) then the analysis of intake from food alone is interesting and informative.

#### 5.3.2.2 Vitamins of the B Complex

The association between vitamin B6 intakes for those people who had previously been diagnosed with diabetes was compared to those who had not been previously diagnosed. Diabetes status does not appear to be associated with meeting vitamin B6 dietary requirements and even after controlling for age and BMI vitamin B6 intakes from food were still not associated with diabetes status. Previous researchers have assessed blood levels of vitamin B6 post diabetes diagnosis and found that people with diabetes have low blood levels of vitamin B6 when compared to healthy controls (Wilson & Davis, 1977; Davis, Calder & Curnow, 1976). It has been suggested vitamin B6 may improve glucose tolerance in patients with gestational diabetes (Spellacy, Buhi & Burk, 1977; Coelingh-Bennink & Schreurs, 1975). More recent research could clarify relationships that may exist between dietary vitamin B6 and diabetes status.

Very little research has been conducted on the possible relationship between intakes of vitamin B12, thiamin and riboflavin and diabetes status. Diabetes status does not appear to be significantly associated with meeting vitamin B12 requirements. The results also showed that diabetes status is not significantly associated with meeting vitamin B12 or thiamin requirements even after controlling for age and BMI. The intake of riboflavin and its possible relationship to diabetes status were also analyzed. Diabetes status is not significantly associated with meeting riboflavin requirement and after controlling for age and BMI, riboflavin intakes from food were not associated with diabetes status.

#### 5.3.2.3 Minerals

Unlike the antioxidants and the B vitamins studied, all three of the minerals investigated, magnesium, iron and zinc did appear to differ between people with diabetes and those not previously diagnosed with diabetes when data were analyzed by Chi-Square. However, when these data were controlled for age and BMI and reanalyzed using logistic regression then the associations were no longer detected.

A significantly higher percentage of people with diabetes (45.3%) are meeting their requirement for magnesium as compared to people without diabetes (28%). Previous research has shown an inverse association between magnesium intake prior to diagnosis and risk of developing NIDDM. Kao, Folsom, Nieto, Mo, Watson & Brancati (1999) examined the diets of people prior to diabetes diagnosis. They found an association between serum magnesium levels and incidence of NIDDM but found no association between dietary magnesium intake and incidence of NIDDM. Other researchers who investigated dietary intake prior to diabetes diagnosis did find an inverse association between dietary magnesium intake and risk of developing diabetes (Meyer, Kushi, Jacobs, Slavin, Sellers & Folsom, 2000; Lopez-Ridaura, Willett, Rimm, Liu, Stampfer, Manson & Hu, 2004). Even after controlling for age and BMI, magnesium intakes from food, post diagnosis, were not associated with diabetes status.

Jiang, Manson, Meigs, Ma, Rifai & Hu (2004) found that higher iron stores are associated with an increased risk of NIDDM. This provides some support to the findings on iron.

Although NIDDM was not looked at specifically, the vast majority of participants would likely have this type of the disease as this is the most common form of diabetes accounting for 90% of all cases (Porte, Sherwin & Baron, 2003). When the data were reanalyzed after controlling for age and BMI, iron intakes from food did no longer appear to be significantly associated with diabetes status.

As with iron, zinc intakes may be different for those previously diagnosed with diabetes as compared with those not previously diagnosed with diabetes. This difference was no longer apparent when the data were reanalyzed to control for age and BMI. Previous researchers have studied zinc levels post diabetes diagnosis and have suggested that people with diabetes tend to have low zinc levels in circulation and some tend to be zinc-deficient (Pidduck, Wren & Evans, 1970; Nakamura, Higashi, Nishiyama, Fujimoto & Matsuda, 1991).

**5.4 Strengths and Limitations of the Study**

There are several strengths and limitations to using data from the Nutrition Newfoundland and Labrador (NNL) survey. One of the strengths is that NNL is representative of the population of Newfoundland and Labrador. A stratified probability sample design that was developed by Statistics Canada was used to select the participants for the NNL survey. Also, the survey was conducted in eleven areas throughout the province with urban and rural areas of the province being represented. Data were collected on both weekdays and weekends and the sample design selected independent samples for both the spring and fall seasons.

Another strength of using the NNL data is that trained interviewers conducted face-to-face interviews. An intensive two-week training session was provided for interviewers so that interview techniques would be consistent. Interviewers were given a survey kit which included items like cutlery, dishes, wooden shapes, measuring utensils, thickness measures and pictures of cuts of meat to ensure accuracy in approximating volumes of food consumed. Interviewers were also trained to use three dimensional food models to ensure accuracy in recording food data.

An additional strength of using the NNL data is that the interviewers measured weight, height and waist-hip circumferences. This allows for more accurate Body Mass Index (BMI) calculations since several studies suggest that self-reported weights are often unreliable, especially in the obese (Jeffrey, 1996; World Health Organization, 1998; Villanueva, 2001.

A further strength is that prior to this study vitamin E intake had not been analyzed for the residents of Newfoundland and Labrador as the software needed to analyze these intakes was not available. As a result this study is the first to provide any insight into the vitamin E intakes of people living in Newfoundland and Labrador.

There were some limitations to using data from the NNL survey. Roebothan (2003) described the response rate of the NNL survey at the time of data collection as being 51.4%. Files of the provincial health insurance plan, Medical Care Plan (MCP), were used to draw a sample of Newfoundland and Labrador residents for the NNL survey. At the time of sampling, these files were not up to date. In 1988, the file had been used for the Newfoundland Heart Health Survey (Newfoundland Department of Health and Department of National Health and Welfare 1990). Among the individuals who were drawn from the Medical Care Plan files at that time, 66% were located and invited to participate. Among these 75% completed the home interview and 65% completed both the interview and the clinic component of the survey (overall 43% to 50% participated). A number of individuals approached for participation in the Newfoundland Heart Health Survey had moved from their registered addresses and not notified the Medical Care Plan. Also, individuals who had died or had left the province may not have been deleted from the file (Newfoundland Department of Health and Department of National Health and Welfare, 1990). Problems with the MCP files therefore partly explain the poor response rate of the Heart Health Survey. By the time these files were used for the NNL survey they were almost a decade more outdated than when they were used for the Newfoundland Heart Health Survey.

Another limitation is that data from the NNL survey were collected to address the goals and objectives of that particular survey and as a result the information may be somewhat limited in answering questions raised in the present study. For example, in the NNL survey diabetes status was self-reported. Participants were asked whether or not they had been told by a doctor or other health care worker that they had diabetes/high blood sugar (except during pregnancy) (Question 26, Part II, Form D, Appendix D). Any respondent who refused to answer this question was excluded from the analysis in the present study. Since diabetes status was self-reported and not based upon a clinical assessment the possibility exists that the number of people who actually had diabetes was underreported due to the fact that the participant answered this question incorrectly or was unaware that he/she had diabetes even when they did as they had not yet been diagnosed with the condition. Previous research has indicated that many cases of diabetes in North America are often undiagnosed and as a result are not reported (Heart and Stroke Foundation of Canada, 1999). Also the NNL data does not address what type of diabetes the participant may have as it just asks about diabetes in general. Separating those with IDDM from those with NIDDM before analyzing for nutrient intakes could have provided some interesting findings. A clinical assessment to accompany the collection of dietary intake data would have been ideal but these data were not available.

Also dietary intake data were collected via a 24-hour recall (Roebothan, 2003). Although this is an acceptable method of collecting dietary intake data it relies on the co-operation and memory of the respondents. Energy intake is often underreported in surveys (Mertz, Tsui, Judd, Reiser, Hallfrisch, Morris, Steele & Lashley, 1991) and fat intake (much of which has high vitamin E content) may also be underreported. In fact Bridfel, Sempos, McDowell, Chien & Alaimo (1997) found that fat intake was more likely to be underreported than energy intake in the NHANES III survey. Also, the amount and type of fat and oils added to food during preparation are difficult to assess using recall methods. Most animal fats contribute negligible vitamin E to the diet but plant oils contribute significantly to vitamin E intake. An underreporting of plant oils could account for an underestimation of total vitamin E intake (Institute of Medicine, 2000).

The small number of people with diabetes in this study was also a limitation. Many of the Chi-Square analyses included small numbers of people with diabetes as compared with people without diabetes. This could explain why associations between certain nutrients and diabetes status were not found. In general, nutritional epidemiological studies do tend to require high numbers of participants to make significant findings pertaining to nutrient intakes (Michels, 2003).

When the in person interviews were conducted in the participant's home, supplement information was recorded directly from the supplement label. However, when the interviews were conducted elsewhere supplement information such as DIN (drug identification number) and the product name was not always available. As a result of this the content of vitamin C and/or vitamin E in a supplement could not be found for all supplements. The missing supplements were then excluded from the analysis and this is another disadvantage of this study. Supplement intakes for a number of nutrients were not available at the time of analysis. Even though in Newfoundland and Labrador there is a lower percentage of people that use supplements as compared to residents in other parts of Canada (Roebothan, 2003), true total intake of a nutrient should include consideration of nutrient consumed both through food and supplements.

When diagnosed with diabetes people may change their diets and this is a drawback in many population studies addressing dietary intakes of those with diabetes. For example, in our sample many who had been diagnosed with diabetes could have improved their diets after diagnosis as diet is often used in the treatment and management of both IDDM and NIDDM (Pickup & Williams, 2003). It is the long-term habits that the present study is truly interested in as it is these habits, which may or may not be associated with the development of diabetes. An alternative could have been to ask the participants about their diets prior to being diagnosed with the disease in question but due to recall problems this retrospective data would be very unreliable. Such data were not collected on NNL respondents. This change in diet with diagnosis could explain why some nutrient intakes, according to the Chi-Square analysis, appeared to be better in people with diabetes than in people without diabetes. These differences do not exist after controlling for age and BMI. Nevertheless some people do not change their behaviours whether they are diagnosed with an illness or not. For example, Roebothan (2003) found that only 83% of those diagnosed with diabetes made any changes in their behaviour to deal with the illness. Also there is a strong tendency for people to maintain their eating habits with time (Devine, Connors, Bisogni & Sobal, 1998; Devine, Bove & Olson, 1999; Paquette & Devine, 2000). It should also be noted that data pertaining to many individuals who have diabetes but are undiagnosed may be mixed in with data pertaining to the non-diabetic group in NNL as there is evidence to suggest that a large number of cases of diabetes in North America are undiagnosed and as a result are unreported (Heart and Stroke Foundation of Canada, 1999).

# CHAPTER VI

## CONCLUSION AND RECOMMENDATIONS

The results suggest that intakes of vitamin E and vitamin C by the Newfoundland and Labrador population are not adequate. Considering vitamin E intake from food alone, 88.4% of the population is not consuming adequate vitamin E to meet their needs. However, taking a vitamin E supplement does make a significant contribution to meeting vitamin E requirements for the people who take them. Considering total vitamin E (food and supplements) 82.3% of the population is not consuming adequate vitamin E. When total vitamin C intake (food and supplements) is considered, 48.3% of male non-smokers and 45.3% of female non-smokers are not consuming adequate vitamin C to meet their needs. Smokers are even more likely to have inadequate intakes of total vitamin C, with 78.8% of male smokers and 73.6% of female smokers having inadequate intakes.

As a large percentage of the Newfoundland and Labrador population has inadequate intakes of vitamin E and vitamin C, recommendations can be made for people of this province to eat more foods containing these nutrients, like nuts and oils for vitamin E and fruits and vegetables for vitamin C. More health promotion activities are also needed to educate the public about what foods are good sources of vitamin E and vitamin C. More research also needs to be done to examine the barriers to healthy eating as previous research has found that fruit and vegetable consumption appears to be inadequate in Newfoundland and Labrador (Statistics Canada, 2001).

Although there are limitations on using data collected for another purpose, it was interesting to search for any possible relationship between nutrient intakes and diabetes status. There were no dietary intake data available for participants prior to diagnosis and so very limited conclusions could be drawn regarding the intakes of nutrients and the risk of developing diabetes. Many people adjust their diet once diagnosed, although some people do not. Chi-Square analysis suggested that people with diabetes had higher intakes of magnesium, iron and zinc when compared to people without diabetes. These associations disappeared after controlling for age and BMI.

In conclusion more research is needed to determine if vitamin E, vitamin C, magnesium, iron and zinc are actually associated with diabetes. A long-term prospective collection of dietary intake data prior to and after diagnosis of IDDM and NIDDM would be ideal. The literature suggests that these data could indeed be informative for further diabetes research. The secondary nature of the analyses performed in this study and the small numbers of participants limited conclusions that could be drawn. More research is also needed to determine if supplementation is helpful in diabetes prevention. Further research is necessary to link intakes of specific nutrients to both the cause and the existence of disease states such as diabetes.

## REFERENCES


Ahuja, J. K., Goldman, J. D. & Moshfegh, A. J. (2004). Current status of vitamin E nutriture. *Annals of the New York Academy of Sciences, 1031*, 387-390.

American Home Economics Association (1980). *Handbook of Food Preparation,* 8th Ed. American Home Economics Association, Washington, D. C.

Ames, B. N., Shigenaga, M. K. & Hagen, T. M. (1993). Oxidants, antioxidants and the degenerative diseases of aging. *Proceedings of the National Academy of Sciences, 90*, 7915-22.

Balram, B. C., Villalon, L., Ericson, P. (2005). *New Brunswick Nutrition Survey.* New Brunswick: New Brunswick Department of Health and Wellness.

Barr, S. I. (2004). *British Columbia Nutrition Survey: Report on Supplements.* Prevention & Wellness Planning, B.C. Ministry of Health Services.

Baynes, J. W. (1991). Perspectives in diabetes: role of oxidative stress in development of complications in diabetes. *Diabetes, 40*, 405-412.

Beaton, G. H., Milner, J., McGuire, V., Feather, T. E. & Little, J. A. (1983). Source of variance in 24-hour dietary recall data: implications for nutrition study design and interpretation. Carbohydrate sources, vitamins, and minerals. *American Journal of Clinical Nutrition, 37*, 986-995.

Bender, D. A. (2002). *Introduction to Nutrition and Metabolism,* 3rd Ed. Taylor and Frances, New York.

Bialostosky, K., Wright, J., Kennedy-Stephens, J., McDowell, M. & Johnson, C. (2002). *Dietary intake of macronutrients, micronutrients and other dietary constituents: United States 1988–94.* National Centre for Health Statistics, Vital Health Statistics 11(245).

Bird, C. E. & Fremont, A. M. (1991). Gender, time use and health. *Journal of Health and Social Behaviour, 32*, 114-129.

Bird, C. E. & Ross, C. E. (1993). Houseworkers and paid workers: qualities of the work and effects on personal control. *Journal of Marriage and Family, 55*, 913-925.

Bowes and Church (1998). *Food Values of Portions Commonly Used, 17th Ed.* Lippincott, Philadelphia, PA.

Bridfel, R. R, Sempos, C. T., McDowell, M. A., Chien, S. & Alaimo, K. (1997). Dietary methods research in the Third National Health and Nutrition Examination Survey: Underreporting energy intake. *American Journal of Clinical Nutrition, 65*, 1203S-1209S.

Burnett, R., Cakmak, S. & Brook, J. (1998). The effect of urban air ambient pollution mix on daily mortality rates in 11 Canadian cities. *Canadian Journal of Public Health, 89*, 152-160.

Canadian Diabetes Association (2001). *Type 2 Diabetes Prevention and Health Promotion Strategy.* St. John's, Newfoundland and Labrador: Canadian Diabetes Association, Newfoundland and Labrador Division and Newfoundland and Labrador Heart Health Program.

Canadian Population Health Initiative (2004). *Improving the Health of Canadians.* ISBN 1-55392-325-1. Ottawa.

Coelingh-Bennink, H. J. T. & Schreurs, W, H. P. (1975). Improvement of oral glucose tolerance in gestational diabetes by pyridoxine. *British Medical Journal, 3*, 3-15.

Cohen, S. & Wills, T. A. (1985). Stress, social support and the buffering hypothesis. *Psychology Bulletin, 98*, 310.

Colditz, G. A., Manson, J. E., Stampfer, M. J., Rosner, B., Willett, W. C. & Speizer, F. E. (1992). Diet and risk of clinical diabetes in women. *American Journal of Clinical Nutrition, 55*, 1018-1023.

Colditz, G. A., Willett, W. C., Stampfer, M. J., Mason, J. E., Hennekens, C. H., Arky, R. A. & Speizer, F. E. (1990). Weight as a risk factor for clinical diabetes in women. *American Journal of Epidemiology, 132*, 501-513.

Compendium of Nonprescription Products, 3rd CNP Ed. (1996). Canadian Pharmaceutical Association, Ottawa, ON, Canada.

Compendium of Pharmaceuticals and Specialties, 31st Ed. (1996). Canadian Pharmaceutical Association, Ottawa, ON, Canada.

Davis, R. E., Calder, J. S. & Curnow, D. H. (1976). Serum pyridoxal and folate concentrations in diabetes. *Pathology, 8*, 151-156.

Dallongeville, J., Marecaux, N., Fruchart, J. C. & Amouye, P. (1998). Cigarette smoking is associated with unhealthy patterns of nutrient intake: a meta-analysis. *The Journal of Nutrition, 128*, 1450-1457.

Devine, C. M., Connors, M., Bisogni, C. & Sobal, J. (1998). Life-course influences on fruit and vegetable trajectories: qualitative analysis of food choice. *Journal of Nutrition Education, 30*, 361-370.

Devine, C. M., Bove, C. & Olson, C. M. (1999). Continuity and change in women's weight orientation through pregnancy and the postpartum period: the influence of life course trajectories and transitional events. *Social Science and Medicine, 50*, 567-582.

Drugstore.com, Inc. (2004). *Vitamins and Diet.* Retrieved July 21, 2004, from http://www.drugstore.com/templates/browse/default.asp?catid=28460&trx=GFI-0-EVGR-MCN&trxp1=30&trxp2=28460&trxp3=2&trxp4=ML

Evans, R. G., Barer, M. L. & Marmor, T. R. (1994). *Why are some people healthy and others not? The determinants of health of populations.* Aldine De Gruyter, Hawthorne, New York.

Eyre, H., Kahn, R. & Robertson, R. M. (2004). Preventing cancer, cardiovascular disease and diabetes: a common agenda for the American Cancer Society, the American Diabetes Association, and the American Heart Association. *CA: A Cancer Journal for Clinicians, 54*, 190-207.

Feskens, E. J., Virtanen, S. M., Rasanen, L., Tuomilehto, J., Stengard, J., Pekkanen, J., Nissinen, A. & Kromhout, D. (1995). Dietary factors determining diabetes and impaired glucose tolerance. *Diabetes Care, 18*, 1104-1112.

Fogarty, A., Lewis, S., Weiss, S. & Britton, J. (2000). Dietary vitamin E, IgE concentrations, and atopy. *Lancet, 356*, 1573-1574.

Fogt, R. (2002). *Common Cooking Conversions*. Retrieved Feb. 25, 2004, from http://www.onlineconversion.com/cooking.htm

Ford, E. S., Williamson, D. F. & Liu, S. (1997). Weight change and diabetes incidence: findings from a national cohort of US adults. *American Journal of Epidemiology, 146*, 214-222.

Ford, E. S. (2001). Vitamin supplement use and diabetes mellitus incidence among adults in the United States. *American Journal of Epidemiology, 153*, 892-897.

Ford, E. S., Mokdad, A. H., Giles, W. H. & Brown, D. W. (2003). The metabolic syndrome and antioxidant concentrations: findings from the third national health and nutrition examination survey. *Diabetes, 52*, 2346-2352.

Foy, C. G., Bell, R. A., Farmer, D. F., Goff, D. C. & Wagenknecht, L. E. (2005). Smoking and incidence of diabetes among U.S. adults. *Diabetes Care, 28*, 2501-2507.

Giugliano, D., Ceriello, A. & Paolisso, G. (1996). Oxidative stress and diabetic vascular complications. *Diabetes Care, 19*, 257–267.

Gove, W. R. & Tudor, J. F. (1973). Adult sex roles and mental illness. *American Journal Of Sociology, 78*, 812-835.

Government of Canada (2003). Food and Drug Act: Food and Drug Regulations, Consolidated Regulations of Canada, c. 870. Retrieved Jan. 7, 2005, from http://www.hc-sc.gc.ca/food-aliment/friia-raaii/food_drugs-aliments_drogues/act-loi/pdf/e_f-vtamns.pdf

Hampl, J. S., Taylor, C. A. & Johnston, C. S. (2004). Vitamin C deficiency and depletion in the United States: The Third National Health and Nutrition Examination Survey, 1988 to 1994. *American Journal of Public Health, 94*, 870-875.

Health and Welfare Canada (1988). *Canadian Guidelines for Healthy Weights.* Ministry of National Health and Welfare, Ottawa.

Health Canada (1992). *Canada's Food Guide to Healthy Eating.* Minister of Public Works and Government Services Canada. Catalogue No. H39-252/1992E.

Health Canada (1998). *Canada's Physical Activity Guide to Healthy Active Living.* Ottawa, Health Canada.

Health Canada (1999). *Diabetes in Canada: National Statistics and opportunities for improved surveillance, prevention and control.* Public Works and Government Services Canada. Catalogue No. H49-121/1999. Ottawa.

Health Canada (1999). *Toward a Health Future: Second Report on the Health of Canadians.* Minister of Public Works and Government Services. Catalogue No. H39-468/1999E.

Health Canada (2002). *What is the Population Health Approach?* Retrieved June25, 2004, from http://www.hc-sc.gc.ca/hppb/phdd/approach/index.html#What

Health Canada (2002). *What Do Canadians Do About Nutrition?* Office of Nutrition Policy and Promotion. Catalogue No. H39-654/2002E-IN. Ottawa.

Health Canada (2003). *Canadian Guidelines for Body Weight Classification in Adults.* Office of Nutrition Policy and Promotion. Catalogue No. H49-179/2003E. Ottawa.

Health Canada (2003). *Diabetes: are you at risk?* Health Canada: Ottawa, Ontario. Retrieved Nov. 29, 2004 from http://www.hc-sc.gc.ca/pphb-dgspsp/ccdpc-cpcmc/diabetes-diabete/english/risk/index.html

Health Canada (2004). *What Determines Health*? Retrieved June 25, 2004, from http://www.phac-aspc.gc.ca/ph-sp/phdd/determinants/index.html

Health Canada (2004). *Drug Product Database.* Retrieved July 10, 2004, from http://www.hc-sc.gc.ca/hpb/drugs-dpd/

Health Canada (2007). *Eating Well with Canada's Food Guide. A Resource for Educators and Communicators.* Minister of Health: Ottawa, Ontario. Catalogue No. H164-38/2-2007E.

Heart and Stroke Foundation of Canada (1999). *The Changing Face of Heart Disease and Stroke in Canada.* Ottawa, Ontario: Heart and Stroke Foundation of Canada.

Horner, N. K., Patterson, R. E., Neuhouser, M. L., Lampe, J. W., Beresford, S. A. & Prentice, R. L. (2002). Participant characteristics associated with errors in self-reported energy intake from the Women's Health Initiative food-frequency questionnaire. *American Journal of Clinical Nutrition, 76*, 766-773.

Institute of Medicine (1997). *Dietary Reference Intakes for Calcium, Phosphorus, Magnesium, Vitamin D, and Fluoride.* National Academy Press, Washington, D. C.

Institute of Medicine (1998). *Dietary Reference Intakes for Thiamin, Riboflavin, Niacin, Vitamin B6, Folate, Vitamin B12, Pantothenic Acid, Biotin, and Choline.* National Academy Press, Washington, D. C.

Institute of Medicine (2000). *Dietary Reference Intakes for Vitamin C, Vitamin E, Selenium and Carotenoids.* National Academy Press, Washington, D. C.

Institute of Medicine (2001). *Dietary Reference Intakes for Vitamin A, Vitamin K, Arsenic, Boron, Chromium, Copper, Iodine, Iron, Manganese, Molybdenum, Nickel, Silicon, Vanadium and Zinc.* National Academy Press, Washington, D. C.

Institute of Medicine (2002). *Dietary Reference Intakes for Energy, Carbohydrate, Fiber, Fat, Fatty Acids, Cholesterol, Protein, and Amino Acids (Macronutrients).* National Academy Press, Washington, D. C.

Jiang, R., Manson, J. E., Meigs, J. B., Ma, J., Rifai, N. & Hu, F. B. (2004). Body iron stores in relation to risk of type 2 diabetes in apparently health women. *The Journal of the American Medical Association, 291*, 711-717.

Jeffrey, R. W. (1996). Bias in reported body weight as a function of education, occupation, health and weight concern. *Addictive Behaviors, 21*: 217-222.

Joung, I. M. A., Meer, J. B. W. Van Der & Mackenbach, J. P. (1995). Marital status and health care utilitzation. *International Journal of Epidemiology, 24*, 569-575.

Kao, W. H. L., Folsom, A. R., Nieto, F. J., Mo, J. P., Watson, R. L., Brancati, F. L. (1999). Serum and dietary magnesium and the risk for type 2 diabetes mellitus: the atherosclerosis risk in communities study. *Archives of Internal Medicine, 159*, 2151-2159.

Kaplan, G. A., Pamuk, E. R., Lynch, J. W., Cohen, R. D., & Balfour, J. L. (1996b). Inequality in income and mortality in the United States: Analysis of mortality and potential pathways. *British Medical Journal, 312*, 999-1003.

Kessler, R. C., House, J. S & Turner, J. B. (1987). Unemployment and health in a community sample. *Journal of Health and Social Behaviour, 28*, 51-59.

Kessler, R. C. & McRae, J. A. (1982). The effect of wives employment on the mental health of married men and women. *American Sociological Review, 47*, 216-227.

Kleinbaum, D. G., Kupper, L. L., Muller, K. E., & Nizam, A. (1998). *Applied Regression Analysis and Other Multivariable Methods.* Duxbury Press, Pacific Grove, CA.

Knight, J. A. (1999). *Free Radicals, Antioxidants, Aging, & Disease.* AACC Press, Washington, DC.

Knowler, W. C., Barrett-Connor, E., Fowler, S. E., Hamman, R. F., Lachin, J. M., Walker, E. A. & Nathan, D. M. (2002). Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. *New England Journal of Medicine, 346*, 393-403.

Le Grand, J. (1987). Inequalities in health. *European Economic Review, 31*, 182-191.

Lemieux, S., Mongeau, L., Paquette, M., Laberge, S. & Lachance, B. (2004). Health Canada's new guidelines for body weight classification in adults: challenges and concerns. *Canadian Medical Association Journal, 171,* 1361-1363.

Lichtenstein, A. H. & Russell, R. M. (2005). Essential nutrients: food or supplements? Where should the emphasis be? *Journal of the American Medical Association, 294,* 351-358.

Lopez-Ridaura, R., Willett, W. C., Rimm, E. B., Liu, S., Stampfer, M. J., Manson, J. E. & Hu, F. B. (2004). Magnesium intake and risk of type 2 diabetes in men and women. *Diabetes Care, 27*, 134-140.

Luchsinger, J. A., Tang, M. X., Shea, S. & Mayeux, R. (2003). Antioxidant vitamin intake and risk of Alzheimer disease. *Archives of Neurology, 60*, 203-208.

Mann, J. and Truswell, S. (1999). *Essentials of Human Nutrition.* Oxford University Press, New York.

Maras, J. E., Bermudez, O. I., Qiao, N., Bakun, P. J., Boody-Alter, E. L. & Tucker, K. L. (2004). Intake of alpha-tocopherol is limited among US adults. *Journal of the American Dietetic Association, 104*, 567-575.

Matthews, D. D. (2003). *Diabetes Sourcebook*, 3rd Ed. Omnigraphics, Inc.

Mayer-Davis, E. J., Costacou, T., King, I., Zaccaro, D. J. & Bell, R. A. (2002). Plasma and dietary vitamin E in relation to incidence of type 2 diabetes: the insulin resistance and atheroscerosis study (IRAS). *Diabetes Care, 25*, 2172-2177.

Mendelson, R., Tarasuk, V., Chappell, J., Brown, H. & Anderson, G. H. (2003). *Report of the Ontario Food Survey*. Toronto, Ontario: Ontario Ministry of Health.

Mertz, W., Tsui, J. C., Judd, J. T., Reiser, S., Hallfrisch, J., Morris, E. R., Steele, P. D. & Lashley, E. (1991). What are people really eating? The relationship between energy intake derived from estimated diet records and intake determined to maintain body weight. *American Journal of Clinical Nutrition, 54*, 291-295.

Meyer, K. A., Kushi, L. H., Jacobs, D. R., Slavin, J., Sellers, T. A. & Folsom, A. R. (2000). Carbohydrates, dietary fiber, and incident type 2 diabetes in older women. *American Journal of Clinical Nutrition, 71*, 921-930.

Michels, K. B. (2003). Nutritional epidemiology – past, present, future. *International Journal of Epidemiology, 32*, 486-488.

Millar, W. & Stephens, T. (1993). Social status and health risks in Canadian adults: 1985 and 1991. *Health Reports, 5*, 143-156. Statistics Canada, Cat. No. 82-003-XPB.

Mino, M., Nakamura, H., Diplock, A. T. & Kayden, H. J. (1993). *Vitamin E: Its Usefulness in Health and in Curing Diseases.* Japan Scientific Societies Press, Tokyo.

Ross, C. E. & Mirowsky, J. (1989). Explaining the social patterns of depression, control and problem solving - or support and talking? *Journal of Health and Social Behaviour, 30*, 206-219.

Montonen, J., Knekt, P., Jarvinen, R. & Reunanen, A. (2004). Dietary antioxidant intake and risk of type 2 diabetes. *Diabetes Care, 27*, 362-366.

Morens, D. M., Grandinetti, A., Waslien, C. I., Park, C. B., Ross, G. W. & White, L. R. (1996). Case-control study of idiopathic Parkinson's disease and dietary vitamin E intake. *Neurology, 46*, 1270-1274.

Murphy, S. P., Subar, A. F. & Block, G. (1990). Vitamin E intakes and sources in the United States. *American Journal of Clinical Nutrition, 52*, 361-367.

Nakamura, T., Higashi, A., Nishiyama, S., Fujimoto, S. & Matsuda, I. (1991). Kinetics of zinc status in children with IDDM. *Diabetes Care, 14*, 553-557.

National Research Council (1989). *Diet and health: implications for reducing chronic disease risk.* National Academy Press, Washington, D. C.

Nelson, M., Black, A. E., Morris, J. A. & Cole, T. J. (1989). Between and within subject variation in nutrient intake from infancy to old age: estimating the number of days required to rank dietary intakes with desired precision. *American Journal of Clinical Nutrition, 50*, 155-167.

Newfoundland Department of Health and Department of National Health and Welfare (1990). *Report of the Newfoundland Heart Health Survey (1988-89).* St. John's, Newfoundland and Labrador: Province of Newfoundland and Labrador.

Nova Scotia Heart Health Program, Nova Scotia Department of Health, Health and Welfare Canada (1993). *Report of the Nova Scotia Nutrition Survey.* Halifax, NS: Nova Scotia Department of Health.

Oberley, L. W. (1988). Free radicals and diabetes. *Free Radical Biology and Medicine, 5*, 113-124.

World Health Organization (1986). *Ottawa Charter for Health Promotion.* Health Promotion, 1, iii-v.

Ozben, T. (1998). *Free radicals, oxidative stress, and antioxidants: pathological and physiological significance*. Plenum Press, New York.

Pan, X. R., Li, G. W., Hu, Y. H., Wang, J. X., Yang, W. Y., An, Z. X. et al. (1997). Effects of diet and exercise in preventing NIDDM in people with impaired glucose tolerance: the da qing IGT and diabetes study. *Diabetes Care, 20*, 537-544.

Paquette, M. & Devine, C. (2000). Dietary trajectories in the menopause transition among Quebec women. *Journal of Nutrition Education, 32*, 320-328.

Pickup, J. C. & Williams, G. (2003). *Textbook of Diabetes 1,* 3rd Ed. Blackwell Publishing, Massachusetts.

Pidduck, H. G., Wren, P. J. & Evans, D. A. (1970). Hyperzincuria of diabetes mellitus and possible genetic implications of this observation. *Diabetes, 19*, 240-247.

Porte, D, Sherwin, R. S. & Baron, A. (2003). *Diabetes Mellitus*, 6th Ed. McGraw-Hill, New York.

Reeder, B. A., Angel, A., Ledoux, M., Rabkin, S. W., Young, T. K. & Sweet, L. E. (1992). Obesity and its relation to cardiovascular disease risk factors in Canadian adults: Canadian heart health surveys research group. *Canadian Medical Association Journal, 146*, 2009-2019.

Resnick, H. E., Valsania, P., Halter, J. B. & Lin, X. (2000). Relation of weight gain and weight loss on subsequent diabetes risk in overweight adults. *Journal of Epidemiology and Community Health, 54*, 596-602.

Reunanen, A., Knekt, P., Aaron, R. K., & Aromaa, A. (1998). Serum antioxidants and risk of non-insulin dependent diabetes mellitus. *European Journal of Clinical Nutrition, 52*, 89-93.

Roberfroid, M. & Calderon, P. B. (1995). *Free Radicals and Oxidation Phenomena in Biological Systems.* Marcel Dekker, Inc., New York.

Robbins, J. M., Vaccarino, V., Zhang, H. & Kasl, S. V. (2005). Socioeconomic status and diagnosed diabetes incidence. *Diabetes Research and Clinical Practice, 68*, 230-236.

Roebothan, B. V. (2003). *Nutrition Newfoundland and Labrador: The Report of a Survey of Residents of Newfoundland and Labrador, 1996.* St. John's, Newfoundland: Department of Health and Community Services, Province of Newfoundland and Labrador.

Ross, D. P., Scott, K. & Kelly, M. A. (1996). Overview: children in Canada in the 1990s. In Growing up in Canada, National Longitudinal Survey of Children and Youth. Ottawa: Human Resources Development Canada and Statistics Canada, Minister of Industry, pp. 15-45.

Samson, F. E. (1999). *Free Radicals and Aging*. Retrieved July 20, 2004, from http://www.accessexcellence.org/LC/ST/bgfreerad.html

Sizer, F. & Whitney, E. (2003). *Nutrition Concepts and Controversies,* 9th Ed. Wadsworth, Belmont, CA.

Smythies, J. R. (1998). *Every Person's Guide to Antioxidants.* Rutgers University Press, New Brunswick.

Spellacy, W. N., Buhi, W. C. & Burk, S. A. (1977). Vitamin B6 treatment of gestational diabetes mellitus. *American Journal of Obstetrics and Gynecology, 127*, 599-602.

Statistics Canada (1996). *Family Characteristics, Census 1996.* Compiled by the Community Accounts Unit based on custom tabulations from the Census of Population 1996, Statistics Canada. Retrieved April 27, 2005 from www.communtiyaccounts.ca

Statistics Canada (1996). *Highest level of schooling and school attendance, 1996.* Compiled by the Community Accounts Unit based on custom tabulations from the Census of Population 1996, Statistics Canada. Retrieved April 27, 2005 from www.communtiyaccounts.ca

Statistics Canada (1996/97). *Leisure-time physical activity, by age group and sex, household population aged 12 and over, Canada and provinces, every 2 years.* Statistics Canada, National Population Health Survey, 1996/97, cross sectional sample, health file.

Statistics Canada (1996/97). *Social Support, by age group and sex, household population aged 12 and over, Canada and provinces, every 2 years.* Statistics Canada, National Population Health Survey, 1996/97, cross sectional sample, health file.

Statistics Canada (2001). *Canadian Statistics: Persons with diabetes by sex, provinces.* Retrieved May 4, 2004, from http://www.statcan.ca/english/Pgdb/health54a.htm

Statistics Canada (2001). *Dietary Practices, by age group and sex, household population aged 12 and over, Canada, provinces, territories, health regions and peer groups, every 2 years.* Canadian Community Health Survey, Cycle 1.1, 2000/01.

Statistics Canada (2001). *Table 1.2.4.2 Diabetes, by sex, household population aged 12 and over, Canada and provinces, 1994/95-1998/99.* Retrieved Oct. 26, 2004, from http://www.statcan.ca/english/freepub/82-221-XIE/tables/htmltables/P1242.htm

Statistics Canada (2002). *Diabetes, by sex, household population aged 12 and over, Canada, provinces, territories, health regions and peer groups, 2000/01.* Retrieved Mar. 28, 2005 from http://www.statcan.ca/english/freepub/82-221-XIE/01103/tables/pdf/1246.pdf

Statistics Canada (2002). *Population by Selected Age Groups and Sex for Canada, Provinces and Territories, 1996 Census - 100% Data.* Retrieved Oct. 19, 2004, from http://www.statcan.ca/english/census96/canprv.pdf

Statistics Canada (2002). *Body Mass Index (BMI) Canadian standard, by sex, household population aged 20 to 64 excluding pregnant women, Canada, provinces, territories, health regions and peer groups, 2000/01.* Health Indicators. Catalogue No. 82-221-XIE.

Tabachnick, B. G. & Fidell, L. S. (2001). *Using Multivariate Statistics*, 4th Ed. Allyn & Bacon, Boston, MA.

Taylor, J., VanTil, L. & MacLellan, D. (2002). *Prince Edward Island Nutrition Survey.* Charlottetown, PEI: Document Publishing Centre.

Tjepkema, M. (2005). *Nutrition: Findings from the Canadian Community Health Survey - Adult obesity in Canada: Measured height and weight.* Statistics Canada. Catalogue No.82-620-MWE.

Tooze, J. A., Subar, A. F., Thompson, F. E., Troiano, R., Schatzkin, A. & Kipnis, V. (2004). Psychosocial predictors of energy underreporting in a large doubly labelled water study. *American Journal of Clinical Nutrition, 79*, 795-804.

Traber, M. & Blumberg, J. (2000). *What consumers need to know about vitamin E.* Retrieved September 22, 2003, from http://www.eatright.org/images/leadership/fansa-vite0800.pdf

Troppmann, L. Johns, T. & Gray-Donald, K. (2002). Natural health product use in Canada. *Canadian Journal of Public Health, 93*, 426-430.

Tuomilehto, J., Lindstrom, J., Eriksson, J. G., Valle, T. T., Hamalainen, H., Ilanne-Parikka, P. et al. (2001). Prevention of type 2 diabetes mellitus by changes in lifestyle among subjects with impaired glucose tolerance. *New England Journal of Medicine, 344*, 1343-1350.

University of Saskatchewan (2001). *Saskatchewan Nutrition Survey: Report of a Survey in the Province of Saskatchewan, 1993-94.* Saskatoon, Sask: University of Saskatchewan.

Verbrugge, L. M. (1985). Gender and health: an update on hypotheses and evidence. *Journal of Health and Social Behaviour, 26*, 156-182.

Villanueva, E. V. (2001). The validity of self-reported weight in US adults: a population based cross-sectional study. *BMC Public Health.* Retrieved Jan. 19, 2005 from http://www.biomedcentral.com/1471-2458/1/11

Wang, Y., Rimm, E. B., Stampfer, M. J., Willett, W. C. & Hu, F. B. (2005). Comparison of abdominal and overall obesity in predicting risk of type 2 diabetes among men. *American Journal of Clinical Nutrition, 81*, 555-563.

Webb, G. P. (2002). *Nutrition: A Health Promotion Approach,* 2nd Ed. Oxford University Press Inc. New York.

Weiss, B. D., Hart, G., McGee, D. L. & D'Estelle, S. (1992). Health status of illiterate adults: relation between literacy and health status among persons with low literacy skills. *Journal of the American Board of Family Practice, 5*, 257-264.

Weston, A. & Laffey, P. (2001). *Newfoundland Nutrition Survey 1996.* Data documentation. Technical report BBCA: 451311-008. Bureau of Biostatistics and Computer Applications, Food Directorate, Health Canada. Ottawa, ON.

Whitham, D. & Hamilton, T. (2002). *Glycemic Index: The Index in Depth.* Retrieved June 15, 2004 from, http://www.diabetes.ca/Section_About/glycemic.asp

Wilkins, K. & Park, E. (1998). Home Care in Canada. *Health Reports, 10*, 29-37 Statistics Canada Cat. No. 82-003-XPB.

Will, J. C., Ford, E. S. & Bowman, B. A. (1999). Serum vitamin C concentrations and diabetes: findings from the Third National Health and Nutrition Examination Survey, 1988-1994. *American Journal of Clinical Nutrition, 70*, 49-52.

Wilson, R. G. & Davis, R. E. (1977). Serum pyridoxal concentrations in children with diabetes mellitus. *Pathology, 9*, 95-99.

Wingard, D. L. (1982). The sex differences in mortality rates: demographic and behavioural factors. *American Journal of Epidemiology, 115*, 205-216.

Wolff, S. P. (1993). Diabetes mellitus and free radicals: free radicals, transition metals and oxidative stress in the aetiology of diabetes mellitus and complications. *British Medical Bulletin, 49*, 642-652.

World Health Organization (1998). *Obesity: Preventing and Managing the Global Epidemic: Report of a WHO Consultation on Obesity.* Geneva, Switzerland: World Health Organization.

## APPENDIX A

**FORM A-2**

**NON-RESPONSE QUESTIONS**

**Identifier #☐☐☐☐☐☐**

Non-response questions completed ☐ Yes ☐ No

*If you face a refusal: At the first phone contact, if an eligible person refuses to participate, tell the person that you have a few short questions to ask. Remind them that these questions refer to them personally, not the household. Ask all four questions below.*

*If the person accepts: Ask questions 1 and 2 only after completing the Demographic Profile (Form E) but before doing the height and weight measurements.*

1. During the past month, did you eat bread?

☐ Yes ☐ No

If yes, what type of bread did you usually eat? (Check only one) **DO NOT READ**

☐ Whole wheat (100%, 75%, 60%)
☐ Multigrain/Cracked Wheat
☐ Do Not Know
☐ White Bread
☐ Molasses Raisin Bread
☐ Other __________

2. During the past month, did you use milk?

☐ Yes ☐ No

If yes, what type of milk did you usually use? (Check only one) **DO NOT READ**

☐ Whole milk
☐ 2% milk
☐ 1% milk
☐ Skim milk
☐ Powdered Skim milk
☐ Powdered whole milk
☐ Evaporated milk
☐ Other __________
☐ Do not know

---

3. During the past month, did you use any vitamin-mineral supplement?

☐ Yes ☐ No

4. Have you ever smoked cigarettes?

☐ Yes ☐ No → END. ☐ Refused to answer → END.

↓

At the present time do you smoke cigarettes?

☐ Yes ☐ No → END. ☐ Refused to answer → END.

↓

Do you usually smoke cigarettes every day?

☐ Yes ☐ No → END. ☐ Refused to answer → END.

↓

How many cigarettes do you smoke a day?

☐☐☐ Number ☐ Refused to answer

## APPENDIX B

**FORM B**

## NEWFOUNDLAND AND LABRADOR NUTRITION SURVEY

FACILITATOR # ☐☐ 24 HOUR RECALL FORM Identifier Number ☐☐☐☐☐☐

| Time 00:01 23:59 | Rest/ Cafe. * | Meal/ Snack ** | Home Prep. *** | Food Description | Salt | # of Portions | Model | Thick-ness |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

* Restaurant/Cafeteria
- C = cafeteria
- F = fast food
- R = restaurant (table service)
- T = take-out outlet, deli
- V = vending machine, snack bar

** Meal/Snack
- BK = breakfast
- L = lunch
- D = dinner (supper)
- BC = brunch
- S = snack, in-between meals

*** Homemade
- H = home made baked products made from scratch or a mix in your own home.
- E = home made baked products made from scratch or a mix <u>elsewhere</u> than in your own home.

Did you prepare most of the foods you ate yesterday? Yes __ No __ (1)

FOR INTERVIEWER ONLY:

In the interview, was the respondent assisted by the person who prepared the meals? Yes__ No __ N/A __ (2)

## APPENDIX C

FORM C

Identifier #: [ | | | | ]

# NEWFOUNDLAND & LABRADOR NUTRITION SURVEY
# FOOD FREQUENCY QUESTIONNAIRE

**PART I.** This section deals with the frequency of consumption of specific foods during the past month.

| FOOD | FREQUENCY | | | PORTION SIZE | | COMMENTS |
|---|---|---|---|---|---|---|
| | FURTHER FOOD DESCRIPTION(S) | # | DAY/D WEEK/W MONTH/M | REFERENCE PORTION SIZE OR MODEL | HOW MUCH/ HOW MANY? | |
| HOW OFTEN DID YOU CONSUME:<br>01 Broccoli | | | | MO-M | | |
| 02 Carrots or mixed vegetables & carrots | | | | MO-M | | |
| 03 Cabbage, coleslaw, and sauerkraut | | | | MO-M | | |
| 04 Cauliflower | | | | MO-M | | |
| 05 Spinach - cooked | | | | MO-M | | |
| 06 Spinach - raw | | | | MO-M | | |
| 07 Squash (dark yellow) | | | | MO-M | | |
| 08 Turnip | | | | MO-M or ½ CR-L, T-4 | | |
| 09 Green peas | | | | MO-S | | |
| 10 Greens | | | | MO-M | | |
| 11 Fish (excluding shellfish) - fried | | | | PC-S | | |
| 12 - cooked other ways | | | | PC-S | | |
| 13 All shellfish -dipped in butter/ margarine/ mayonnaise -fried | | | | 10 units or 1/2 cup (w/o shell) | | |
| 14 - cooked other ways | | | | 10 units or MO-M (w/o shell) | | |

| FOOD | FREQUENCY | | | PORTION SIZE | | COMMENTS |
|---|---|---|---|---|---|---|
| | FURTHER FOOD DESCRIPTION(S) | # | DAY/D WEEK/W MONTH/M | REFERENCE PORTION SIZE OR MODEL | HOW MUCH/ HOW MANY? | |
| 15 Poultry - fried | | | | PC-S | | |
| 16 - cooked other ways | | | | PC-S | | |
| 17 Beef and Veal - steaks, roasts, stews and other cuts | | | | PC-S | | |
| 18 - hamburgers | | | | PC-S | | |
| 19 - other ground beef | | | | PC-S | | |
| 20 Liver (all types) | | | | PC-S | | |
| 21 Lamb and Mutton - roasts, chops and other cuts | | | | PC-S | | |
| 22 Pork and Ham - roasts, chops and other cuts | | | | PC-S | | |
| 23 - bacon | | | | 1 STRIP | | |
| 24 Wild game - large animals | | | | PC-S | | |
| 25 - small animals | | | | PC-S | | |
| 26 - wild birds | | | | PC-S | | |
| 27 Seal or whale | | | | PC-S | | |
| 28 Beans - boiled or baked | | | | MO-M | | |
| 29 Weiners (includes hot dogs) or Sausages | | | | 1 UNIT | | |
| 30 Bologna | | | | 1 CR-L,T-1 | | |
| 31 Luncheon meats | | | | 1 SLICE | | |
| 32 Salt meat, riblets | | | | PC-S | | |
| 33 Pizza | | | | 1 SLICE | | |
| 34 Cheese (more than 24% b.f.) | | | | 1 SLICE or 1/3 PC-S | | |
| 35 Light Cheese (10-24% b.f.) | | | | 1 SLICE or 2 TBL | | |
| 36 Cottage cheese or any cheese (less than 10% bf) | | | | MO-S | | |
| 37 Eggs or egg dishes | | | | 1 EGG | | |

| FOOD | FREQUENCY | | | PORTION SIZE | | COMMENTS |
|---|---|---|---|---|---|---|
| | FURTHER FOOD DESCRIPTION(S) | # | DAY/D. WEEK/W MONTH/M | REFERENCE PORTION SIZE OR MODEL | HOW MUCH/ HOW MANY? | |
| 38 Potatoes - french fries or pan fried | | | | MO-L | | |
| 39 - baked or boiled | | | | BA-L 1 medium | | |
| 40 - scalloped, mashed, potato salad, or potatoes in stews and casseroles | | | | MO-L | | |
| 41 Potato chips or tortilla chips | | | | 1 BO-L | | |
| 42 Rich gravy or pan drippings | | | | 1/4 CUP | | |
| 43 Scrunchions | | | | 2 TBL | | |
| 44 Cream or cheese sauce | | | | 1/4 CUP | | |
| 45 Yogourt (more than 1% b.f.) | | | | 1/2 CUP 175 G | | |
| 46 Light Yogourt (1% or less b.f.) | | | | 1/2 CUP 175 G | | |
| 47 Ice cream, regular or rich | | | | 1/2 CUP | | |
| 48 Low fat ice cream, frozen yogourt, ice milk or sherbet | | | | 1/2 CUP | | |
| 49 Bread, white | | | | 1 SLICE | | |
| 50 Bread, whole wheat | | | | 1 SLICE | | |
| 51 Crackers | | | | 1 CRACKER | | |
| 52 Cookies | | | | 1 COOKIE | | |
| 53 Donuts, cakes, pies, muffins, or croissants | | | | 1 UNIT | | |
| 54 Beer | | | | 1 BOTTLE | | |
| 55 Wine | | | | 4 FOZ | | |
| 56 Spirits | | | | 1 FOZ | | |

| FOOD | FREQUENCY | | | PORTION SIZE | | COMMENTS |
|---|---|---|---|---|---|---|
| | FURTHER FOOD DESCRIPTION(S) | # | DAY/D WEEK/W MONTH/M | REFERENCE PORTION SIZE OR MODEL | HOW MUCH/ HOW MANY? | |
| **IN TEA AND COFFEE, WHAT KIND OF MILK DID YOU USE? [DO NOT READ LIST]** | | | | | | |
| 57 whole milk | | | | 1 TBL | | |
| 58 2% milk | | | | 1 TBL | | |
| 59 1% milk | | | | 1 TBL | | |
| 60 skim milk | | | | 1 TBL | | |
| 61 dry skim milk powder | | | | 1 TSP | | |
| 62 whole milk powder | | | | 1 TSP | | |
| 63 cream or creamers | | | | 1 TBL | | |
| 64 evaporated milk, regular (whole) - undiluted | | | | 1 TBL | | |
| 65 evaporated milk, light - undiluted | | | | 1 TBL | | |
| 66 evaporated milk, 2% - undiluted | | | | 1 TBL | | |
| 67 evaporated milk, skim - undiluted | | | | 1 TBL | | |
| 68 evaporated milk, regular (whole) - diluted | | | | 1 TBL | | |
| 69 evaporated milk, light - diluted | | | | 1 TBL | | |
| 70 evaporated milk, 2% - diluted | | | | 1 TBL | | |

71 other types of milk (please specify) ______________________________

72 did not use milk or cream (please check) _____

73 used coffee whitener (please check) _____

74 did not drink tea or coffee (please check) _____

| FOOD | FREQUENCY | | | PORTION SIZE | | COMMENTS |
|---|---|---|---|---|---|---|
| | FURTHER FOOD DESCRIPTION(S) | # | DAY/D WEEK/W MONTH/M | REFERENCE PORTION SIZE OR MODEL | HOW MUCH/ HOW MANY? | |
| **ON CEREALS WHAT KIND OF MILK DID YOU USE? [DO NOT READ LIST]** | | | | | | |
| 75 whole milk | | | | 1/2 CUP | | |
| 76 2% milk | | | | 1/2 CUP | | |
| 77 1% milk | | | | 1/2 CUP | | |
| 78 skim milk | | | | 1/2 CUP | | |
| 79 cream | | | | 1/2 CUP | | |
| 80 evaporated milk, regular (whole) - undiluted | | | | 1/2 CUP | | |
| 81 evaporated milk, light - undiluted | | | | 1/2 CUP | | |
| 82 evaporated milk, 2% - undiluted | | | | 1/2 CUP | | |
| 83 evaporated milk, skim - undiluted | | | | 1/2 CUP | | |
| 84 evaporated milk, regular (whole) - diluted | | | | 1/2 CUP | | |
| 85 evaporated milk, light - diluted | | | | 1/2 CUP | | |
| 86 evaporated milk, 2% - diluted | | | | 1/2 CUP | | |

87 other types of milk (please specify) ______

88 ate cereals dry (please check) ___

89 did not eat cereals (please check) ___

| FOOD | FREQUENCY | | | PORTION SIZE | | COMMENTS |
|---|---|---|---|---|---|---|
| | FURTHER FOOD DESCRIPTION(S) | # | DAY/D WEEK/W MONTH/M | REFERENCE PORTION SIZE OR MODEL | HOW MUCH/ HOW MANY? | |
| **AS A BEVERAGE, WHAT KIND OF MILK DID YOU DRINK? [DO NOT READ LIST]** | | | | | | |
| 90 whole milk | | | | 1 CUP | | |
| 91 2% milk (white or chocolate) | | | | 1 CUP | | |
| 92 1% milk | | | | 1 CUP | | |
| 93 buttermilk | | | | 1 CUP | | |
| 94 skim milk | | | | 1 CUP | | |
| 95 evaporated milk*, regular (whole) - undiluted | | | | 1 CUP | | |
| 96 evaporated milk*, light - undiluted | | | | 1 CUP | | |
| 97 evaporated milk*, 2% - undiluted | | | | 1 CUP | | |
| 98 evaporated milk*, skim - undiluted | | | | 1 CUP | | |

*If the evaporated milk was diluted, please print "DILUTED" in the appropriate "COMMENTS" column

99 other types of milk (please specify) ______________________________

100 did not drink milk (please check) _____

**HOW FREQUENTLY IN THE LAST MONTH DID YOU HAVE MEALS FROM?**

| | FURTHER DESCRIPTION(S) | # | DAY/D WEEK/W MONTH/M | COMMENTS |
|---|---|---|---|---|
| 101 restaurants (table service) | | | | |
| 102 take out, fast food restaurants or delis | | | | |
| 103 cafeterias (tray service) | | | | |

Identifier #: | | | | | | |

PART II. This section deals only with homemade foods and uses of fat over the past month. *Please check (√) the main source(s) of fat used. (If more than one source is checked, then all checks will be calculated as equal proportions*

| | MAIN SOURCE | |
|---|---|---|
| | | IF YOU ATE HOME DEEP-FAT FRIED FOODS AT LEAST TWICE THIS PAST MONTH, WHAT WAS THE MAIN KIND OF FAT OR OIL USED? [DO NOT READ LIST] |
| 104 | | a) Vegetable oil |
| 105 | | b) Lard, bacon, or animal fat |
| 106 | | c) Shortening |
| 107 | | d) Do not know |
| 108 | | e) Did not eat home deep-fried foods this past month |
| | | IF YOU ATE HOME PAN-FRIED FOODS AT LEAST TWICE THIS PAST MONTH, WHAT WAS THE MAIN KIND OF FAT OR OIL USED? [DO NOT READ LIST] |
| 109 | | a) Butter |
| 110 | | d) Soft margarine |
| 111 | | e) Hard margarine |
| 112 | | f) Lard, bacon, animal fat, or scrunchions |
| 113 | | g) Shortening |
| 114 | | h) Oil |
| 115 | | i) Pam or no oil |
| 116 | | j) Do not know |
| 117 | | k) Did not eat home pan-fried foods this past month |

Identifier #: | | | | | |

| | MAIN SOURCE | |
|---|---|---|
| | | IF YOU ATE HOME-BAKED FOODS AT LEAST TWICE THIS PAST MONTH, WHAT WAS THE MAIN KIND OF FAT OR OIL USED? [DO NOT READ LIST] |
| 118 | | a) Butter |
| 119 | | d) Soft margarine |
| 120 | | e) Hard margarine |
| 121 | | f) Shortening |
| 122 | | g) Oil |
| 123 | | h) Lard, bacon, or animal fat |
| 124 | | i) Do not know |
| 125 | | j) Did not eat home-made baked goods that contained fat this past month |
| | | WHAT WAS THE MAIN KIND OF "FAT SPREAD" YOU USED ON BREAD, BUNS, MUFFINS, ETC. THIS PAST MONTH? [DO NOT READ LIST] |
| 126 | | a) Butter |
| 127 | | d) Soft margarine |
| 128 | | e) Hard margarine |
| 129 | | f) Low calorie margarine |
| 130 | | g) Lard, bacon or pork fat |
| 131 | | h) None or none of these |
| 132 | | i) Did not eat bread, buns, muffins, etc. this past month |

| | MAIN SOURCE | |
|---|---|---|
| | | WHAT WAS THE MAIN KIND OF "FAT SPREAD" YOU PUT ON POTATOES OR VEGETABLES THIS PAST MONTH? [DO NOT READ LIST] |
| 133 | | a) Butter |
| 134 | | d) Soft margarine |
| 135 | | e) Hard margarine |
| 136 | | f) Low calorie margarine |
| 137 | | g) Sour cream |
| 138 | | h) Lard, bacon fat, or animal fat |
| 139 | | i) None or none of these |
| 140 | | j) Did not eat potatoes and vegetables this past month |

**PART III.** This section deals with your food habits during the past month. *Please check (✓) one or more when relevant.*

| | MOST OFTEN | *[If the person did not eat meat or poultry or fish in Part I, then check (✓) "Did not eat meat/poultry/fish cooked by these methods this past month" below where appropriate (instead of asking questions #139 to 183)].* |
|---|---|---|
| | | OF THE MEAT YOU ATE LAST MONTH, WHAT WAS THE MOST COMMON METHOD OF COOKING IT? *[DO NOT READ LIST]* |
| 141 | | a) Broiled |
| 142 | | b) Pan-fried with fat |
| 143 | | c) Pan-fried without fat or with pan spray |
| 144 | | d) Deep-fat fried |
| 145 | | e) Oven-roasted (Baked) |
| 146 | | f) Boiled/stewed/pot-roasted |
| 147 | | g) Microwaved |
| 148 | | h) Barbecued |
| 149 | | i) Steamed/Poached |
| 150 | | j) Did not eat meat cooked by these methods this past month |

| | MOST OFTEN | *[If the person did not eat meat or poultry or fish in Part I, then check (✓) "Did not eat meat/poultry/fish cooked by these methods this past month" below where appropriate (instead of asking questions #139 to 183)].* |
|---|---|---|
| | | **OF THE POULTRY YOU ATE LAST MONTH, WHAT WAS THE MOST COMMON METHOD OF COOKING IT? *[DO NOT READ LIST]*** |
| 151 | | a) Broiled |
| 152 | | b) Pan-fried with fat |
| 153 | | c) Pan-fried without fat or with pan spray |
| 154 | | d) Deep-fat fried |
| 155 | | e) Oven-roasted (Baked) |
| 156 | | f) Boiled/stewed |
| 157 | | g) Microwaved |
| 158 | | h) Barbecued |
| 159 | | i) Steamed/Poached |
| 160 | | j) Did not eat poultry cooked by these methods this past month |
| | | **OF THE FISH YOU ATE LAST MONTH, WHAT WAS THE MOST COMMON METHOD OF COOKING IT? THIS DOES NOT INCLUDE CANNED FISH. *[DO NOT READ LIST]*** |
| 161 | | a) Broiled |
| 162 | | b) Pan-fried with fat |
| 163 | | c) Pan-fried without fat or with pan spray |
| 164 | | d) Deep-fat fried |
| 165 | | e) Oven-roasted (Baked) |
| 166 | | f) Boiled/stewed |
| 167 | | g) Microwaved |
| 168 | | h) Barbecued |
| 169 | | i) Steamed/Poached |
| 170 | | j) Did not eat fish cooked by these methods this past month |

| | MOST OFTEN | *[If the person did not eat meat or poultry or fish in Part I, then check (✓) "Did not eat meat/poultry/fish cooked by these methods this past month" below where appropriate (instead of asking questions #139 to 183)].* |
|---|---|---|
| | | *[If the person did not eat meat or poultry in part I, then check (✓) "Did not eat meat/poultry this past month" below where appropriate.* |
| | | **OF THE MEAT YOU ATE LAST MONTH, DID YOU EAT THE VISIBLE FAT OF THE MEAT?** |
| 171 | | a) Always |
| 172 | | b) Sometimes |
| 173 | | c) Never |
| 174 | | d) Did not eat meat this past month |
| | | **OF THE POULTRY YOU ATE LAST MONTH, DID YOU EAT THE SKIN ON THE POULTRY?** |
| 175 | | a) Always |
| 176 | | b) Sometimes |
| 177 | | c) Never |
| 178 | | d) Did not eat poultry this past month |
| | | **OF THE MEAT OR POULTRY YOU ATE LAST MONTH, DID YOU EAT GRAVY WITH YOUR MEAT OR POULTRY?** |
| 179 | | a) Always |
| 180 | | b) Sometimes |
| 181 | | c) Never |
| 182 | | d) Did not eat meat or poultry this past month |
| | | **OF THE FISH YOU ATE LAST MONTH, DID YOU EAT GRAVY WITH YOUR FISH?** |
| 183 | | a) Always |
| 184 | | b) Sometimes |
| 185 | | c) Never |
| 186 | | d) Did not eat fish this past month |

| | | |
|---|---|---|
| | | **IN THE PAST MONTH, WHAT WAS THE MAIN KIND OF DRESSING YOU ADDED TO YOUR SALADS? [DO NOT READ LIST]** |
| 187 | | a) mayonnaise |
| 188 | | b) mayonnaise-type and regular salad dressing |
| 189 | | c) low calorie and calorie reduced salad dressing |
| 190 | | d) other (i.e. yogourt, vinegar only, tomato juice, etc.) |
| 191 | | e) Did not add dressing |
| 192 | | f) Did not eat salad this past month |

Identifier #: | | | | | | |

**PART IV.** This section deals with WHY you choose the foods that you eat.
*(Briefly probe to confirm some action is being taken). Please check (✓) one or more when relevant.*

| | | |
|---|---|---|
| **ARE YOU CHOOSING OR AVOIDING FOODS OR TYPES OF FOODS BECAUSE YOU ARE CONCERNED ABOUT:** | | |
| 193 | | Maintaining or improving your health? |
| 194 | | Heart disease? |
| 195 | | Cancer? |
| 196 | | Osteoporosis (brittle bones)? |
| 197 | | High Blood Pressure? |
| 198 | | Weight gain? |
| **ARE YOU CHOOSING TO EAT FOODS OR TYPES OF FOODS BECAUSE OF:** | | |
| 199 | | the nutrients they contain? |
| 200 | | the unsaturated fat content? |
| 201 | | the fibre content? |
| **ARE YOU AVOIDING FOODS OR TYPES OR FOODS BECAUSE OF:** | | |
| 202 | | the fat content? |
| 203 | | the salt content? |
| 204 | | the cholesterol content? |
| 205 | | the sugar content? |
| 206 | | the saturated fat content? |
| **ASK ONLY IF SUBJECT HAS NOT MENTIONED MEAT:** | | |
| 207 | | Are you a vegetarian? |

| | |
|---|---|
| **ARE YOU FOLLOWING ANY SPECIAL DIET?** | |
| 208 | ☐ Yes (Specify)____________________<br>☐ No (Go to Question # 210) |

| | | |
|---|---|---|
| **WAS THIS SPECIAL DIET PRESCRIBED BY A DOCTOR, DIETITIAN OR OTHER HEALTH PROFESSIONALS?** | | |
| 209 | Doctor: | ☐ Yes ☐ No ☐ Refused |
| 210 | Dietitian: | ☐ Yes ☐ No ☐ Refused |
| 211 | Other health professionals: | ☐ Yes (Specify)________________<br>☐ No ☐ Refused |

Identifier #: | | | | | |

[IF THE PERSON HAS A SECOND INTERVIEW ASSIGNED, THEN GO TO FORM D, QUESTION #1]

212 HAVE YOU EVER SEEN OR HEARD ABOUT THE "CANADA'S FOOD GUIDE TO HEALTHY EATING"? *(Show Food Guide)*

☐ Yes

☐ No (Go to Form D, Question #1)

213 Do you use it?

☐ Yes

☐ No (Go to Form D, Question #1)

214 How do you use it? *(Check one or more when relevant)*

☐ for shopping e.g. to help prepare my shopping list

☐ for planning/choosing meals (at home)

☐ for choosing foods in restaurants

☐ other (specify) ____________________

# APPENDIX D

Identifier # [ ][ ][ ][ ][ ][ ]

# NEWFOUNDLAND AND LABRADOR NUTRITION SURVEY

## NUTRITION AND HEALTH QUESTIONNAIRE

I would like to ask you some questions about your health.

## PART I

I am going to read you a list of actions people might take to prevent heart disease or heart attacks. For each one, please tell me if you think it would have little or no effect, a moderate effect, or a large effect? **(READ LIST)**

| | | Little or No Effect | Moderate Effect | Large Effect | Not Sure |
|---|---|---|---|---|---|
| 1 | First, losing weight: If one is overweight, would weight reduction have little or no effect, a moderate effect, or a large effect in preventing heart disease? | 1 | 2 | 3 | 9 |
| 2 | How about reducing cigarette smoking? Would that have little or no effect, a moderate effect, or a large effect in preventing heart disease? | 1 | 2 | 3 | 9 |
| 3 | Lowering high blood pressure? | 1 | 2 | 3 | 9 |
| 4 | Lowering high blood cholesterol? | 1 | 2 | 3 | 9 |
| 5 | Eating fewer high-fat foods? | 1 | 2 | 3 | 9 |
| 6 | Eating fewer high cholesterol foods? | 1 | 2 | 3 | 9 |
| 7 | Eating fewer high-salt foods? | 1 | 2 | 3 | 9 |
| 8 | Eating more high-fibre foods? | 1 | 2 | 3 | 9 |

Identifier # ☐☐☐.☐☐

PART II

The next few questions are about physical exercise.

9 How do you describe your work? By work I mean paid and non-paid work. Which of the following best describes how you spend <u>most</u> of your work time. **(Check one only).**

☐ My work is mainly sitting. I do not walk much during work, e.g. telephone operator, secretary.

☐ In my work I walk or move quite a lot, but I do not have to lift or carry heavy things, e.g. shop assistant, light housework.

☐ In my work I have to walk and carry a lot, climb staircases often or go uphill, e.g. carpentry, farm work, heavy housework.

☐ My work is heavy physical labour where I usually have to carry, lift heavy things, dig or shovel, e.g. forestry work, heavy farm work, warehouse work.

10 In your spare time, do you do any sport, physical activity, or work in which you are moving a lot, but your heart does not beat rapidly such as walking, house cleaning, or gardening?

Y☐ N☐ **(go to 13)**

11 How many times during the average week do you do such activities?

**DO NOT READ**

☐ < 3 x per week

☐ 3 x per week

☐ > 3 x per week

Identifier # ☐☐☐☐☐☐

12 For each time that you do these activities on average how many minutes do you spend at it (or them)?

**DO NOT READ**

☐ < 20 minutes

☐ between 20 & 29 minutes

☐ 30 minutes or more

13 In your spare time, do you do any sport, physical activity, or hard work that would make your heart beat rapidly such as hockey, soccer, swimming, jogging or aerobics?

Y☐ N☐
(go to 16)

14 How many times during the average week do you do such activities?

**DO NOT READ**

☐ < 3 x per week

☐ 3 x per week

☐ > 3 x per week

15 For each time that you do these activities, on average how many minutes do you spend at it (or them)?

**DO NOT READ**

☐ < 20 minutes

☐ between 20 & 29 minutes

☐ 30 minutes or more

The next few questions are about smoking.

16 Have you ever smoked cigarettes? Y☐ N☐ (go to 20)

17 At the present time do you smoke cigarettes? Y☐ N☐ (go to 20)

18 Do you usually smoke cigarettes every day? Y☐ N☐ (go to 20)

19 How many cigarettes do you smoke a day? ☐☐ cigarettes

20 Were you ever told by a doctor or other health care worker that your blood cholesterol was high? Y☐ N☐ (go to 23)

21 Are you now doing anything to lower your blood cholesterol? Y☐ N☐ (go to 23)

22 What are you doing to lower your blood cholesterol? **(DO <u>NOT</u> READ LIST. Check all that apply)**

- ☐ diet
- ☐ medications
- ☐ exercise program
- ☐ other (describe) ______________________

Identifier # ☐☐☐☐☐☐

23 Were you ever told by your doctor or other health care worker that you had high blood pressure (except during pregnancy)?

Y☐ N☐
(go to 26)

24 Are you now doing anything for your blood pressure?

Y☐ N☐
(go to 26)

25 What are you doing for your high blood pressure? **(DO <u>NOT</u> READ LIST. Check all that apply).**

☐ diet
☐ medications
☐ exercise program
☐ other (describe) ______________________________

26 Have you ever been told by your doctor or other health care worker that you have diabetes, or high blood sugar (except during pregnancy)?

Y☐ N☐
(go to 29)

27 Are you now doing anything for your diabetes, or high blood sugar?

Y☐ N☐
(go to 29)

Identifier # ☐☐☐☐☐☐

28 What are you doing for your diabetes, or high blood sugar? **(DO NOT READ LIST. Check all that apply).**

- ☐ diet
- ☐ pills to lower blood sugar
- ☐ insulin
- ☐ exercise program
- ☐ other (describe) ______________________________

**PART III**

Now I would like to talk a little about foods eaten in Newfoundland and Labrador.

29 During the past year, did you eat berries grown in Newfoundland and Labrador? (This includes berries in jams, preserves and pies)

Y☐ N☐
**(go to 32)**

30 What type or types of berries did you eat?

| | |
|---|---|
| blueberries | ☐ |
| raspberries | ☐ |
| bakeapples | ☐ |
| partridgeberries | ☐ |
| strawberries | ☐ |
| others | ☐ |

(specify) ____________
____________

31 Last year, approximately how many gallons/litres of berries did your family eat?

____________ Gallons
____________ Litres

32 Do you or your family grow your own fruits and/or vegetables?

Y☐ N☐
**(go to 34)**

33 If you wanted to grow fruits/vegetables, would you have an appropriate piece of land available to you?

Y☐ N☐

34 During an average week, how often do you eat pickled foods (including pickled vegetables and relishes, pickled meats and fishes, but excluding salt beef and salt pork)?

**DO NOT READ**

☐ < 1 x per week

☐ 1-2 x per week

☐ 3-4 x per week

☐ > 4 x per week

35 <u>SinceMay of 1995</u>, have you eaten any of the following game meats?

| | | |
|---|---|---|
| Moose or caribou | Y☐ | N☐ |
| Rabbit | Y☐ | N☐ |
| Wild birds | Y☐ | N☐ |
| Seal or whale | Y☐ | N☐ |
| Bear | Y☐ | N☐ |

**(If NO to all go to 38)**

36 Did you eat more, about the same, or less game meat this year as compared to five years ago?

☐ More
☐ Same (go to 38)
☐ Less

Identifier # ☐☐☐☐☐☐

37 If you eat more or less game meat can you tell me why?

____________________
____________________
____________________

38 Did you eat more, about the same, or less fresh water fish, such as trout, this year as compared to five years ago?

- ☐ More
- ☐ Same (go to 40)
- ☐ Less

39 If you eat more or less fresh water fish, can you tell me why?

____________________
____________________
____________________

40 Did you eat more, about the same, or less salt water fish, such as cod, this year as compared to five years ago?

- ☐ More
- ☐ Same (go to 42)
- ☐ Less

41 If you eat more or less salt water fish, can you tell me why?

____________________
____________________
____________________

PART IV

42 During the last 30 days, which of the following statements best describes the amount of food available to be eaten by you and your family?

Always enough food to eat ☐ **(Go to Form E)**
Sometimes not enough food to eat ☐ **(Go to 43)**
Often not enough food to eat ☐ **(Go to 43)**

43 To what extent did each of the following reasons contribute to this lack of food?

a. Problems with transportation.

Not at all ☐
A Little ☐
A Lot ☐

b. Not having working appliances (such as a refrigerator or a stove) for storing or preparing foods.

Not at all ☐
A Little ☐
A Lot ☐

c. Not having enough money to buy food or beverages.

Not at all ☐
A Little ☐
A Lot ☐

d. Not having an adequate choice of foods available to you.

Not at all ☐
A Little ☐
A Lot ☐

44 During the last month, did you or your family skip any meals because there was not enough food or money to buy food?

Y☐ N☐

**Acknowledgements:** *Nova Scotia Nutrition Survey*
*Saskatchewan Nutrition Survey*
*Alberta Nutrition Survey*
*Prince Edward Island Nutrition Survey*

# APPENDIX E

FORM E

Identifier # [ ][ ][ ][ ][ ][ ]

# NEWFOUNDLAND & LABRADOR NUTRITION SURVEY

## DEMOGRAPHIC PROFILE

**In order to compare your answers with people from similar backgrounds we would like to ask you a few questions about yourself.**

1. How many people, including yourself, live in this household?

[ ][ ]

2. Of that total number, how many persons are under 18 years old and are your dependents?

[ ][ ]

3. What is the highest grade or level of education you have ever attended or ever completed? (Mark only one)

01 ☐ No schooling

02 ☐ Some Elementary

03 ☐ Completed Elementary

04 ☐ Some Secondary

05 ☐ Completed Secondary

06 ☐ Some Community College, Technical College, or Nurse's training

07 ☐ Completed Community College, Technical College, or Nurse's training

08 ☐ Some University (e.g. B.A. M.A. PhD) or teachers college

09 ☐ Completed University (e.g. B.A. M.A. PhD) or teachers college

10 ☐ Other education or training (Specify ______________)

Identifier # [ ][ ][ ][ ][ ][ ]

4. What is your current marital status? Are you...

01 ☐ Single (Never Married)?

02 ☐ Married (and not separated), or living common law?

03 ☐ Separated?

04 ☐ Divorced?

05 ☐ Widowed?

5. For statistical purposes only, we need to know your best estimate of the total income, before taxes, of all household members last year (1995). Could you please tell me from the card which letter applies to your total household income?

A
B
C
D
E
F
G
H
I

**APPENDIX F**

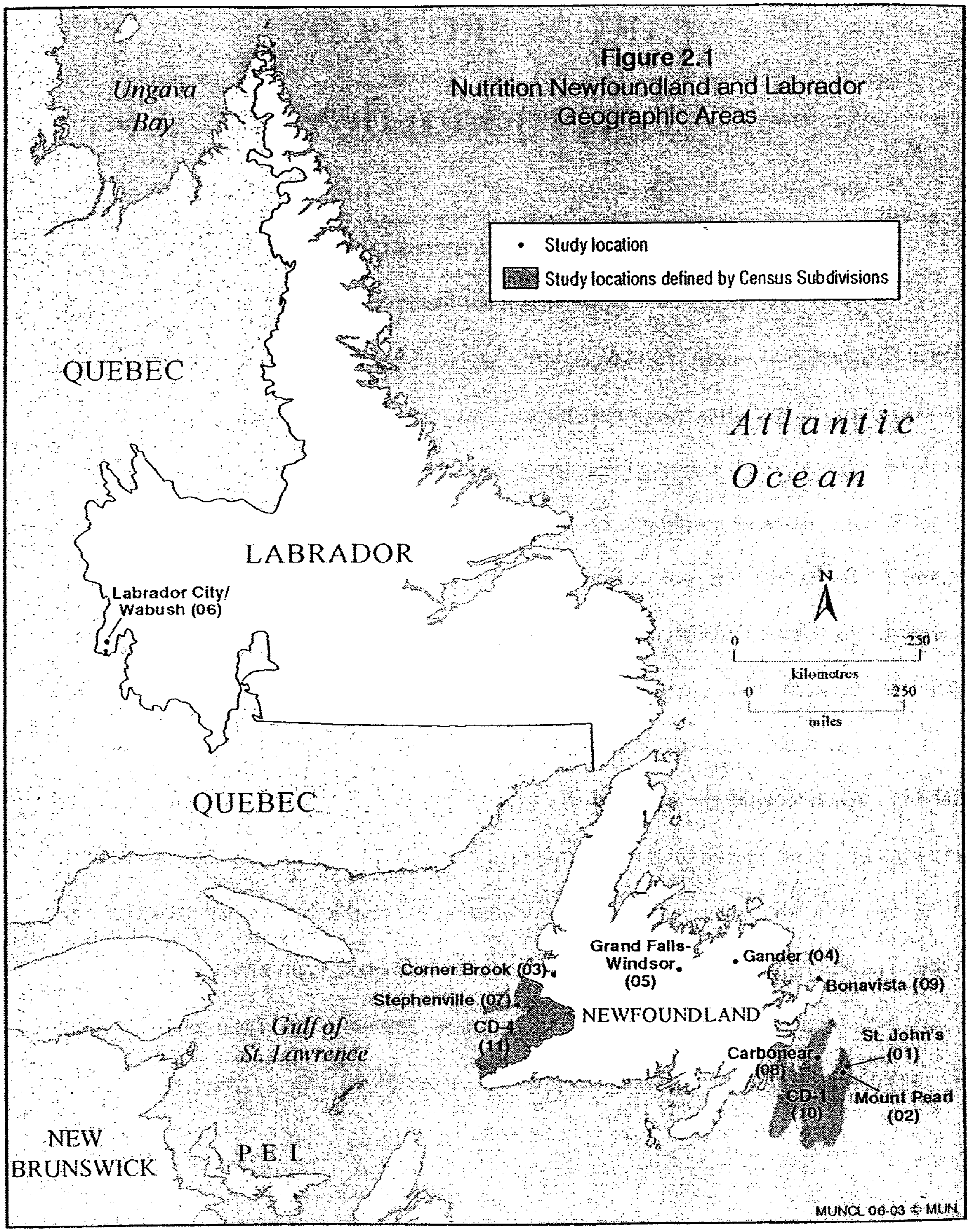
Figure 2.1
Nutrition Newfoundland and Labrador
Geographic Areas
Study location
Study locations defined by Census Subdivisions
Ungava Bay
QUEBEC
LABRADOR
Labrador City/
Wabush (06)
QUEBEC
Atlantic
Ocean
N
0
250
kilometres
0
250
miles
Grand Falls-
Windsor
(05)
Gander (04)
Corner Brook (03)
Bonavista (09)
Stephenville (07)
NEWFOUNDLAND
CD-4
(11)
Gulf of
St. Lawrence
Carbonear
(08)
St. John's
(01)
CD-1
(10)
Mount Pearl
(02)
NEW
BRUNSWICK
P.E.I.
MUNCL 06-03 © MUN

# APPENDIX G

## APPENDIX H