University of Alberta

Consumer Preferences for Milk and Yogurt Products in Canada

by

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A thesis submitted to the Faculty of Graduate Studies and Research
in partial fulfillment of the requirements for the degree of

Master of Science
in
Agricultural and Resource Economics

Department of Resource Economics and Environmental Sociology

Fall 2012
Edmonton, Alberta

Abstract

This research examines Canadian consumer preferences for milk and yogurt products, both those currently available in the marketplace as well as hypothetical products. Self-reported consumption and choice experiments are used to determine consumer preferences for various attributes and how these preferences are influenced by demographic and health characteristics. The results from the consumption analysis indicate that many demographic and health characteristics are significant factors in predicting milk/yogurt consumption, that milk and yogurt consumers are not the same people, and that consumers of individual dairy products fall into different demographic categories. The choice experiment analysis indicates that individuals have narrowly distributed WTP values for fat content and informational attributes and widely distributed WTP values for functional attributes. In general, women over 50 appear to be WTP more for informational attributes and vitamin-enhanced products than the general population, while young adults are WTP more than the general population for probiotic dairy products.

Acknowledgements

I would like to thank my supervisor Dr. Ellen Goddard for all of the time and advice she has given me. I have learned much from her and have enjoyed the work we have done together. I would also like to thank my supervisory committee for their guidance and input. In addition, I would like to thank all of the professors in the department of Resource Economics and Environmental Sociology who I took classes with, who answered my questions years later, and who were always willing to give me a hand. I would like to thank my family, without whose love and support I would not have been able to complete this degree. I would also like to thank my friends in the REES department who provided the occasional, much needed, mental break, whether in the form of lunch, a walk, or a good talk.

I would also like to thank the Canadian Dairy Commission and the Food and Health Innovation Initiative (Faculty of Agricultural, Life & Environmental Science, University of Alberta) for financial support, as well as Sunburn Media for the graphic design work.

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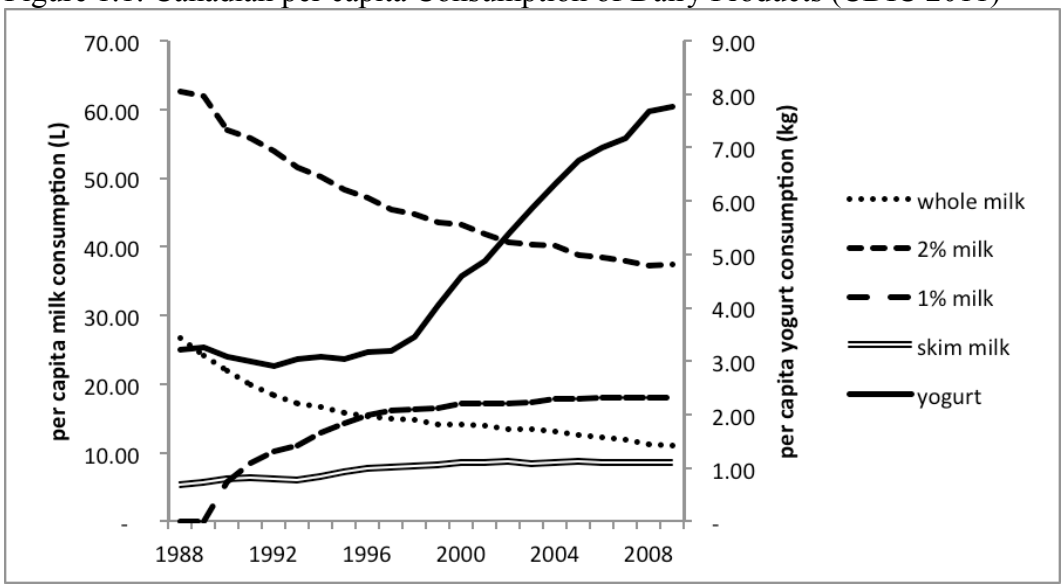
Chapter 1: Introduction

1.1. Background

In the past 20 years, the dairy market in Canada has not experienced the kind of growth which has characterized most other sectors in agri-food business (AAFC 2012). The per capita intake of some products, such as cheese, has remained relatively constant, while other products, such as butter and ice cream, have shown a decline in per capita consumption (CDIC 2011). Despite some increases in the consumption of skim and 1% milk, total fluid milk consumption has declined. The only dairy product in Canada to have a striking increase in per capita consumption since 1996 is yogurt. Please see Figure 1.1 for more details. This trend has also been noted in the US and some European countries (Giacomo 2008). These may could be related to the changing Canadian population, changing attitudes towards diet.

Figure 1.1: Canadian per capita Consumption of Dairy Products (CDIC 2011)



The trend towards decreased milk consumption and increased yogurt consumption in Canada has been well documented. According to AAFC (2011), per capita consumption of all dairy products except yogurt is expected to either continue to fall or to increase less rapidly. Moffat and Galloway (2008) found

that fewer than half of school-aged children consume the recommended daily servings of milk products. One of the reasons that milk consumption may be declining is that many nine to seventeen year olds in Canada drink water, juice or sugar sweetened beverages instead of milk, which has the negative nutritional result of lowering calcium intake (Loughlin 2004). According to the B.C. Dairy Foundation, consumption of milk in British Columbia is declining at a rate of 1% to 1.5% annually (Lazarus 2003). The AAFC (2011) notes that yogurt is the one dairy category expected to experience substantial growth in the near future, and consumption of yogurt in Canada has been increasing by approximately 7% annually (Lamoureux 2005).

There are several possible reasons for the increase in yogurt consumption, including the higher number of yogurt products available at the retail level, the greater advertising spending on yogurt, functional claims (probiotics) for some yogurts and yogurt's reputation as a healthy food. The nutritional information given on labels, in addition to third party endorsements, may also play a role. Despite the fact that both milk and yogurt are good sources of vitamins B_2 and B_{12}, only some yogurt brands (one milk brand) choose to highlight this on their nutrition facts panel.

1.1.1. Heath Implications

Given the decline in overall dairy consumption, it is not surprising that there is substantial evidence that many segments of the Canadian population do not consume an adequate amount of dairy products (as determined by Health Canada) in their diet in terms of ensuring that they receive appropriate levels of the micronutrients that are most commonly found in dairy products. More specifically, adolescents and elderly women are consuming inadequate quantities of dairy products (Ray et al 2003; Garriguet et al 2008). Dairy products are a primary source of calcium and vitamins D, B_2, and B_{12} in the Canadian diet. It is possible that the declining consumption level of dairy products is therefore contributing to micronutrient deficiencies in the Canadian population and subsequent increases in health care spending.

1.1.2. Trend Towards Healthy Eating

As the link between nutrition and health is becoming increasingly understood, consumers may be choosing food products based on health consequences more frequently. Both the characteristics of a food as well as the consumer's perceptions about the food determine what the consumer believes to be a healthy food product.

1.1.2.1. Beliefs and Attitudes

In addition to considering how healthy a food product is in terms of fat content, functional attributes, or reputation, it is also important to consider how individual health beliefs and attitudes affect food choices. If a person believes that their diet plays a role in their overall health, they are more likely to consider things like fat, fibre, or vitamin content before deciding what product to consume. People who are less concerned with their health or who do not believe that their diet affects their health are more likely to choose products based on taste, convenience, or price. As such, health attitudes and beliefs could be playing a role in Canadian food, milk, or yogurt consumption.

1.1.2.2. Functional Foods

Consumers, aware of the link between diet and health, may be becoming more interested in foods which are sold as improving health status or decreasing the risk of certain diseases (Peng et al 2006). Because yogurt has a reputation as being a 'healthy' food, which has been supported in recent years by scientific and clinical evidence (Khurana and Kanawjia 2007), this increased awareness of the healthfulness of one's diet could be a major factor in rising yogurt sales.

Functional foods have been recognized in North America as a separate food category in recent years, foods that contain 'additional' health benefits; globally the market for functional foods was approximately US $33 billion in 2006 (Hobbs and Zou 2006), and it is expected to reach US $176.7 billion by 2013 (Roberts 2009). Some types of yogurt, specifically probiotic yogurts, are recognized as functional foods. The global market for probiotics, including foods, ingredients, and supplements, was US $14.9 billion in 2007 and US $16 billion in 2008

(Granato et al 2010). Probiotic yogurts are the largest probiotic food product in terms of sales, accounting for 36.6% (Granato et al 2010). According to Saxelin (2008), drinkable yogurts are the fastest growing probiotic product in Europe. Functional yogurt products have been responsible for attracting new consumers to purchase yogurt in Italy (Bonanno 2009). In addition to probiotic yogurts, there are also functional yogurts enhanced with soluble and insoluble fibres, omega 3 fatty acids, conjugated linoleic acid (CLA), vitamins, and antioxidants (Khurana and Kanawjia 2007).

Other dairy products have been developed with some of the same functional characteristics as yogurts and sold at the retail level. Kraft® developed a probiotic cheddar cheese for Canada and the US in 2007, but it has disappointed Kraft in terms of consumer acceptance and sales (Starling 2009). Sorrento® has developed an omega-3 enriched cheese, and Natrel® introduced a probiotic milk in 2008, both of which are currently on the market, but are not experiencing nearly the same kind of growth which has characterized functional yogurt products. For some unknown reason, consumers appear to be more accepting of functional yogurt products than other types of functional dairy products.

Foods which have been fortified with beneficial vitamins or minerals beyond their required or natural levels are also considered functional foods. Many processed functional foods are voluntarily vitamin enriched, such as Vitamin Water®. There are functional yogurts currently available which have been fortified with additional calcium, vitamin D, and other vitamins. Under current Health Canada regulations however, fluid milk cannot have vitamins or minerals added to it (besides vitamins A and D which must be added in specific amounts, a regulation that has existed in Canada since the 1970's) (CFIA 2012). Foods pervasive in the food supply are not eligible for voluntary fortification by processors, and this list includes milk and some types of cheeses. It does not, however, include yogurt or any other dairy products (Health Canada 2005). There are specific regulations for different categories of vitamins and minerals which are discussed in further detail in Section 2.4.7.

1.1.2.3. Fat Content

One of the trends that can be seen in Canadian dairy consumption is a decrease in products that are high in fat such as butter, ice cream, whole fat milk, condensed milk, and whole fat sour cream. This is likely attributable to the fact that it has become common knowledge that consuming too much saturated fat (such as the fat found in dairy products) can lead to higher risk of cardiovascular disease (Eckel et al 2009). Non-fat and low-fat yogurt varieties have become increasingly available in Canadian grocery stores, while full fat yogurts have become harder to find. Traditional yogurt can contain up to 8% milk fat, but most yogurts currently sold in Canada are either fat free or contain approximately 1-3% milk fat.

1.1.3. Food Environment and Context

The environment and context in which people are making their food purchasing and consumption decisions can have a large impact on their choices. For example, individuals might choose different products for home consumption vs. away from home consumption. They might also make different choices based on their location, the season, the occasion, or the people they are with.

1.1.4. Product Positioning

1.1.4.1. Advertising

Marketing and advertising also play a role in determining consumer purchasing behaviour, and as such, advertising must be considered as a possible reason for the growth of the yogurt industry. Some advertising data was compiled to compare trends in advertising spending between different dairy products, as well as between major yogurt brands. While the amount of money spent advertising milk decreased from 1999-2001, there was an overall increase of 158% from 1999-2005 (Nielsen 2005). Cheese advertising followed a similar trend with an overall increase of 8.1% over the same period. In aggregate, yogurt had a constant increase in advertising dollars, which resulted in a 295% increase from 1999-2005. This trend was not constant among the larger brands though,

whose advertising dollars fluctuated on a year to year basis. Danone had the most consistent increases in advertising dollars among yogurt brands.

Figure 1.2: Dollars Spent on Advertising in the Canadian Dairy Industry (ACNielsen 2005)

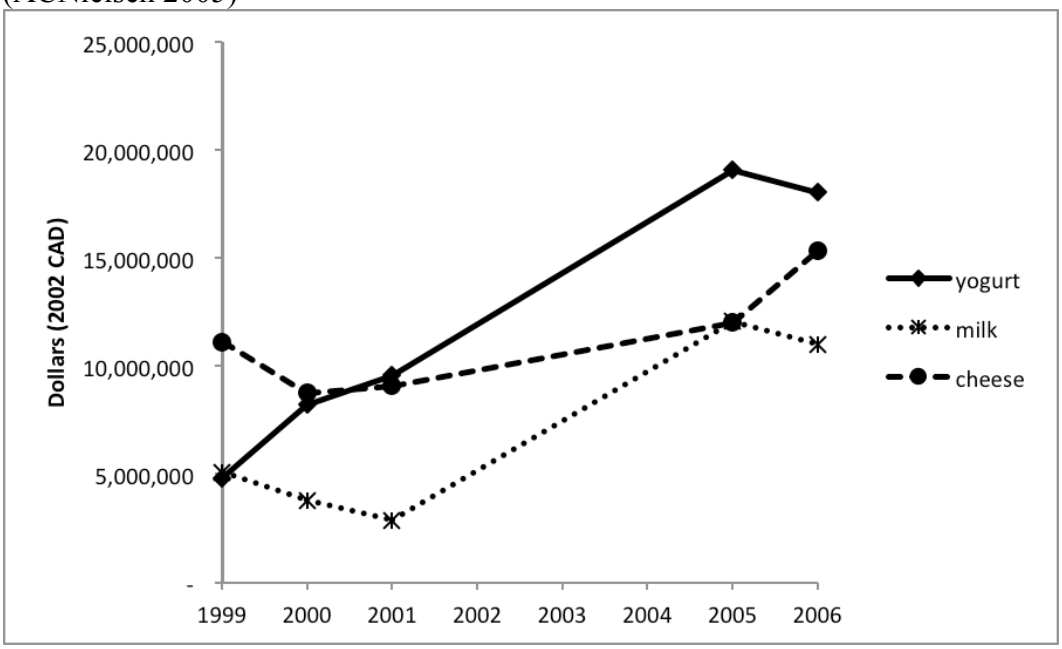
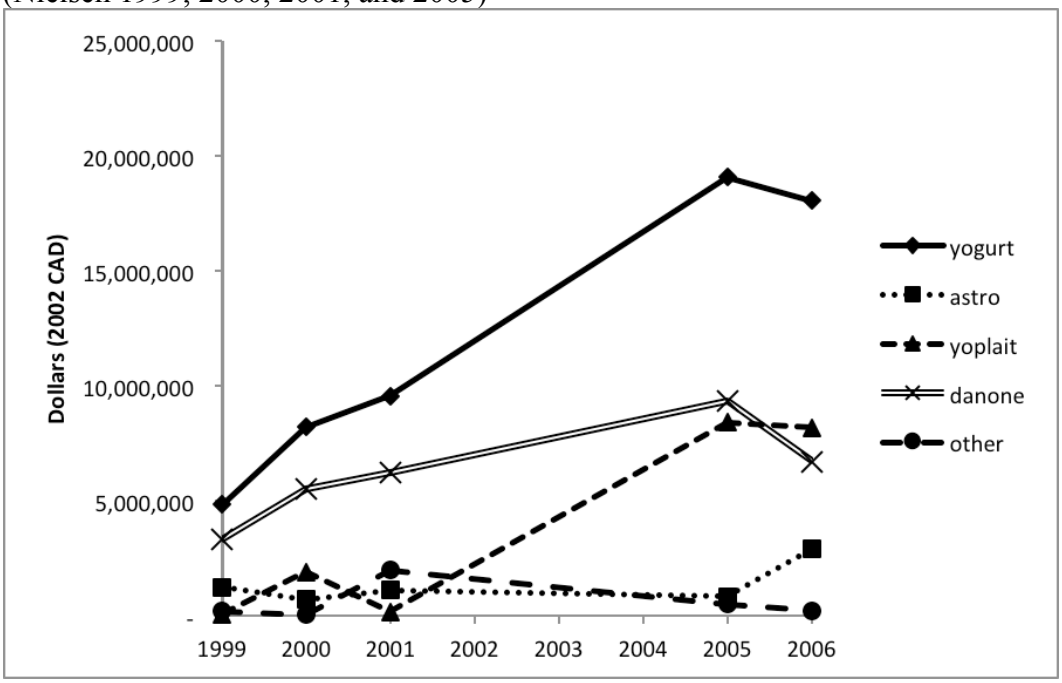


Figure 1.3: Dollars Spent on Advertising in the Canadian Yogurt Industry (Nielsen 1999, 2000, 2001, and 2005)



1.1.4.2. Product Packaging

Most food products, including milk and yogurt, must be packaged to move from the producer to the consumer. The primary role of packaging is to maintain the quality of the product, but packaging can also be utilized to attract the attention of the consumer or to deliver information about the product to the consumer. Some of the information provided is mandatory, such as the nutrition facts panel, while some is voluntary, such as a third party endorsement. The role these types of information play in determining product choice is discussed further in subsequent chapters. Packaging design in terms of colours and graphics, while no doubt important, is not discussed extensively in this study.

1.1.4.2.1. Information Requirements

Several types of information are required on food packages by Health Canada, such as the quantity of product in the package, the ingredients, the best before date, and the nutrition facts panel. On the nutrition facts panel, the amount of macronutrients (carbohydrate, protein, fat) per serving must be given along with the amount of calcium, iron, vitamin A, and vitamin C. Food processors may choose to include the amounts of additional micronutrients on the nutrition facts panel, which many do if their product is a good source of one or more other vitamins or minerals. This may lead consumers who read the nutrition facts panel to believe that a product showing this information has more beneficial micronutrients than a product without this information. The majority of yogurt packages, but only one milk package (ie: Lucerne), have more than the required amount of nutrient information, potentially leading consumers to believe that there are more micronutrients in yogurt than there are in milk.

1.1.4.2.2. Third Party Endorsements

Another potentially important aspect of health information on food packaging to be considered is a health endorsement from a third party, such as the Health Check™ symbol of the Heart and Stroke Foundation. In Canada, the yogurt brands that have a Health Check™ symbol on some of their eligible products are Western Family®, Eating Right®, and Astro®. There are no milk

products in Canada with a Health Check^{TM} symbol. This could imply to consumers that yogurt is a healthier food choice than milk.

1.1.4.3. Product Line Extension in Yogurts

The past decade has seen a dramatic increase in not only the sales of yogurt, but also the varieties of yogurts available for purchase. In 2001, there were four kinds of yogurts found in Canadian grocery stores; low-fat, non-fat, regular, and fresh cheese. In 2004, there were eight kinds; the ones mentioned previously as well as drinkable, tubes, lactose-free, and non-dairy. By 2008, there were eleven kinds; low fat, non fat, regular, fresh cheese, drinkable, tubes, mousse, creamy, organic, sugar free, and probiotic. When the different types are combined with the brands available, the number of varieties went from 9 in 2004 to 28 in 2008 without even taking all of the new flavours into account (PMB 2008). It is possible that the yogurt product line extensions of the past decade have played a role in the increase in yogurt sales.

1.1.5. Price

When developing a model for the consumption of any good, it is important to take price into account. Consumer theory states that the quantity demanded of any normal good decreases as its price increases. There is no reason that yogurt or milk would be an exception to this rule. Since consumers are expected to be willing to pay for 'healthy' attributes in food products, in addition to the fact that foods with additional processes or ingredients are more expensive to produce, yogurts which contain probiotics, additional calcium, or a reduced fat content are typically more expensive. It is important to determine how this price premium affects the demand for different yogurt brands. A study by Topcu and Isik (2008) found that price was one of the most important determinants for yogurt choice among Turkish consumers. In a study of yogurt consumption in Italy, Giacomo (2008) found that the own-price elasticity of yogurt was large relative to other dairy products (approximately -0.64). Davis et al (2011) found that own-price and expenditure elasticities for cheese were elastic in the US. Similarly, Davis et al (2012) found that own-price and expenditure elasticities for fluid milk were

either elastic or unitary elastic. In a study conducted by AAFC (2007), an own price elasticity of -0.88 was found for dairy products as a category. A study by Hassan and Johnson (1976) found a demand elasticity of -0.44 for milk and -0.91 for cheese in Canada while a study by Moschini and Moro (1993) found a demand elasticity of -0.34 for milk and -0.40 for cheese in Canada. Veeman and Peng (1997) found an own price elasticity of -0.81 for yogurt in Canada.

Yogurt is more expensive per serving than milk. On a $ per % of DRI level, the vitamins in yogurt are more expensive. On average, vitamin B_2 costs 0.01$/% in milk and 0.04$/% in yogurt. Vitamin B_{12} costs about 0.008$/% in milk and 0.026$/% in yogurt. Vitamin D costs approximately 0.008$/% in milk and 0.032$/% in a vitamin D fortified yogurt.

1.1.6. Demographic Characteristics

Preferences for most goods may be partially a function of individual consumer characteristics, which can be categorized by demographics. Based on past studies (Paulionis 2008, Siegrist et al 2008, Barrios et al 2008), the most common demographic factors to be considered when estimating food demand are gender, age, income, household size, number of children, and region. Food preferences are subject to individual consumer preferences which are often determined by demographic characteristics. Although there are few studies focusing specifically on yogurt demand, a study by Topcu and Isik (2008) found that income level, number of children in the household, and other demographics were important determinants of yogurt preferences. Davis et al (2012) found that several demographic factors, including the presence of children in the home, household size, gender, region, education, and income were important predictors of demand for fluid milk. Davis et al (2011) found that age, education, gender, household size, and region were important predictors of cheese demand. Garriguet (2008) found that age and gender were predictors of fluid milk consumption in Canada. Chase et al (2009) found that income, education, and presence of children in the home were predictors of yogurt consumption in Canada.

1.2. Objectives

Why has yogurt consumption increased while the consumption of other dairy products has remained stagnant or even declined? Some of the possible reasons for the increase in yogurt sales have been outlined in this chapter. There have been many studies confirming the decline in fluid milk consumption in Canada as well as evidence that adolescents and women over 50, the population sub-groups most at risk from low dairy consumption, are not consuming adequate amounts of dairy products. There is also evidence that there are calcium, vitamin D, vitamin B_2 and vitamin B_{12} deficiencies in some segments of the Canadian population.

The economic problem is that an externality could exist due to the fact that some people consume inadequate levels of micronutrients, resulting in sub-optimal health and subsequent increases in health care costs which are incurred by the government and therefore by tax payers. These micronutrient deficiencies, and their subsequent negative outcomes, could be diminished by increasing the consumption of dairy products, especially among at-risk groups.

What has not been studied is how demographic characteristics affect dairy product consumption in conjunction with how these factors differ between population sub-groups or how preferences for different dairy products vary by group. Understanding these factors and differences would be useful tools in policy development for the public health sector. Another area which has not been studied is how various product attributes in dairy products might impact overall dairy consumption. This should be of interest to the Canadian dairy industry which has been suffering from declining milk consumption over past decades.

There are many possible factors that affect the decision-making process when choosing a food product to purchase or consume. These include demographic characteristics, such as age and gender, cultural influences, education level, personal preferences, health beliefs, attitudes, nutrition knowledge, convenience, and price, just to name a few. Some of these factors are consciously considered by consumers, whereas they may not realize that some of

the other factors are affecting their selection. By understanding what influences individual decision making, it is likely that policies will be more effective in impacting consumption patterns.

Specifically, the overall objective of this study is to understand the contributing factors in the consumer's decision-making process when choosing dairy products. This objective is explored by attempting to answer the following two questions:

1) How do demographic and health status characteristics affect milk and yogurt consumption?
2) How do various combinations of product attributes in milk and yogurt impact consumer preferences?

The first question will be answered by examining who consumes milk and yogurt; whether or not they are the same people, what their general demographic and health characteristics are, and what lies behind their pattern of milk and yogurt consumption. Variation in dairy product intake by individuals could be related to region, income, education, food security status, age, gender, the presence of children in the home, health status, or health attitudes and beliefs. Milk and yogurt intake will be analyzed using two data sets: the Canadian Community Health Survey, Cycle 2.2, Nutrition conducted by Statistics Canada in 2004 which is the only national 24-hour dietary recall available in Canada, as well as self-reported intake data collected from an independent 2011 national dairy survey. These data sets are discussed in more detail in Chapter 3.

In order to address the second question, economic experiments are conducted to evaluate probable consumer responses to milk and yogurt with different attributes, attributes that might be important in increasing sales of yogurt and/or milk and reducing micronutrient deficiencies in the Canadian diet. To explore whether the same attributes would be desirable in milk and yogurt, the same attributes are included for both products in the choice experiments. The attributes included are price, fat content, probiotic (or not), vitamin-enhanced (or not), voluntary nutrition labeling, and a Health Check^{TM} symbol. Using the results from the regressions

estimated for the experimental data, willingness to pay (WTP) is calculated for the attributes in both milk and yogurt.

The potential outcome of this research is that it could identify which consumer characteristics and product attributes could be responsible for increases in future demand for milk or yogurt. If the factors responsible for the success of yogurt in the marketplace can be identified, perhaps this information can be applied to other dairy products to increase overall dairy consumption. Both the overall health of the Canadian population as well as the Canadian dairy industry could benefit from this research.

1.3. Outline of Thesis

In this section, the organization of the study is described. In Chapter 2, a review of the literature on many topics including consumer theory, functional foods, complexity in decision-making, trends in the dairy industry, the Health Belief Model, and stated preference analysis is provided. In Chapter 3, the data sets used to address the objectives of this research are described in detail and compared demographically to Canadian census data and the methods used to address the objectives, both theoretically and econometrically, are described.

In Chapters 4, 5, and 6, the analysis and results are presented. In Chapter 4, the focus is on the demographic analysis of the Canadian Community Health Survey cycle 2.2 data using the two-stage Heien and Wessells (1990) procedure, and the analysis is performed on both aggregated (milk, yogurt, and cheese) and disaggregated (skim milk, 1% milk, 2% milk, whole milk, low/non-fat yogurt, and full-fat yogurt) data. In Chapter 5, similar demographic analysis done with the National Dairy Survey data (designed by the author) using probit and ordered probit models is described. In Chapter 6, the choice experiments conducted as part of the National Dairy Survey and the willingness to pay for different product attributes in milk and yogurt are obtained from the analysis of the data collected.

In Chapter 7, a summary of the research, final conclusions, limitations of this study, and recommendations for further research are provided.

Chapter 2: Literature Review

2.1. Introduction

The objective of this study is to attempt to understand the individual decision-making process behind choosing milk and yogurt products in Canada. There are many potential factors that may play a role in these choices, and in order to affect change in dairy consumption, it is critical to understand their implications. If declining dairy product consumption is becoming detrimental to public health in Canada, then understanding the decision to consume dairy could benefit the general health of the Canadian population.

This chapter reviews the literature pertaining to the Canadian dairy industry, consumer theory, functional foods, food packaging, health attitudes and beliefs, and methods of collecting data on food consumption and preference, in order to better understand the important underlying theories involved in food product choices.

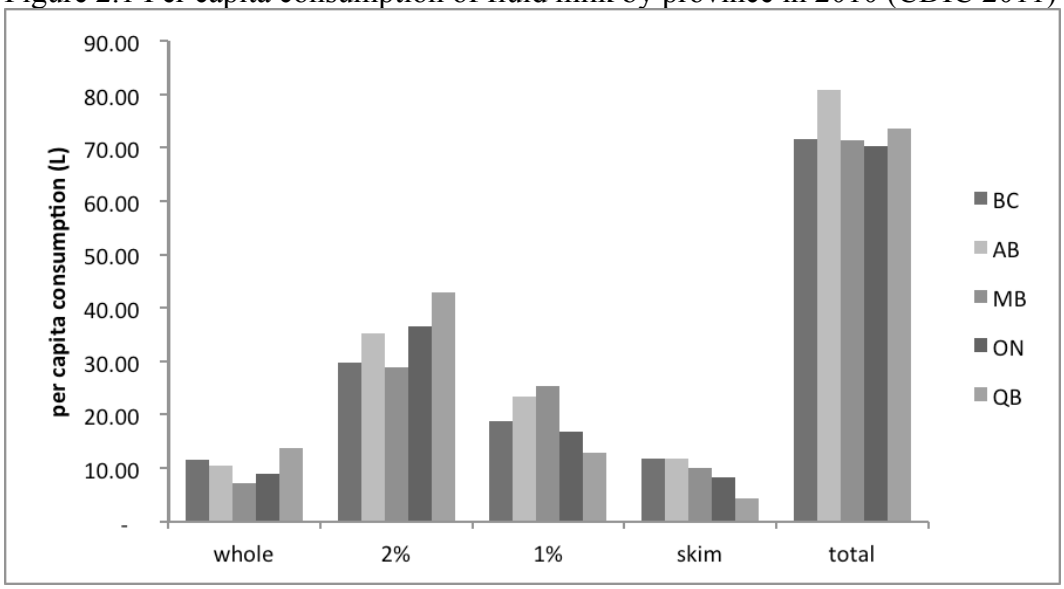
2.1.1. Trends in Canadian Dairy Product Consumption

The Canadian Dairy Information Centre (CDIC 2011) provides data on milk consumption for Canada as a whole as well as provincially for Ontario, Quebec, Manitoba, Alberta, and British Columbia from 1989 to 2010. Nationally, 2% milk is the most commonly consumed milk at 37 litres per year on a per capita basis. Next is 1% milk at 18 litres per year, followed by whole milk at 11 litres per year and finally skim milk at 9 litres per year. However, the trend in the past 20 years has been to cut back the amount of fat consumed in the diet, so unsurprisingly 2% and whole milk per capita consumption have declined. Many consumers have switched to skim or 1% milk to lower the fat content of their diet. It is important to note that 1% milk was only introduced to the Canadian market in 1989. For its first decade on the market the consumption of 1% milk went from 0 to 17 litres per capita per year, but from 1999-2010, consumption of 1% milk only increased by 5%. Despite the increases in skim and 1% milk consumption, total per capita consumption of fluid milk has decreased by 21% between 1989 and 2010.

In terms of total fluid milk, on a provincial level, per capita consumption (litres per year) is the highest in Alberta, followed by Quebec, while BC, Manitoba, and Ontario are quite similar. The decline in consumption from 1989 to 2010 is the largest in Ontario at 26%, with Manitoba and Quebec close behind at 24% and 22% respectively. Alberta and BC have experienced a 17% drop in total per capita consumption of fluid milk between 1989 and 2010.

The CDIC only provides data on the consumption of other dairy products on a national level rather than provincially. Nationally, per capita consumption of yogurt was relatively constant through the 1990's at around 3 litres per year. From 1999 to 2009, per capita consumption of yogurt increased to just over 8 litres per year. Per capita consumption of ice cream and butter have decreased from 1989 to 2010 by 52% and 30%, respectively. Cheese has seen a small increase over the same time period of 5%. For more details, please see Figures 1.1 and 2.1.

Figure 2.1 Per capita consumption of fluid milk by province in 2010 (CDIC 2011)



2.1.2. Health implications

Dairy products are the primary source of calcium and vitamins D, B_2, and B_{12} in the Canadian diet. Calcium is critical for the development and maintenance of healthy bones and prevention of osteoporosis (Whitney and Rolfes 2005).

Consumption of calcium also helps maintain a healthy body weight and protects against hypertension (Whitney and Rolfes 2005). Vitamin D is used by the body in conjunction with calcium to maintain the skeletal structure and is also critical in the prevention of osteoporosis. Vitamin D has also been shown to prevent some forms of cancer (Speer 2010). Vitamins B_2 and B_{12} are very important in human metabolism. B_{12} is crucial in DNA synthesis, and deficiencies in either of these vitamins can cause a range of health problems including neurodegeneterative diseases (Whitney and Rolfes 2005).

There is some evidence that the changes in dairy consumption patterns in Canada have resulted in some population groups consuming less than the daily recommended servings of dairy products as defined by the Eating Well with Canada Food Guide (Health Canada 2004). More specifically, there is evidence that adolescents (Garriguet 2008) and women over 50 (Ray et al 2003) are consuming inadequate quantities of dairy products. These groups are at a higher risk for developing negative health impacts as a result of insufficient vitamin and mineral intake from dairy products. Peak bone mass is reached in humans in the early twenties. Insufficient calcium and/or vitamin D through childhood and adolescence negatively impacts peak bone mass making an individual more susceptible to osteoporosis later in life (Whitney and Rolfes 2005). In addition, milk is often replaced with sugar-sweetened beverages by adolescents and young adults, leading to an increased risk of obesity and diabetes (Whitney and Rolfes 2005). Women typically experience the onset of menopause in their early fifties, at which point loss of bone mass accelerates. Insufficient calcium and/or vitamin D causes bone mass to decrease even more rapidly, leading to an increased risk of osteoporosis (Whitney and Rolfes 2005). Also of concern for older women is coronary heart disease (CHD). CHD is the leading cause of death for adults in North America, with the risk of developing it increasing around the age of 45-55 (Whitney and Rolfes 2005). Dairy consumption at adequate levels has been shown to reduce the risk of CHD (Shaper et al 1989) and stroke (Abbott et al 1996, Iso et al 1999).

Given that dairy consumption is associated with a decreased risk of various

chronic diseases, increasing dairy consumption in Canada could potentially improve the overall health of the population, most specifically by reducing the incidence of osteoporosis through the increased consumption of calcium and vitamin D found in both milk and yogurt.

2.1.3. Summary

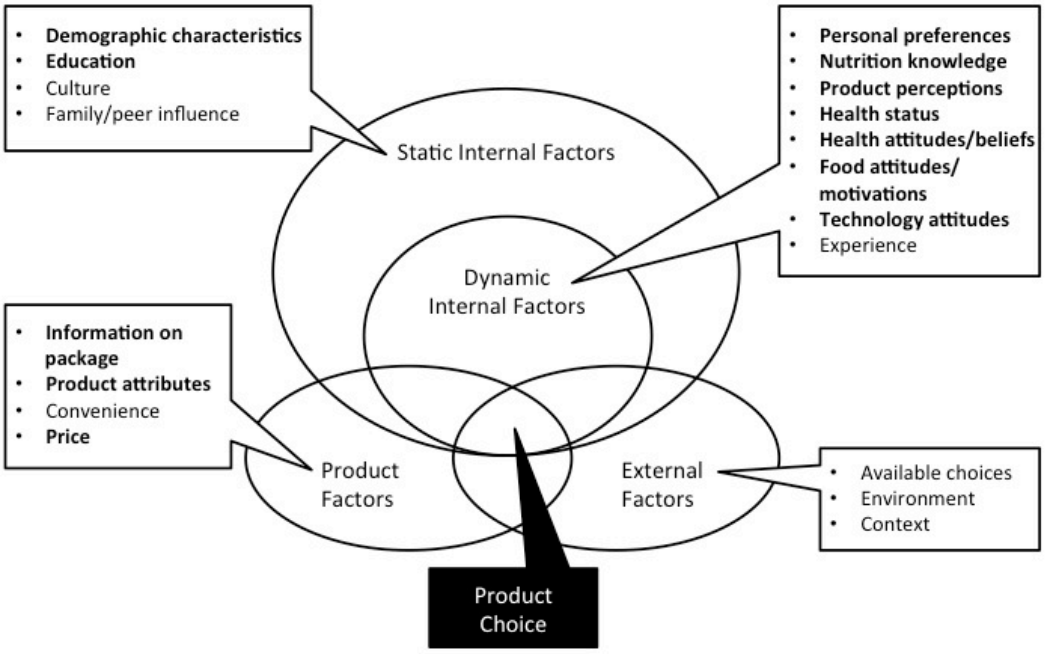
Per capita fluid milk consumption in Canada is declining while per capita yogurt consumption is increasing, in the context of declining overall dairy intake. This could be having negative health impacts in the form of micronutrient deficiencies in the Canadian population. Adolescents/young adults and women over 50 have been identified as at-risk groups for low dairy product consumption. There are many possible reasons for these conflicting individual dairy product trends, one of which may be the general perception that yogurt is a healthy food.

2.2. Conceptual Framework

There are many factors that may play a role in individual food product choice, shown in Figure 2.2. This conceptual framework was adapted from materials outlining factors in health eating by The US Department of Agriculture (2010) and Sims (1998) to organize the factors discussed in this research. These factors are both specific to the individual (internal) and the food product, as well as external to both. Internal factors can be static or dynamic. Static internal factors are principally demographic characteristics, such as age, gender, education level, income, and the presence of children in the home, as well as other characteristics such as culture and the influence of family or peers. Dynamic internal factors are those which constantly evolve, and include nutrition knowledge, product perceptions, personal preferences, health status, health attitudes and beliefs, food attitudes and motivations, technology attitudes, and past experience. Product factors are those specific to the food product such as product attributes, information on the package, price, and convenience. External factors are not specific to the individual or food product, but rather to the situation in which the food is being purchased or consumed, such as the available choices, the

context of the situation, or the food environment. These factors are illustrated in Figure 2.2 and those being used to estimate milk and yogurt preferences in this research (the bolded items in Figure 2.2) will be discussed further in this chapter. While the other (non-bolded) items are valid factors affecting product choice, they are beyond the scope of this thesis.

Figure 2.2: Conceptual framework: Factors affecting individual choice of food product



Adapted from U.S. Department of Agriculture (2010) and Sims (1998).

2.3. Economic Theory

When purchasing goods, it is assumed that consumers are maximizing their utility subject to their budget constraints. How each consumer maximizes utility differs depending on their individual tastes and preferences. This section discusses the economic theory behind how consumers make purchasing decisions, while subsequent sections discuss the factors that affect individual tastes and preferences.

2.3.1. Consumer Theory

Classic consumer theory assumes that consumers have perfect information, which means that they have complete knowledge of all the attributes associated with a good thereby eliminating the role of information variables such as advertising or the information given on product packaging. According to Forker and Ward (1993), the decision making process for the consumer includes determining the options, gathering the appropriate data, analyzing it, and assessing their constraints. In reality, consumers do not have perfect knowledge about a product, so information and past experience become a significant part of the decision making process. In the short run, consumer uncertainty can be reduced through the acquisition of additional information, which is often provided on the package in the form of nutritional information, health claims, or endorsements. According to Teisl et al (2001), utility derived from consuming goods and services may increase with heightened information availability.

Advertising, which includes both generic and brand advertising, is one method of delivering information about a product to consumers. By ensuring that consumers are aware of a product's positive attributes, advertisers can affect consumer perceptions about it, thereby affecting the demand for that good. Health information can also affect consumer attitudes towards a good, especially a food product. For example, as information about the potential health consequences of consuming too much cholesterol became widely known, demand for eggs and red meat decreased noticeably (Brown and Schrader 1990, Burton et al 1996).

2.4. Product Factors

2.4.1. Products as Bundles of Attributes

Basic consumer demand theory assumes that goods are homogeneous. In the actual marketplace, goods are differentiated from each other by their various attributes. When a consumer is at the grocery store and is trying to choose which yogurt to purchase, they can consider the combination of prices, fat content, flavours, brands, probiotics, package size, etc. to identify their utility maximizing

choice. Therefore, processors are constantly trying to produce new or modified products that will have more appeal to consumers than competitors' products. Rather than treating a product group as a homogeneous good, Lancaster (1966) developed a theory in which goods are considered bundles of attributes. Identifying consumer demand for the attributes found in Canadian dairy products is one of the objectives of this study. There are various studies (e.g., Adrian and Daniel 1976, Baker and Crosbie 1993, Baker and Burnham 2001, Manchester 1992, Menkhaus et al 1988, Nauman et al 1995, and Thompson and Kidwell 1998) which use the Lancastarian framework of demand analysis to examine consumer attitudes towards food product attributes. These studies found that consumers consider some attributes to be more important than others, and that their demographic, geographic, and socio-economic characteristics partially determine these attitudes. In order to evaluate attribute preferences, stated preference experiments are often employed.

2.4.2. Food Product Labels

The label on a food product serves two main purposes; first, to attract the consumer's attention, and second, to provide information about the product whether it be mandatory information or additional information to encourage consumer interest. According to Barber and Almanza (2006), who used self-administered questionnaires and purchasing data to evaluate wine purchasing behaviour, consumers shop with their eyes and thus the front label of a product must both stand out from its many competitors on the shelf as well as meet certain informational standards. In addition to the different shapes, colours, and styles of packaging that play a role in distinguishing a product, consumers also draw conclusions about the quality of the product based on packaging. Wells et al (2007) found that over 73% of consumers use the packaging to assist them in choosing which food product to buy. A study by Court et al (2009) found that most consumers only make their final purchasing decision once they are actually in the store, highlighting the importance of product packaging. Up to 40% of consumers "change their minds because of something they see, learn, or do" at the

grocery store (Court et al 2009). Young (2010) points out that when there are many competitive products on a shelf, having a disruptive shape or colour draws the consumer's attention.

Another important factor to examine is how consumers process the information given on food packaging, and how information levels influence purchasing behaviour. A study by Doyon et al (2009) found that the level of information given about the functionality of a yogurt product did influence which product was chosen and how much the participant was willing to pay for it. However, the change due to the new information was not consistent across products. They found that giving more information increased the willingness to pay for regular and probiotic yogurt, had no effect on omega-3 enriched yogurt, and decreased the willingness to pay for yogurt with vegetable sterols. A study by Chocarro et al (2009) found that less experienced consumers rely more on label information in selecting food products, whereas more experienced consumers base their choices on brands.

2.4.3. Health Information

Providing consumers with information about the health benefits of a food or its ingredients could affect whether or not consumers purchase it. Baixauli et al (2008) did a study collecting information from participants about sensory acceptability, health and nutrition perceptions, and consumption and purchase intentions both with and without label information with regards to muffins containing functional ingredients. They were then able to categorize participants into groups based on health consciousness, implying that some categories of people may react differently to the same set of attributes or information. Marette et al (2010) found that consumers react positively to positive health information on food packaging but that they do not react to the more complicated information about scientific uncertainties in supporting documents. The objective of Lyly et al (2007) was to determine how package information affected consumer acceptance and willingness to pay for functional food products. Participants were asked questions about their likelihood of purchasing the product both before and after

sensory evaluation, both with and without providing health claims to elicit acceptability and WTP. They found that while health claims increased WTP for the functional products, WTP decreased after tasting the products. Urala and Lahteenmaki (2003) found that consumers valued attributes such as healthiness, taste, and price differently for different food product categories. Annett et al (2008) found that while environmental information about organic production didn't impact overall liking of organic whole wheat bread among Canadians, health information did increase overall liking.

2.4.3.1. Health Claims

Health Canada regulates the health claims that are permitted on food packaging in Canada. There are currently 5 approved claims that describe the relationships between several nutrients (sodium, calcium and vitamin D, saturated and trans fat, fruits and vegetables, and non-fermentable carbohydrates) and health outcomes (Health Canada 2011). Any other claim that a food product has a specific health benefit is not permitted.

2.4.3.2. Nutrient Claims

Health Canada also regulates the nutrient content claims that are permitted on food packages in Canada (Health Canada 2011b). A nutrient content claim is one where there is a statement that the product is 'a good source of', 'low in', 'high in', 'no added', etc., followed by the nutrient, such as fibre, fat, sugar, etc. There are specific rules outlined by Health Canada pertaining to exactly how much or how little of a nutrient must be present in the food product in order to qualify for a given nutrient content claim.

2.4.4. Nutrition Facts Panel

Consumers may also use the nutritional information included on the package to help them choose a product. The presence of a nutrition label improves the consumer's level of knowledge with regards to that product, reduces search costs and increases shopping efficiency. (Berning et al 2010). Derby and Levy (2001) found that nutrition information can cause individuals to change their purchasing behaviour. According to Stranieri et al (2010), most consumers place

some importance on nutrition labeling, but many do not consider it when choosing a product.

Balcombe et al (2010) found that while nutrition labels are important in making purchasing decisions, there are clear differences between how individuals from different demographic groups use nutrition labels. Gender, income level, and education level were found to be determining factors in whether or not a consumer looks at the nutrition label on a food product before purchasing it (Cowburn and Stockley 2005). Several studies (e.g., Singer 2006, Kemp 2007, and Keller 1997) have found that most consumers rely on the nutrition facts panel on the back of the product rather than on health claims on the front. However, front of package health claims did have a positive effect on consumers with low motivation to process information. Conversely, Stranieri et al (2010) found that more people use health claims than nutrition labels. Mazis (1997) found that consumers are more accepting of health claims when they also have a full nutrition facts panel on the back of the package for more complete information. Keller (1997) found that consumers use the Nutrition Facts Panel more extensively than they do nutrition claims on the front of the package when choosing a product. Wansink (2004) found that the presence of a shorter health claim on the front of the package in conjunction with more complete nutrition information on the back resulted in positive consumer perception about the product.

Cowburn and Stockley (2005) found that consumers were able to accurately find and use simple nutrition information, but that this ability varied with label design and education level. Many consumers struggled to interpret more complex nutrition information, but most consumers were more confident about using the label information to compare one product to another rather than to evaluate products individually. Levy (1992) found that consumers best understand nutrient amounts shown in weights for macronutrients but as a percentage of daily intake for micronutrients. Drichoutis et al (2006) found that consumers use nutrition labels mainly to avoid things that they perceive as unhealthy and that women and individuals with higher levels of education are more likely to consider the

nutrition label when choosing a product. In general, people with higher levels of nutrition knowledge desire more nutrition information on food packages (Burton 1996). Not surprisingly, they also found that more price sensitive consumers are less likely to consider nutrition labels when making a food purchasing decision.

Bowman (2004) found that consumers who considered nutrition important read food labels to determine the fat and calorie content of food products. Jordan (2004) found that consumers spend more time looking at the nutrition label for information on nutrients that they consider beneficial and less time looking for information on nutrients that they consider negative. Nayga (2002) found that label use has a positive effect on the nutrient quality of the diet. Variyam (2008) found that people who use nutrition labels had higher fibre and iron intakes than non-users. A study by Mhurchu and Gorton (2007) in New Zealand indicated that consumers are not capable of choosing foods in a way that balances nutrient intake and that they make food decisions based solely on fat content. Grunert and Wills (2007) found that consumers were mostly interested in the calorie and fat contents of a food product, followed by salt and sugar. Balcombe et al (2010) found that individuals were most concerned by salt and saturated fat intake.

2.4.5. Third Party Endorsements

Another aspect to consider is whether using a recommendation agent or third party logo affects a consumer's likelihood of purchasing a food product. This could include a symbol such as the Heart and Stroke Foundation's Health Check™ logo or an in-store logo signifying a healthy choice. Lando and Labiner-Wolfe (2007) used focus groups to evaluate consumer interest in nutritional information given on food labels and whether it impacted their dietary choices, and found that consumers thought that a healthy choice icon would be useful. This was supported by Young and Swinburn's (2002) study, which found that approximately 59% of shoppers in New Zealand used the 'pick the tick' logo to assist them in making healthy food choices. Conversely, using interviews and protocol analysis, Rayner et al (2001) found that shoppers rarely use endorsements, and on occasion even use the endorsement to reject a product. In a

study of Australian beef consumers, Umberger and Mueller (2010) found that many respondents placed some value on having a healthy choice symbol associated with a food product. In Canada, 82% of consumers view the Heart and Stroke Foundation as a credible source of food and nutrition information, and 70% of consumers are more likely to purchase a food product with a Heath Check™ symbol (Ipsos Reid 2009).

Reid et al (2004) conducted a study using interviews and surveys to link "attitudinal and awareness factors that might explain changes in food purchase behaviors and dietary patterns related to the Heart and Stroke Foundation of Canada's Health Check™ food information program". They found that consumers who were limiting their dietary fat intake used the Health Check symbol to help with purchasing decisions. Kozup (2003) found that heart-healthy claims or logos were positively viewed by consumers in general.

2.4.6. Functional Foods

There is currently no universally accepted definition for functional foods. According to Margaret (2002) "... a food can be regarded as functional if it is satisfactorily demonstrated to beneficially affect one or more target functions in the body beyond adequate nutritional effects in a way that is relevant to either an improved state of health and well-being and/or to a reduction of risk of disease... Functional foods must remain foods, and they must demonstrate their effects in amounts that can normally… be consumed in the diet. They are not pills or capsules, but part of a normal food pattern".(pg5).

Despite yogurt's reputation as a healthy food, conventional yogurt is not considered to be a functional food. Yogurt with additional ingredients with health benefits such as probiotics, fibre, and omega-3 fatty acids, are, however, considered to be functional foods.

If increasing the consumption of functional foods can have positive health outcomes, it is important to know who is willing to try them and why, as well as how to promote the acceptance of functional food products.

A survey conducted by AAFC (2004) included two questions to address

what forms of functional foods respondents would be willing to try in order to consume more of the nutrient in question (half of the respondents were asked questions concerning lycopene while the other half were questioned about omega-3 fatty acids). The questions served to establish both the form of the ingredient preferred (such as powder, pills, or natural sources) as well as the types of food they would be willing to consume it in. They found that Canadian consumers are more likely to choose natural sources of functional ingredients and if seeking a food fortified with the ingredient, prefer standard, healthy foods to be fortified (AAFC 2009).

In addition to asking these types of questions, asking consumers whether or not they typically purchase specific products (such as probiotic or fortified yogurt), how often they purchase specific products, or why they choose specific products could also help to examine consumer preferences for functional foods. Herath et al (2008) used questions assessing respondents' attitudes and motivations towards foods to predict their propensity to try functional foods. Landstrom et al (2007) used questions assessing respondents' familiarity and knowledge of functional foods to determine their likeliness to try functional foods. Schifferstein and Oude Ophuis (1998) asked respondents how frequently they purchased organic foods as part of their study examining determinants of organic food consumption.

2.4.6.1. Functional Food Studies

There have been many studies in recent years examining consumer demand for functional foods. Teratanavat and Hooker (2006), in their study concerning consumer preferences and valuation for a soy fortified tomato juice, found that the health benefits of the product and the naturalness of the ingredients were positively valued but that the valuations were affected by respondent income, education, and food purchasing behavior. They also found that nutrients which are naturally occurring were preferred over fortification, and that their data contained substantial heterogeneity suggesting multiple consumer segments. In a Japanese study about consumer demand for credence attributes in canola oil, Hu et al (2006) found that consumers were willing to pay extra for organic or functional oil, and that the information provided affected the WTP measures.

Henson et al (2008) had Canadian respondents answer a structured questionnaire through a face-to-face interview to determine consumer propensity to use functional foods containing lycopene, based on demographic and health belief characteristics. Hailu et al (2009) found that in evaluating consumer valuation of functional foods, there are distinct segments within the population which differ in their preferred method of functional ingredient delivery as well as on acceptance of verified (or non-verified) health claims. Siegrist et al (2008) collected data through a mail survey in Switzerland and found that individuals who have trust in the food industry are more likely to buy functional foods and that health claims attached to a product with a positive health image were most positively viewed. In their study determining the demand for functional wines in Spain, Barreiro-Hurle et al (2008) found that the functional attribute was valued similarly to ageing in red wine. In their study evaluating consumer response to antioxidant enriched apples, Markosyan et al (2009) found that consumers who typically purchase organic food products were less likely to purchase functional apples but that providing information about the potential health benefits of apples increased consumer WTP. They also noted that people in different geographic locations had different WTP means. O'Connor and White (2010) found that attitudes and dread risk were significant predictors of willingness to try functional foods among Australian consumers.

2.4.7. Micronutrient Fortification

Vitamins and minerals fall under the category of micronutrients. Health Canada regulates what foods must be or may be fortified with various micronutrients. Some foods have fortification requirements, such as fluid milk being fortified with vitamin D or table salt being fortified with iodine. In other cases, food producers wish to fortify food products, making them functional foods, in hopes of attracting consumers. This type of fortification is termed discretionary fortification and is closely regulated by Health Canada in order to protect consumer safety. Producers may not use discretionary fortification for staple foods (such as milk, flour, or rice), fresh foods (such as meat or fresh produce), or

infant foods (Health Canada 2005). For the purpose of this study which examines consumer choices for attributes (including fortification with calcium and vitamins B_2, B_{12}, and D) in milk and yogurt, it is important to note that under current regulations, yogurt could have vitamins added to it but milk could not. Health Canada also categorizes micronutrients into different risk categories which determines what foods and in what quantities they can be added. Risk category A is comprised of micronutrients which are unlikely to cause any harmful side effects if consumed in excess, and includes vitamins B_2 and B_{12}. According to Whitney and Rolfes (2005), there are no adverse effects of excess vitamin B_2 or B_{12} intake and no upper intake level for either vitamin had been set. Risk category B is comprised of micronutrients which have potentially serious adverse effects, but with low risk of excessive intake at regulation levels, and includes calcium and vitamin D. The upper level of calcium is 2500 mg/day and excessive amounts can cause constipation and kidney disfunction (Whitney and Rolfes 2005). Vitamin D has an upper level of 50 ug/day, while excess amounts can cause elevated blood calcium, calcification of soft tissues, and frequent urination (Whitney and Rolfes 2005). Based on data from the CCHS 2.2 (Statistics Canada 2004), individuals in the 95^{th} percentile for consumption of calcium and vitamin D are well below the upper limit. Risk category C is comprised of micronutrients with serious adverse effects and those with a narrow margin of safety, such as iron and vitamin A. Micronutrients in risk category C are not permitted in discretionary fortification.

2.4.8. Summary

There is evidence that information provided on food packaging does affect product choice. Many consumers choose products with health claims, some base their purchasing decision on what they see on the nutrition facts panel, and others are more likely to choose products with some kind of health endorsement. Functional foods have become a popular area of research in the past decade. Similarly to general food product choices, many factors seem to affect consumer propensity to use functional foods, including demographic characteristics,

nutrition knowledge, health beliefs, and acceptance of food technologies. These factors will be further considered in this study. There are other types of product factors, such as brand, convenience, and flavour, which are also potentially important in the consumer's decision-making process, but these factors are not a focus of this study.

2.5. External Factors

There are factors which influence a food purchasing decision which are not specific to the individual or the product, but rather to the circumstance. These are the external factors, and include things such as the choices available to the consumer when they are trying to make a decision and the context or environment of the consumption circumstance (such as eating at home vs. eating in a restaurant, or a weekday vs. a weekend). External factors are discussed in this section, with a focus on the increasing number of available choices and the subsequent complexity of making a decision.

2.5.1. Product Line Extensions

In addition to a surplus of information, the consumer can also be overwhelmed by a surplus of product choices. This is an important factor to consider in the yogurt sector as it has undergone significant product line extensions in the past decade. Young (2010) notes that because of the increased number of products a consumer has to choose between, they do not have the time or capacity to compare all the products logically and therefore no longer make a rational, but rather an emotional decision. This often leads to choosing the familiar product.

According to Fuller (2011, pg.4), product line extensions are those that require little time or research for development, require no major manufacturing changes or equipment purchases, necessitate little change in marketing strategy, do not require new purchasing skills or raw material sources, and do not require new storage or handling techniques for the final product. Based on these criteria,

the development of new flavours and assortments of yogurt would be considered a product line extension for a company already producing yogurt.

It is possible that the increase in the assortment of yogurt products over the past decade has played a role in the growth of yogurt sales. Kadiyali et al (1999) found that in a market where two brands of yogurt are sold, sales and profits for both brands increase when one of the brands introduces a product line extension. Draganska (2005) found that the number of flavours a brand offers has the greatest effect on the market share of that brand for yogurt as well as several other food products. Several studies found that one of the most important success indicators for a product line extension was the initial strength or familiarity of the parent brand (Reddy et al 2004, Lomax and McWilliar 2001, Volckner and Sattler 2006). Dens and De Plesmacker (2010) found that extensions of established brands are preferred by consumers over new brands, and that while advertising is important for new brands, it is does not have a significant impact on purchase intention for line extensions.

2.5.2. Complexity in Choice

In reality, the ability of consumers to consistently make the utility maximizing choice is restricted by their ability to process information. Unfortunately, humans have a finite cognitive capacity for processing and understanding information, which creates susceptibility to an information overload (Jacoby et al 1974). By this rationale, increasing amounts of information can lead to a decrease in decision efficiency. Keller and Stalin (1987) also found that too much information inhibits the consumer's ability to make consistent choices, but that it is not necessarily a linear relationship. They found that as information levels increase, there is first an improvement in decision making efficiency, then once a certain information level threshold has been reached, there is a decrease in decision making efficiency.

The selection of yogurt products is increasingly diverse. With the large number of choices facing a consumer, how do they decide which product to purchase? Because there are so many yogurt products to choose from, consumers

may or may not make their purchasing decisions rationally, making their choices difficult to predict.

According to Court et al (2009), there are several stages in the decision making process of consumers. Traditionally, the decision making process was thought of as a funnel, where the consumer starts by considering a certain number of brands and narrows it down with each step until a single brand emerges. Now, because of the increased number of product choices, marketing, and better informed consumers, the decision making process has changed and now a circular model which includes brand consideration, consumer research or information gathering, and post-purchase experience is being suggested.

Shao et al (2008) propose that consumers make decisions in several waves when faced with a large set of alternatives, thus decreasing the complexity of the decision making task. Ballantyne et al (2005) state that today's consumers suffer from choice fatigue due to the large number of choices they face and the time constraints they have to make a purchasing decision. In an effort to simplify the decision making process, consumers tend to put products into groups, and will often create a smaller choice set at the point of purchase by only including certain product brands in their reduced choice set. Swait and Erdem (2007) investigated the impact of brand credibility on consumer choice set formation by conducting an experimental choice task using several brands.

According to Reid et al (2004), "up to 80% of food purchase decisions are made at the supermarket".(pg.146) It is possible that with the increasing number of yogurts available, consumers are overwhelmed by the number of choices, and thus may simply choose the familiar product (status quo) rather than re-evaluating the choices every time. Using choice experiments to examine demand for public goods, Boxall et al (2009) found that the complexity of a choice task positively affects an individual's propensity to choose the status quo. DeShazo and Fermo (2002) attempted to determine the relationship between choice set complexity and choice consistency, as did Dellaert et al (2007), with the finding of decreased choice consistency as complexity increased. In order to decrease the complexity of choosing, some consumers may automatically eliminate some brands from the

group of products they are considering purchasing. It should be noted that consumers do not always benefit from an increased number of choices. In some cases, a greater variety of products to choose from can actually lower both product demand and the utility achieved from that good (Iyengar and Lepper 2000, Schwartz et al 2002).

2.5.3. Summary

Although consumers will choose the utility maximizing option in theory, the wide assortment of varieties of milk and yogurt products combined with excess information may result in non-rational decision-making within product categories. In addition, because milk and yogurt are not homogeneous products, the decision-making process focuses mainly on the products' characteristics.

2.6. Static Internal Factors

Static internal factors can include any individual specific characteristics that essentially stay the same throughout one's lifetime. Although there are several types of these factors, such as things that are difficult to define like culture and the influence of tradition, for the purposes of this study, demographic characteristics are the static internal factors being focused on to understand milk and yogurt choices.

2.6.1. Demographic Characteristics

Consumer preferences vary across demographic characteristics, and food preferences are no exception. When trying to increase the consumption of a particular food to improve health outcomes, it is important to consider the demographic group being targeted to maximize the impact of a given policy or action.

Paulionis (2008) found that age played an important role in determining whether consumers would be willing to try functional food products. Siegrist et al (2008) found that older consumers were more likely to purchase functional foods than younger consumers were. Barrios et al (2008) found that 18-30 year olds

were the least likely age category to purchase functional foods in Spain. In Canada, West et al (2002) found that consumers with children in the household, men, metropolitan consumers, and consumers in Quebec were the most willing to purchase functional foods. Chase et al (2009) found that age and presence of children in the household were the main predictors of purchasing omega-3 fortified foods.

2.7. Dynamic Internal Factors

Dynamic internal factors are individual specific characteristics that evolve throughout one's lifetime. These include factors such as beliefs, attitudes, and knowledge towards food, health, nutrition, and technology, as well as perceptions and past experiences.

2.7.1. Health Status

The health status of an individual will likely affect the foods they choose to purchase. People may choose to consume foods that they perceive as healthy in order to maintain their health or prevent future diseases. People living with poor health or chronic health conditions may choose foods that they believe will improve their health. Functional foods in particular may be used as a way of improving one's health.

2.7.2. Consumer Perceptions About Dairy Products

Consumers have many ideas about how dairy products affect human health, some of which are accurate and some of which are not. It is also possible that perceptions with regards to the healthfulness of dairy products may differ depending on the product in question. Bus and Worsley (2003) found that Australian consumers have generally positive perceptions about milk. Most knew that milk was a good source of protein, calcium, and vitamins, but there were misperceptions about whole milk with regards to its fat and calorie content. Jones (2008) found that consumers from both New Zealand and the US thought that dairy products "contained calcium, developed and maintained healthy bones,

prevented cavities, and had a great taste"(pg.69). However, a study in Europe by Kopacek and Obermaier (2010) found that many consumers avoid milk because of perceptions that milk is bad for humans, that it is high in animal fat, that it causes mucus, and that it contains hormone and antibiotic residues. Cash et al (2005) as well as Peng et al (2006) report that Canadian consumers have both positive and negative perceptions of dairy products as a result of mixed messages in the media. Hailu et al (2009) state that consumers have a general perception of yogurt being a healthy food and that using it as a vehicle for functional ingredients is compatible with this healthy image.

Yogurt, along with other fermented dairy products, is widely considered to be a healthy food product (Hashim et al 2009). The fermentation of milk to produce yogurt and other products is essentially the conversion of lactose to lactic acid by beneficial bacteria. Yogurt is considered healthy partly due to the presence of the beneficial bacteria and partly because of the reduced amount of lactose (Hekmat and Koba 2006). Yogurt is also widely considered to have beneficial impacts on digestive health (Roberts 2009). The only negative health association with yogurt is the fat content, but this has been addressed by the increased number of low and non-fat yogurt options available for purchase (PMB 2008).

In addition to perceptions, knowledge about nutrition and health also impact food choices and could be affecting dairy product consumption. Several studies (Shah et al 2010, Ranilovic et al 2009, Satia et al 2010) demonstrate that there is a relationship between nutrition knowledge and food choice behaviours.

2.7.3. Attitudes and Beliefs

There are many different scales, models, and constructs designed to elicit individual attitudes towards a variety of concepts. In terms of food consumption decisions, Schifferstein and Oude Ophuis (1998) used various health attitude measures (including the Health Locus of Control and the Health Consciousness scale) to determine how these attitudes affect consumer likeliness to purchase organic foods. Herath et al (2008) used attitudinal and motivation constructs

(which were non-validated), which had been included in a national Agriculture and Agri-Food Canada survey, to better understand the reasons consumers purchase functional foods. They found that consumers could be clustered into groups based on these attitude and motivation scores that predicted the types and forms of functional foods they would be likely to purchase. Fishbein and Ajzen (1975) also developed an approach to model behaviours based on attitudes which has been applied to food choices. Of particular interest in this study are the Health Belief Model and the Food Technology Neophobia Scale, which are used to assess individual beliefs about health and novel food technologies, respectively. The Health Belief Model, rather than other measures of health attitudes, is used in this research as it can be specified to particular health concerns or nutrient intakes which is directly applicable to the objective of determining the factors affecting milk and yogurt consumption.

2.7.3.1. Health Belief Model

One of the determinants of functional food use is an individual's health attitudes and beliefs. Whether or not they believe that they are in control of their own health and whether or not they believe that their diet can impact their health are factors in choosing healthy foods. One theory which examines these attitudes is the Health Belief Model.

The Health Belief Model (HBM) is an explanatory model which was developed by Irwin Rosenstock in 1966 in an effort to understand why some individuals make use of health services while others do not. Rosenstock (1988) emphasizes the fact that individual behaviour is a result of both emotional and cognitive elements. The theory is based on the following aspects of health: perceived susceptibility, perceived seriousness, perceived benefits, and perceived barriers. Perceived susceptibility is a measure of how likely an individual thinks that he or she is to contract a given disease. Many people think that despite the statistical probability that they are at risk, they do not truly believe that it will happen to them. The higher the perceived susceptibility, the more likely people are to take preventative action. Perceived seriousness refers to both the distress caused by thinking of the disease in addition to the hardships a person believes a

disease will impose on their life. Again, the higher the perceived seriousness, the more likely an individual is to take preventative actions. Perceived benefits are the reduction in one's mind to their susceptibility to a disease as a result of a given action or behaviour. Perceived barriers are negative aspects of actions (such as cost, time restrictions, and pain) which could reduce likelihood of a disease. A person is more likely to take action or implement a behaviour the more the perceived benefits outweigh the perceived barriers. Rosenstock points out that in addition to the previous factors, a cue to action is also necessary for an individual to adopt a health improving behaviour. In 1988, Rosenstock et al suggested that a measure of self-efficacy (a person's belief that they are capable of taking action) be included in the construct to predict health behaviour.

Several studies have used the HBM to predict eating behaviour, since there is a direct link between diet and health outcomes. Deshpande et al (2009) used the HBM to predict healthy eating behaviour among university students. They found that their data supported the use of the HBM in a nutritional setting, and that perceived susceptibility, seriousness, benefits, and self-efficacy were positively linked with healthy eating behaviours while perceived barriers was negatively linked. Li and Levy-Milne (2008) conducted interviews with high-school students from British Colombia based on the HBM to understand the determinants of fruit and vegetable intake among adolescents and how it might be increased. Sun et al (2006) used the HBM to predict the usage of a functional soy sauce among women in China. They found that the HBM could explain consumption intention of the functional soy sauce, and that by improving nutrition education people's understanding of the benefits of consuming the product would increase and therefore attitudes towards the product would improve. Swaim et al (2008) found that only the measure of self-efficacy, and none of the other HBM elements, explained post-menopausal women's actions to prevent osteoporosis. Vassallo et al (2009) evaluate consumer willingness to try functional breads in Europe as a function of demographic variables and health attitudes and beliefs characterized by the Health Belief Model.

2.7.3.2. Food Technology Neophobia Scale

Functional foods are only a valid means of improving health insofar as people are willing to try them. Some people are distrustful of new unfamiliar foods or of foods produced using a novel technology, and are therefore unwilling to try some functional foods. The Food Technology Neophobia Scale (FTNS) can be used to determine an individual's aversion to novel food processing techniques and help predict willingness to try functional foods.

The Food Neophobia Scale (FNS) was developed by Pliner and Hobden in 1992 as a tool to predict whether individuals would be willing to try new foods. Several studies (e.g., Meiselman et al 2010, Monneuse et al 2008, Tuorila et al 2000, Mustonen and Tuorila 2010, Olabi et al 2009) have made use of the FNS as part of an explanatory model for food behaviours. Tuorila et al (2000) found that willingness to try new food products is influenced by education level, urbanization, gender, and age. Mustonen and Tuorila (2010) found that increasing children's education about new foods decreased their level of food neophobia. Olabi et al (2009) examined food neophobia among college students and found that socio-economic status in addition to past travel and ethnic food experiences were important predictors.

It is important to note that the FNS predicts willingness to try new foods, but that functional foods may not be considered new by many consumers because they retain their familiar appearance and sensory characteristics. Some individuals will however be reluctant to try foods that they think have been produced with an unfamiliar technology (such as irradiation, genetic modification, etc.) As such, Cox and Evans (2008) developed the FTNS which is based loosely on the FNS, and is therefore highly correlated with it, but also considers consumers fear of novel technology. They note that because functional foods retain their familiar appearance but often utilize novel technologies in their production, the FTNS is a more appropriate predictor of their acceptance than is the FNS. Evans et al (2010) went on to demonstrate the reliability and predictive validity of the FTNS in their 2010 study. The fact that the FTNS is a relatively new tool is likely the reason that no other studies were found using it.

2.8. Methods for Assessing Food Intakes and Preferences

There are several ways of determining what foods people consume, how often they consume it, and what their food preferences are. To find out what people currently eat and how much or how often they eat it, dietary recalls and surveys are often used. Both of these methods have their strengths and weaknesses which are discussed subsequently, but the key thing to note is that they are only applicable with actual food products. In order to determine what consumer preferences would be for a hypothetical food product, a different approach must be taken, which is why stated preference experiments are useful in the absence of revealed preference data.

2.8.1. Dietary Recalls

There are several ways of estimating individual food intake (Gibson 2005), one of which is a dietary recall. A dietary recall is a retrospective method of evaluating the food and beverage consumption of an individual over a specified period of time, usually 24 hours. Information about exactly what the individual ate and how much of it they consumed is obtained in either a face-to-face or telephone interview. One of the shortcomings of using a 24-hour dietary recall is that a single 24-hour recall is not necessarily representative of typical eating patterns, and thus repeated 24-hour recalls with the same individuals is often recommended (MRC 2012). Single 24-hour recalls can, however, be useful in establishing mean intakes for large groups. The benefits of using dietary recalls to collect food intake information are that the burden on the respondent is relatively low, literacy level is not an issue, and it's retrospective nature doesn't alter food intake patterns (MRC 2012). The drawbacks of using dietary recalls are that some respondents may not have accurate recollection of food consumed and that some individuals may selectively recall specific food items and omit others (as with all self-reported food intake methods) (MRC 2012).

In 2004, Statistics Canada conducted the Canadian Community Health Survey Nutrition Cycle 2.2 which included a 24-hour dietary recall. This data is

available to researchers, and will be utilized in this research to evaluate dairy product intake. Because it is the only national level dietary data available since 1969, several studies have been done using this data source to evaluate consumption of both nutrients and specific foods.

Garriguet (2008) used the CCHS 2.2 data to evaluate beverage intake of Canadians. He found that children over the age of four consumed a little over one serving of milk per day (Health Canada recommended amount of dairy products is 2-4 servings depending on age and gender). Garriguet (2008) also found that on average adults only consumed a half serving of milk per day, while Health Canada recommends 2-3 servings of dairy per day. It is possible that Canadians are meeting their dairy needs with other dairy products such as yogurt or cheese, but this possibility was not evaluated in the beverage studies. Vatanparast et al (2009) used the CCHS 2.2 data to determine the calcium intake of Canadian adults by age, gender, and region. They found that mean calcium intakes in 2004 were below the daily recommended intake (DRI), and because dairy products are the main source of calcium in the Canadian diet, it is likely that other micronutrients found in dairy products are also not being consumed in adequate quantities. Tarasuk et al (2010) used the CCHS 2.2 data to assess how income and education levels affected nutrient intakes of Canadians. Trend analysis was used to find evidence that income and education levels were associated with the consumption of certain food groups (including dairy) and nutrient intakes. Similarly, Kirkpatrick and Tarasuk (2008) used the CCHS 2.2 data in regressions to examine the relationship between household food insecurity and inadequate nutrient intakes and whether it differed between children and adults.

Langlois et al (2009) studied the relationship between diet composition and obesity among Canadian adults using the CCHS 2.2 data. In their study logistic regressions were used to determine the relationship between obesity and the intake of each nutrient and demographic characteristics such as gender, age, marital status, education. Fischer et al (2009) conducted a study using the CCHS 2.2 data to provide information about the sources of sodium in the Canadian diet. They used not only the sodium intake data but also the actual food choice data to

determine which foods were the leading contributors of sodium in order to assist the reduction of sodium consumption. Vatanparast et al (2010) used the CCHS 2.2 data in a similar fashion to assess the daily vitamin D intake of Canadians. In spite of these previous studies there are gaps in our understanding of variation in dairy product intake across demographic, regional and health status characteristics. The CCHS 2.2 data provides the best currently available data set to establish Canadian cross sectional differences in dairy intakes.

The only other Canadian dietary recalls identified were done in the Arctic. Sharma et al (2009) conducted a 24-hour dietary recall in the Northwest Territories for 101 respondents to characterize the overall diet quality and determine the nutrients that should be targeted in future programs among the Inuvialuit population. Hopping et al (2010) conducted a 24-hour dietary recall in Nunavut to assess the quality of diet among the Inuit population living in the Canadian arctic. Both of these Arctic studies found diets lacking in several categories.

2.8.2. Self-Reported Food Intake Frequency

Another method of assessing food intake is by conducting a survey that includes food frequency questions. The food frequency questions can focus on a broad spectrum of foods or on a specific group of foods. These questions typically ask the respondent how often, on average, in the past month up to the past year they consumed the food product in question, and give a multiple choice format range of frequencies for the respondent to choose from. The range usually goes from 'never' to 'more than x times per day' with several options in between, and can be adjusted if necessary for certain types of foods. Some of the strengths of this approach include a low respondent burden, the relative ease of collecting the data compared to dietary recalls, the ability to assess habitual long-term food consumption, and the standardized format of the responses, making the data relatively easy to enter and analyze (MRC 2012). The weaknesses of this approach are that the data does not reflect the overall diet or energy intake of the

individual and that respondents may over-report the frequency of consumption of 'healthy' foods and under-report consumption of 'bad' foods (MRC 2012).

Several studies in Canada have utilized self-reported measures of food intake frequency. A study by Bedard et al (2010) used self-reported food frequency questionnaires to establish fast food consumption habits among French-Canadian women. Lo et al (2008) used a survey containing measures of nutrition knowledge and beverage frequency to determine how a school-nutrition education program could improve beverage intakes among Canadian children in Grade 9. Friesen and Innis (2010) used a food frequency questionnaire to estimate intake of several types of fatty acids among pregnant women in Canada. Poliquin et al (2009) used an abbreviated food frequency questionnaire to determine levels of calcium and vitamin D in the Canadian population.

2.8.3. Food Intake Collection Method Summary

Based on the aforementioned literature, food frequency questions, rather than dietary recalls, appear to be a more frequently used method for estimating intakes of specific foods or nutrients rather than overall diet quality. Given that this study focuses on intakes of milk and yogurt, food frequency questions are included in the survey designed to address the objective of determining how demographic and health characteristics affect milk and yogurt consumption. However, because the author has access to a national-level 24-hour dietary recall conducted by Statistics Canada in 2004, analysis of the milk and yogurt intake from this data set will also be conducted to address the same objective.

2.8.4. Using Stated Preference Experiments to Evaluate Preferences for Hypothetical Products

The second objective of this research is to determine how various combinations of product attributes in milk and yogurt impact preferences. In order to address this objective, choices made for products with various informational and health attributes in milk and yogurt need to be assessed. This is crucial, as product attributes were identified in the conceptual framework as one of the

product factors which influence product choice. While some of the attributes (discussed in greater detail in Chapter 3) being examined are available in yogurt in the current marketplace, many of them do not exist for milk products, and many combinations of the attributes are not currently available in the market for milk or yogurt.

Stated preference experiments are very useful in determining consumer preferences for goods which are not available in the market. (Revealed preference data, when available for market goods, should be more accurate than stated preference data, as it reveals actual purchases rather than hypothetical choices.) Stated preference experiments have been used for some time in the transportation, psychology, and marketing literature (Bastell and Louviere 1991, Louviere 1988a, 1988b, 1991, and Hensher 1994). What sets choice experiments apart from other stated preference methods is that individuals are asked to choose between alternative bundles of attributes rather than rating or ranking them, making them consistent with random utility theory (Adamowicz et al 1995). Because of the nature of choice experiments, they provide a thorough description of tradeoffs respondents are willing to make between various product attributes, thereby revealing whether or not individuals are sensitive to attribute levels or even to the attributes themselves. The strengths of choice experiments are that they can be used to determine values for goods or combinations of attributes which are not available in the market and that the attributes and levels of attributes can be adjusted to meet the researcher's objective (Adamowicz et al 1995, Dhar and Simonson 2003). The weaknesses of choice experiments are that due to their lack of consequentiality, respondents may underestimate their sensitivity to price and that estimations done with them may not translate to the real market due to the differing number of options available, prices, or attributes (Dhar and Simonson 2003, Adamowicz et al 1995).

2.8.4.1. Stated Preference Experimental Design

Choice sets should be designed in a way that the attributes are uncorrelated and therefore produce un-confounded parameter estimates of the conditional indirect utility function. This format of question is useful for eliciting the

valuation of the attributes of the product (Grafton et al 2004). According to Grafton et al (2004, pg.264), the advantages of attribute based stated choice methods are as follows: "(1) the control of the stimuli is in the experimenter's hand, as opposed to the low level of control generally afforded by observing the real marketplace; (2) the control of the design matrix yields greater statistical efficiency and eliminates collinearity; (3) the development of more robust models because wider attribute ranges can be applied than are found in real markets; and (4) the introduction and/or removal of products and services is straightforwardly accomplished, as is the introduction of new attributes."

When analyzing the data from a choice experiment, it must be assumed that the choices made by the respondents are based on thorough consideration of the attributes in each alternative of each choice set. Since they will rarely be given an option with all desirable levels of attributes, respondents must determine what they would be willing to give up (in terms of attributes) to gain more desirable levels of other attributes (Grafton et al 2004). An effort should be made to avoid impossible scenarios in choice sets (Adamowicz et al 1995), and experimental design should be based on a fractional factorial design to maximize efficiency.

One of the challenges in designing a choice experiment is balancing the ability of respondents to trade-off attributes with statistical efficiency. Consumer theory assumes that individuals are able to fully process information, that they are perfectly aware of their preferences, and that they consistently use this information to make choices between alternatives (Grafton et al 2004). This is rarely the case in reality, especially when a product is unfamiliar or when an overwhelming amount of information is given (Ohler et al 2000). From a statistical perspective, more accurate results can be obtained when there are more alternatives, attributes, and choice tasks, but if the choice sets are too complex for the respondent's cognitive capacity, they could resort to making random choices or not completing the task, rendering the subsequent results less accurate (Ohler et al 2000).

When designing a choice experiment, there are several factors to consider. Firstly, the number of attributes needs to be determined. According to Green and

Srinivasan (1990), if no more than six attributes are included, the average intercorrelation between attributes will not be greater in absolute value than -0.2 and there will be ample degrees of freedom for the analysis. Choice experiments asking respondents to choose between 2 or 3 scenarios work best with six or fewer attributes as respondents resort to simplifying the task when faced with too many attributes or levels which can distort their true preferences. Deshazo and Fermo (2002) found that when the number of attributes is increased, the variance of the error term also increases. They therefore conclude that the potential increase in consistency provided by more attributes is outweighed by the cognitive burden imposed by more information.

Next, the number of attribute levels needs to be determined. In many cases, the attribute levels are binary (e.g., the product either does or doesn't have probiotics), but for others, such as price, the number of levels are determined by the researcher. Ratcliffe and Longworth (2002) found that while the number of attribute levels doesn't affect coefficient values, there was evidence that the relative importance of an attribute to a respondent increased as the number of that respective attribute's levels increased. Also important is the range between attribute levels. Ohler et al (2000) found that while the attribute range differences had minimal effect on estimated model parameters, narrower ranges made detecting interactions more difficult. Dellaert et al (1999) found that as the difference in attribute levels increased, the consequences of choosing 'wrong' increased, and consistency decreased. With regards to price levels, according to Haab and McConnell (2002), the optimal levels should be close to the true mean WTP. Given that WTP is unknown (or the experiment would be redundant), it must be estimated based on current prices and evidence. Haab and McConnell (2002) also point out that the distribution of bids is important for efficiency. Hanley et al (2005) found that range of the price vector in a choice experiment did not significantly impact the estimated coefficients or WTP measures.

Another issue is that of how many alternatives should be included in a choice set. Deshazo and Fermo (2002) found that giving respondents more alternatives to choose from initially decreased the variance, but once a certain

point number of alternatives were reached, the increased complexity increased the overall variance. Most choice experiments use choice sets ranging from two to four alternatives (Bech et al 2011). Researchers also have to decide whether or not a 'choose neither' option should be given. Deshazo and Fermo (2002) point out that to be consistent with real purchases, consumers should have a 'choose neither' option unless the good being valued is essential. Dhar and Simonson (2003) also recognize that "in many real-world situations, buyers are not forced to choose from any particular set presented to them, and they have the option not to purchase at all, defer purchase, or purchase elsewhere"(pg.146), and found that when respondents are forced to make a choice, the results are often biased or incomplete.

Once the choice sets along with their attributes and levels have been determined, the researcher still needs to decide how many choice sets each respondents should answer and in what form they should have people complete the experiment. Most studies have respondents answer one to sixteen choice sets, with the average being around eight (Bech et al 2011; Deshazo and Fermo 2002). In economic research, it is typically recommended to have a respondent answer between eight and sixteen choice sets (Holmes and Adamowicz 2003). Marketing and psychology research often use more than this, but Hensher et al (2001) found that sixteen choice sets were usually sufficient for statistical analysis, and asking respondents to only consider sixteen choice sets made problems with boredom and fatigue less likely to be an issue.

Several other aspects of experimental design need to be considered. The order of questions should be varied by respondent. Cai et al (2011) found that the order of questions changed respondents' opinions with regards to the attributes in question, resulting in substantial differences in WTP measurements. Attribute levels are usually presented to respondents in a table, but in many real-world food purchasing situations, consumers have to discern a product's attributes by reading the packaging. Green and Srinivasan (1990) note that using pictorial materials rather than paragraph descriptions make the task more engaging for the respondent and provide a less ambiguous, easier way of conveying information,

allowing a greater number of attributes to be used without causing statistical issues. Pictorial materials are "virtually indispensable in conjoint studies" and are being increasingly applied to physical products where package design is an important factor.

There are several ways to conduct a stated preference experiment, the most common being auctions and surveys. While auctions have a greater sense of consequentiality because participants are typically given both money and products which they can use in the experiment, they are both costly and time consuming. Using surveys may have more hypothetical bias, but a much larger sample group can participate. In the past, surveys were often conducted either via mail or telephone, but online surveys are becoming increasingly common. Some of the advantages of doing online surveys include timeliness, the ability to sample a geographically diverse population, automated data collection, and lower costs (Wright 2005, Windle and Rolfe 2011). Lindhjem and Navrud (2011) found that contingent valuation surveys estimating WTP over the Internet did not appear to be significantly different or biased compared to face-to-face interviews. It should be noted that using online surveys can introduce a sampling bias (only people who own a computer and have the internet can participate), but in their study of stated preference collection methods, Windle and Rolfe (2011) found that although there were demographic differences between online and paper based survey respondents, no differences in value estimates or WTP were found between the groups. Fleming and Bowden (2009) also found similar results when comparing mailed-in and web-based survey responses.

2.8.4.2. Stated Preference Studies to Determine Food Preferences

Many studies have utilized stated preference experiments to determine consumer preferences for attributes in their food. Table 2.1 outlines the experimental design of some of the studies discussed in this section and the next. Loureiro and Umberger (2007) analyzed US consumers' preferences and WTP for traceability and origin labeling in beef. They did this by getting 5000 respondents to answer questions about beef purchasing behaviour and attitudes, beef qualities that consumers find desirable, socio-demographics, and a choice experiment.

Mondelaers et al (2009) used a choice experiment showing food labels to approximately 500 Belgian consumers to determine consumer preference for organic vegetables in conjunction with health and environmental traits. Chern et al (2002) used stated preference experiments to estimate consumer WTP for several genetically modified foods in Norway, the United States, Japan, and Taiwan. Hu et al (2009) used an in-store conjoint experiment survey in the United States to determine WTP for several attributes in blueberries.

2.8.4.3. Studies Estimating WTP for Attributes in Dairy Products

There have been several studies examining consumer WTP for various attributes in dairy products. In order to make the numbers more comparable, dollar amounts have been adjusted to reflect a price for the same quantity of milk or yogurt as in this study, or premiums are discussed as a percentage. Maynard and Franklin (2003) found that American respondents were WTP an additional $0.22 to have CLA fortified milk and $0.48 to have CLA fortified yogurt. Bernard and Mathios (2005) found that when purchasing milk, respondents were WTP an additional $0.28 for rBST free milk, $0.77 for organic milk, $0.56 for flavoured milk, and $0.67 for lactose-reduced milk. Skuza (2011) found that American respondents were WTP and additional $0.17 for organic milk. Berges and Casellas (2009) found that Argentinian consumers were WTP a 15% premium over conventional milk prices for milk fortified with zinc. Menrad (2003) estimates that in Europe, probiotic dairy products sell at around 30-50% higher than conventional dairy products. Zou and Hobbs (2007) estimate that probiotic yogurt in Canada elicits a 20-50% price premium over the average price of conventional yogurt.

Table 2.1: Experimental design of several studies using choice experiments to assess WTP for attributes in food.

Study	Food type	# of attributes	# of levels	# of options (not incl. neither)	neither option included (yes or no)	# of choice sets completed by each respondent
Hu et al (2010)	blueberry products	4	2 or 4	2	yes	8

Loureiro and Umberger (2007)	steak	5	2	2	yes	12
Skuza (2011)	milk	2	2	2	no	4
Christoph et al (2011)	various dairy products	6	2 or 3	3	no	4
Mondelaers et al (2009)	organic vegetables	6	3 or 4	3	no	?
Chern et al (2002)	genetically modified vegetable oil, salmon, and corn flake cereal	2 or 3	4	2	?	?

2.8.5. Stated preference method summary

Choice experiments have been used extensively to determine consumer valuation of attributes in foods, be they production, physical, or credence attributes, as well as to examine the relationships between individual characteristics and their attribute valuation. Pictorial choice experiments in online surveys can be effectively used to elicit WTP values. Approximately eight choice sets with three alternatives (one of which is a 'neither' option) and a maximum of six attributes should yield statistically significant and efficient estimations.

2.9. Summary

As outlined by the conceptual framework described in section 2.2, there are various factors impacting product choice. This study focuses on the internal factors, both static and dynamic, as well as product factors. The internal factors will be investigated in order to address the objective of determining how demographic and health characteristics affect milk and yogurt consumption. The product factors are central to addressing the second objective of determining how product attributes (and combinations thereof) affect consumer preferences for milk and yogurt. The first analysis will address the first objective of determining the effects of demographic and health characteristic on milk and yogurt consumption using data collected by Statistics Canada in the CCHS 2.2 in 2004.

Another data set, which is used to address both objectives, is obtained by conducting a nation wide survey online which includes demographic characteristics, self reported dairy product intake and frequency, health attitudes and beliefs, and a pictorial choice experiment (national dairy survey – NDS). The data collected through the NDS will be analyzed to determine how demographic and health characteristics affect milk and yogurt consumption, as well as to analyze consumer choices for various combinations of attributes in milk and yogurt. The analysis of the NDS data will not only provide measures of WTP for various attributes in milk and yogurt, but will help to describe the relationships between demographic and health characteristics and what attributes are valued by respondents, thereby addressing both objectives. All analyses will be done for the whole sample, then for the groups identified as at-risk for low dairy intake: adolescents/young adults and women over 50.

Chapter 3: Methods, Data Collection, and Descriptive Statistics

3.1. Introduction

In the previous chapter, a review of the literature relevant for the empirical analysis of demand for dairy products was presented and a conceptual framework identified. In order to address the two objectives of this research, which are to determine how demographic and health characteristics predict milk and yogurt consumption as well as to determine how product attributes affect intended milk and yogurt consumption, several methods will be employed. The methods with which these objectives will be addressed are discussed in this chapter, beginning with the types of data required, then the explanation of the data sources and development thereof, the kind of analyses to be performed with the data, and finally the descriptive statistics of the data to be used.

The conceptual framework identified several types of factors which could play a role in individual product choice. In order to address the first objective of this research, two different internal factors, demographic and health characteristics, are being examined to determine how they predict milk and yogurt consumption. Analysis of two data sources, discussed in the next section, will enable the modeling of milk and yogurt consumption as a function of demographic and health characteristics. To address the second objective of this research, product factors, in the form of health and information attributes, will be examined to determine how they impact consumer preferences for milk and yogurt. Analysis of stated preference data will provide information about the preferences of various consumer segments for several product attributes in milk and yogurt.

3.2. Data Sources for Consumption Analyses Addressing the First Objective

In order to address the first objective of this study, two data sets are analyzed. The first is the Canadian Community Health Survey, Cycle 2.2, Nutrition (CCHS 2.2) conducted by Statistics Canada in 2004 and the second is an

original National Dairy Survey (NDS) conducted by the authors in January 2011. Both data sets provide some type of milk and yogurt consumption data along with demographic and health characteristics, and will thus be used in analysis aimed at addressing the first objective. More details for both data sets are given in this section. For a comparison of the demographic profiles of both data sets with Canadian census data, see section 3.6.

3.2.1. CCHS 2.2

For micronutrient and dairy product intake, the individual level data collected by Statistics Canada through "The Canadian Community Health Survey (CCHS) Cycle 2.2 (2004) Nutrition: General Health File (including vitamin and mineral supplements) and 24-Hour Dietary Recall" is used (Statistics Canada 2004). The CCHS 2.2 was conducted in 2004 and surveyed a total of 35,107 Canadians of varying ages and backgrounds. The survey excluded members of the Canadian Forces, residents of the territories, First Nations reserves, and institutions. Extensive demographic and health status information was collected in addition to collecting a 24-hour dietary recall. The authors were granted access to this data through the Research Data Centre at the University of Alberta. The CCHS 2.2 is the only available data set which includes an actual dietary recall on a national level since 1969. The 24-hour dietary recall collected information about what food products were consumed by the respondent as well as how much of it they consumed. By using food intake data, actual consumption of various milk and yogurt products can be modeled using demographic and health indicators as explanatory variables, thereby addressing the first objective.

The previous chapter identified several potential negative health implications as a result of declining dairy product consumption and the possibly related decline in micronutrient consumption. As such, this data will also be used to assess the adequacy of the average intake of calcium and vitamin B_2, B_{12}, and D in the Canadian population in order to determine whether the concerns about declining micronutrient consumption are valid. Declining milk consumption was highlighted as a public health concern by Garriguet (2008) and Ray et al (2003). Dairy

consumption has also declined in the US, prompting the study by McCarron and Heaney (2004) estimating that if Americans consumed the daily recommended intake of dairy products, health care costs could be decreased by $200 billion over 5 years.

Used from the CCHS 2.2 is the 24-hour dietary recall data for dairy products summarized in Table 3.1 as well as several demographic and health characteristics listed in Table 3.2. The demographic variables included age (in years), gender (0=male, 1=female), preferred language (0=English, 1=French), education (in years), income (in thousands of dollars), area (0=rural, 1=urban), food security status (on a scale from 0 to 3), and region (dummy variables for Maritimes, Quebec, Ontario, Prairies, and British Columbia). For the regional dummy variables, Ontario is omitted and used as the base case. The health indicator variables included self-rated health status (on a scale from 1 to 5), self-rated physical activity level (on a scale from 1 to 3), chronic health condition (0=no chronic health condition, 1=living with a chronic health condition), smoking status (0=non-smoker, 1=smoker), and body mass index (respondent's weight divided by their squared height). A dummy variable for 'other dairy' was included in the analysis of the aggregate data for milk and yogurt to determine if there was a substitution effect between these products and other dairy products. For milk, the dummy was defined as 1 if the respondent had consumed dairy products other than milk and 0 if they had not. Similarly for yogurt, the dummy was defined as 1 if the respondent had consumed dairy products other than yogurt and 0 if they had not. The other independent variables are retail prices and advertising expenditures for milk, yogurt, and cheese (at a national/regional level and not by individual).

Table 3.1: Percentage of respondents who consumed products in question and mean consumption level among those who did consume them.

	Whole Sample		Women over 50		Adolescents	
	n = 35,107		n = 6,362		n = 6,120	
	%	mean (ml)	%	mean (ml)	%	mean (ml)
total milk	5.86%	204	4.09%	69	5.75%	312
skim	0.44%	233	0.39%	246	0.41%	282
1%	0.87%	273	0.47%	124	1.29%	370
2%	3.57%	166			3.61%	278
whole	0.98%	272	3.22%	40	0.44%	444
total	0.15%	190	-	-	0.25%	208

yogurt						
low/non-fat	0.09%	232	-	-	-	-
whole fat	0.07%	134	-	-	-	-

(- too small to report)

Table 3.2: Mean or % yes for independent variables used in CCHS 2.2 analysis.

		Whole Sample	Women >50	Adolescents
Variable	Abbrev.	%yes / mean	%yes / mean	%yes / mean
age (in years)	age	37.64	67.81	15.78
female (dummy)	sex	51%	100%	50%
French (dummy)	lang	23%	14%	16%
education (years)	ed	12.50	12.23	10.23
income (x $1000)	inc	59.88	37.87	62.89
children (dummy)	child	36%	1%	20%
self-rated health (1=poor, 5=excellent)	SRH	2.67	2.33	2.82
urban (dummy)	urban	82%	77%	78%
physical activity level (1=low, 3=high)	PA	2.35	2.51	1.94
smoking status (dummy)	SS	34%	16%	15%
chronic health condition (dummy)	CHC	36%	76%	19%
BMI	BMI	24.73	26.48	22.41
food security status (0=food secure, 3=severe food insecurity)	FSS	0.10	0.07	0.08
dairy other than milk (dummy)	otmilk	3%	1%	4%
dairy other than yogurt (dummy)	otyog	8%	5%	10%
milk price ($/2L carton)	MPrice	2.88	2.89	2.77
milk advertising ($)	MAd	20.5	20.5	20.5
yogurt price ($/500g)	Yprice	1.84	1.83	1.82
yogurt advertising ($)	Yad	18.1	18.1	18.1
cheese price ($/kg)	Cprice	11.33	11.14	11.16
cheese advertising ($)	CAd	18.6	18.6	18.6
Maritimes (dummy)	provMAR	19%	18%	19%
Quebec (dummy)	provQC	14%	12%	14%
Ontario (dummy)	provON	31%	39%	28%

Prairies (dummy)	provPRA	26%	22%	29%
British Columbia (dummy)	provBC	10%	9%	11%

3.2.2. NDS

The NDS is an original survey designed by the author and was administered in Canada in January 2011. The online survey was conducted by TNS Global and was completed by 1705 Canadians over the age of 18 and living in all ten provinces. (There were 16,000 individuals invited to participate in the survey, 313 people who started the survey but didn't complete it, 717 people who attempted to complete the survey but were in a category with a complete quota and thus rejected, and 1,705 individuals who successfully completed the survey.) This survey collected self-reported milk and yogurt intake in terms of both type typically purchased as well as frequency of consumption, along with demographic information and health status and behaviors. The milk and yogurt intake data will be used to address the first objective of how demographic and health characteristics affect milk and yogurt consumption. In addition, the consumption analysis from the NDS can also be compared with the analysis of the CCHS 2.2 data to determine if there have been changes over time in milk and yogurt consumption patterns. The design of the NDS is now discussed.

3.2.2.1. NDS design

The survey was designed with several sections to elicit information about many of the factors involved in choosing a food product. Unfortunately, exploring the relationships between all of these factors and dairy product choice is not within the scope of this study, so only the aspects needed to address this study's objectives will be discussed in this section. Information collected on other factors will be used in future analyses and papers. Each section of the survey is described below.

3.2.2.1.1. Section I: Demographics

The first objective of this study is to determine how demographic and health characteristics predict milk and yogurt consumption. As such, demographic and

health information obviously need to be collected from respondents. The first section of the survey is concerned with establishing the respondent's demographic characteristics, which are important because preferences for most goods are partially a function of individual consumer characteristics, and demographic and health characteristics were identified in the conceptual framework as internal factors affecting product choices. Based on previous studies (Topcu and Isik 2008, Davis et al 2011, Davis et al 2012, Paulionis 2008, Barrios et al 2008) modeling food consumption, the most common demographic factors to be considered when analyzing demand for a product are gender, age, income, household size, number of children, and region. Food is no exception, and is subject to individual consumer preferences which are often determined by demographic characteristics.

The demographic information collected by this survey includes age, gender, household size, number of children, position in household, marital status, education level, employment status, household income, region, dietary restrictions (such as vegetarianism), height, and weight. Respondents are also asked if they are pregnant or breastfeeding. In addition, the respondents are asked to rate their health status on a scale from 1 to 5 and indicate if they have made any changes in the past year to improve their health. These health-related questions have been used in the CCHS 2.2 (Statistics Canada 2004). Knowing the self-reported health status of the respondents and whether or not they are making changes to improve their health may be useful in determining if there is a relationship between these factors and attitudes towards dairy product attitudes. As self-rated health was identified in the conceptual framework as a dynamic internal factor, it is used as an explanatory variable in the demographic analysis of both the CCHS 2.2 and NDS data. Whether or not people claim to have made changes to improve their health and how this predicts consumption of milk or yogurt would be telling from the perspective of knowing if people consider these products to be part of a healthy diet. Whether or not people who claim to be trying to consume more calcium or less fat in their diets are WTP for dairy products with these attributes is

also important to understand in terms of how stated behaviours relate to product choices.

Table 3.3: Means of demographic characteristics, eating behaviours, and health characteristics from the NDS.

	Whole Sample	Women Over 50	Young Adults
Demographics			
Age (in years)	50.19	60.70	21.76
Children in home (1=yes, 0=no)	26%	8%	41%
Education (in years)	14.28	13.66	13.56
Income (in thousands)	63.49	53.69	62.95
Language (1=French, 0=English)	21%	23%	22%
Gender (1=female, 0=male)	50%	100%	73%
City dummy (1=yes, 0=no)	67%	63%	73%
Town dummy (1=yes, 0=no)	18%	21%	14%
Rural dummy (1=yes, 0=no)	15%	16%	14%
Pregnant dummy (1=yes, 0=no)	1%	0%	0%
Breastfeeding dummy (1=yes, 0=no)	2%	0%	5%
BMI (kg/m^2)	27.96	28.38	24.33
Behaviours			
Eats meat and dairy	95%	94%	92%
Eats dairy but not meat	2%	3%	3%
Eats meat but not dairy	2%	2%	5%
Eats neither meat nor dairy	0%	0%	0%
Health			
Self-rated health (1=poor, 5=excellent)	3.36	3.32	3.49
Has made changes in past 12 months to improve health (1=yes, 0=no)	61%	64%	71%
Reducing salt intake (1=yes, 0=no)	46%	53%	21%
Trying to consume less fat (1=yes, 0=no)	53%	61%	36%
Eating more fruit and/or vegetables (1=yes, 0=no)	64%	72%	45%
Eating less red meat (1=yes, 0=no)	24%	32%	10%
Reduce sugar intake (1=yes, 0=no)	46%	48%	26%
Less snacking (1=yes, 0=no)	35%	39%	36%
Reduce calorie intake/eating less (1=yes, 0=no)	37%	43%	38%
Reducing caffeine intake (1=yes, 0=no)	19%	20%	5%
Taking vitamins and supplements (1=yes, 0=no)	47%	59%	21%
Introducing foods to your diet that may provide health benefits (1=yes, 0=no)	36%	43%	33%

Exercising (1=yes, 0=no)	57%	57%	50%
Quit smoking (1=yes, 0=no)	9%	8%	10%
Reducing alcohol intake (1=yes, 0=no)	21%	20%	21%
Eat less fast food (1=yes, 0=no)	51%	45%	50%
Eat more foods containing fibre (1=yes, 0=no)	46%	55%	21%
Eat more foods containing calcium (1=yes, 0=no)	17%	24%	14%
Drinking more water (1=yes, 0=no)	64%	65%	55%

3.2.2.1.2. Section II: Purchasing and Consumption Behaviours

As previously mentioned, the first objective of this research is to determine how demographic and health characteristics predict milk and yogurt consumption. Therefore, it is critical to collect information about respondents' milk and yogurt consumption to be used as dependent variables in later analyses. This section was created to elicit general information from the respondents about their dairy product purchasing behaviour. As this is stated behaviour, rather than observed behaviour, it suffers from self-reported bias (as do all self-reported behaviours), but as dairy consumption is not controversial nor does it have major negative or positive associations in society, it is unlikely that bias will be a major problem. Harrison et al (2000) report that underreporting of dietary intake is a problem for data collected in the US, but Scagliusi et al (2003) found that sweets and snacks were the most commonly underreported food groups while milk and dairy products did not appear to suffer from major underreporting. Non-dairy consumers (less than 3% of the sample) were retained in the sample for analysis as factors predicting consumption likely also affect the decision not to consume dairy products. It is important to have information about the types of products chosen in addition to frequency as there may be different factors playing a role in these different decisions. Information about the frequency of consumption, factors considered in the decision-making process, and types of products typically purchased are collected for both milk and yogurt. Examples include: "How often do you drink milk at home?" (1=never, 6=more than twice per day) and "Which product do you typically purchase?" (a=skim milk, b=1% milk, c=2% milk,

d=whole milk). Frequency, rather than quantity is used to gauge consumption as it is easier for respondents to estimate how often they consume a product rather than how much of it they consume over a given time period. By collecting this kind of information, factors playing a role in consumption of both overall and specific types of dairy products can be evaluated, and differences between products and between population groups can be assessed.

Table 3.4: Mean for dependent variables used in NDS analysis.

	Whole sample	Women over 50	Young adults
% who typically purchase:			
skim milk	16.25	17.35	16.95
1% milk	28.56	29.16	28.81
2% milk	45.1	45.06	47.46
whole milk	8.04	6.99	3.39
low/non-fat yogurt	70.62	75.66	61.02
full-fat yogurt	10.26	8.67	13.56
Consumption frequency:			
total milk (1-6)	3.87	3.62	4.02
total yogurt (1-6)	3.28	3.48	3.17

Table 3.5: Means of milk consumption behaviours from the NDS.

Milk	Whole Sample	Women Over 50	Young Adults
Do you ever buy milk for yourself (1=never,5=always)	3.84	3.98	3.37
Do you ever buy milk for your house (1=never,5=always)	4.10	4.16	3.61
How often is a two-litre quantity of milk consumed in your home? (1=never, 5=more than 7 times per week)	2.43	2.21	2.83
How often do you drink milk at home? (1=never, 6=more than 2 times per day)	3.82	3.59	3.83
How often do you drink milk away from home? (For example, in restaurants, cafeterias, or as a snack.) (1=never, 6=more than 2 times per day)	2.03	1.73	2.36
Total milk consumption (1=never, 6=more than 2 times per day)	3.87	3.62	4.02
Never drink milk	10%	15%	10%
Do you always purchase the same kind of milk?			

yes	70%	73%	66%
no	27%	24%	27%
n/a	3%	2%	7%
Rank most important			
Price	31%	24%	49%
Flavour	11%	9%	20%
Fat content	34%	43%	14%
Brand	13%	13%	14%
Container size	11%	12%	3%

Table 3.6: Means of yogurt consumption behaviours from the NDS.

Yogurt	Whole Sample	Women Over 50	Young Adults
Do you ever buy yogurt for yourself (1=never, 5=always)	3.24	3.60	2.95
Do you ever buy yogurt for household (1=never, 5=always)	3.32	3.20	3.17
How often is yogurt consumed in your home? (1=never, 5=more than 7 times per week)	2.79	2.76	2.73
How often do you eat yogurt at home? (1=never, 6=more than 2 times per day)	3.21	3.40	3.03
How often do you eat yogurt away from home? (For example, in a restaurant, cafeteria, or as a snack.) (1=never, 6=more than 2 times per day)	1.89	1.76	2.08
Total yogurt consumption (1=never, 6=more than 2 times per day)	3.28	3.48	3.17
Never eat yogurt	0%	12%	14%
Do you always purchase the same kind of yogurt?			
yes	24%	26%	25%
no	68%	66%	68%
n/a	9%	8%	7%
Rank most important			
Price	36%	28%	54%
Flavour	28%	28%	31%
Fat content	12%	17%	3%
Brand	9%	8%	5%
Probiotic content	6%	9%	2%
Sugar content	6%	8%	3%
Container size	3%	2%	2%

3.2.2.1.3. Section III: Attitudes and Beliefs

Individual attitudes and beliefs towards health, nutrition, and technology were identified in the conceptual framework as dynamic internal factors affecting consumer product choice. The goal of this section is to elicit information about these attitudes and beliefs. Attitudes and beliefs differ from the self-reported behaviours in the preceding section because behaviours are real actions happening on a regular basis while attitudes and beliefs inherently affect behaviours but are not necessarily easy for an individual to identify or explain. For example, a respondent could probably state that they drink a glass of milk every morning at breakfast, but that does not capture whether they are doing this because they think milk is tasty or if it is a habit or if they are concerned about developing osteoporosis. Attempting to understand the attitudes and beliefs impacting individual behaviours is the objective of this section.

There are several questions based on the Health Belief Model (Rosenstock 1988) developed to assess the perceived benefits, barriers, risks, susceptibilities, pleasantness, as well as measures of self-efficacy and willingness to use associated with milk and yogurt consumption. The questions used are shown in Table 3.7. It is possible that by analyzing an individual's health beliefs in conjunction with their dairy consumption, relevant associations between the two could be identified. Potential links include those between perceived benefits of dairy consumption and frequency of milk or yogurt consumption or perceived susceptibility of osteoporosis and WTP for milk or yogurt with additional calcium and vitamin D. The responses generated from the HBM section of the survey will be used in the analysis of the stated preference data to determine how health beliefs affect WTP for the various attributes in question.

For the Health Belief Model (HBM) component of the analysis, the study by Vassallo *et al.* (2009) was used as a model. They applied the HBM across four countries in Europe to assess willingness to use functional breads. Vassallo *et al.* identify the following components as relevant to predicting willingness to use functional breads: The behavioural evaluation component, which includes perceived benefits and perceived barriers conceptualized as willingness to use,

self-efficacy, perceived healthiness and pleasantness, the threat perception component, which includes perceived susceptibility and perceived severity, the health motivation component, which includes perceived need to pay attention to health, and the cue to action component.

Vassallo et al (2009) used a 7-point scale for each question addressing these HBM components. It should be noted that our questions used a 5-point scale, but there is no reason for this to be a problem. Following are the questions respondents were asked in the survey to address the HBM components as outlined by Vassallo et al (2009), as well as the possible answers. For some aspects, the same question will be used for both milk and yogurt analysis, for others there may be questions specific to milk or yogurt, and in those cases different questions will be used for the milk and yogurt analysis. In the study by Vassallo et al (2009), they used single statements for some of the constructs and as many as four statements for others. One possible extension of this research is to combine multiple statements using factor analysis to generate a factor loading to use as an explanatory variable in the regressions, as well as a measure of the factor's reliability in the form of Cronbach's alpha.

Table 3.7: Description of questions used in the NDS for the Health Belief Model

Construct	Question	Scale
Willingness to use (milk)	Some new sources of calcium may be available in the future. How likely would you be to use each of the following, assuming the taste, texture, and color of the items would not be changed by adding calcium. Milk with extra calcium?	(1=very unlikely, 5=very likely)
Willingness to use (yogurt)	Some new sources of calcium may be available in the future. How likely would you be to use each of the following, assuming the taste, texture, and color of the items would not be changed by adding calcium. Yogurt or cheese with extra calcium?	(1=very unlikely, 5=very likely)
Perceived barriers	Would you agree or disagree that availability is a barrier to consuming dairy products?	(1=strongly disagree, 5=strongly agree)

Self-efficacy	I am confident that I could eat the recommended amount of dairy products every day. (Canada's Food Guide recommends 2 to 4 servings daily depending on age and gender.	(1=strongly disagree, 5=strongly agree)
Perceived pleasantness (milk)	Total reported milk consumption frequency	(1=never, 6=more than 2 times per day)
Perceived pleasantness (yogurt)	Total reported yogurt consumption frequency	(1=never, 6=more than 2 times per day)
Perceived susceptibility	I believe that I am at risk to develop osteoporosis	(1=strongly disagree, 5=strongly agree)
Perceived severity	I would be worried if I developed osteoporosis.	(1=strongly disagree, 5=strongly agree)
Perceived benefits	Benefits of consuming dairy products include a higher likelihood of consuming adequate vitamins and minerals including calcium.	(1=strongly disagree, 5=strongly agree)

The means for likeliness to use "milk with extra calcium" and "yogurt or cheese with extra calcium" to increase the calcium content of the diet both fell between "neither likely nor unlikely" and "likely". Both total milk and total yogurt consumption frequency means fell between "1-5 times per month" and "1-5 times per week" with milk consumption being higher. The only exception was for young adults, whose average milk consumption frequency was between "1-5 times per week" and "1-2 times per day". The mean for "would you agree or disagree that availability is a barrier to consuming dairy products" fell between "disagree" and "neither agree nor disagree". The mean for "I am confident that I could eat the recommended amount of dairy products every day" fell between "neither agree nor disagree" and "agree". The mean for "I believe that the calcium content of my diet is appropriate for my health" fell between "neither agree nor disagree" and "agree". The mean for "I would be more likely to develop osteoporosis if I did not eat enough dairy products" fell between "neither agree nor disagree" and "agree". The mean for "I would be worried if I developed osteoporosis" fell between "neither agree nor disagree" and "agree" for the whole

sample and young adults, but was between "agree" and "strongly agree" for older women. The mean for "Benefits of consuming dairy products include the fact that I will have improved bone health and be less likely to get osteoporosis" fell between "neither agree nor disagree" and "agree" for the whole sample and young adults but was between "agree" and "strongly agree" for older women.

Women over 50 were the most likely to use "milk with extra calcium" to increase the calcium content of their diet, followed by the whole sample, with young adults being least likely to use it. The same trend was noted for "yogurt or cheese with extra calcium", however the whole sample and women over 50 were more likely to use the "yogurt or cheese with extra calcium" than "milk with extra calcium" whereas the opposite was true for the young adults. Young adults reported the highest frequency of milk consumption while women over 50 reported the highest frequency of yogurt consumption. Young adults were the most likely to agree that "availability is a barrier to consuming dairy products" while women over 50 were the least likely. Young adults and women over 50 were both more likely to agree that "the calcium content of my diet is appropriate for my health" than the whole sample. Women over 50 were more likely than the other groups to agree with the statement "I would be worried if I developed osteoporosis". They were also more aware that consuming dairy products could make them less susceptible to osteoporosis.

Table 3.8: Mean and standard deviation of responses to questions representing the HBM model for the whole sample, women over 50, and young adults.

	Whole Sample		Women Over 50		Young Adults	
Question	mean	SD	mean	SD	mean	SD
Willingness to use – milk	3.656	1.146	3.701	1.187	3.525	1.291
Willingness to use – yogurt	3.701	1.131	3.882	1.078	3.458	1.330
Perceived healthiness and pleasantness – milk	3.869	1.439	3.607	1.511	4.017	1.371
Perceived healthiness and pleasantness – yogurt	3.314	1.302	3.448	1.284	3.169	1.220
Self-efficacy	3.654	0.964	3.665	0.983	3.542	1.164
Perceived susceptibility	2.823	1.132	3.178	1.191	2.797	1.387
Perceived severity	3.957	0.884	4.149	0.823	3.898	1.078

Perceived benefits	3.893	0.765	4.019	0.732	3.831	0.950
Perceived barriers	2.718	1.143	2.670	1.178	2.797	1.243

3.2.2.1.4. Section IV: Knowledge

This section is designed to determine the knowledge level of respondents with regards to health, nutrition, and dairy products, as knowledge was identified in the conceptual framework as an internal factor affecting product choices. The respondents are first asked what sources they use to access information about food and nutrition in order to determine where they obtain their knowledge. This question was also included in the survey entitled "Tracking Nutrition Trends VII" (CCFN 2008). The respondents were also asked several questions assessing their knowledge of various nutrients and dairy products. Several studies (Shah et al 2010; Ranilovic et al 2009; Satia et al 2010) demonstrate that there is a relationship between nutrition knowledge and health behaviours, and theoretically, this should hold true for dairy products. Data generated from these questions is not utilized in the analysis of this thesis, but will, however, be used in subsequent analyses and projects.

3.2.2.1.5. Section V: Stated preference experiment

The data from the stated preference experiments will be used to address the second objective of determining consumer preferences for preferred milk and yogurt attributes, as product attributes were identified in the conceptual framework as a factor in product choices. Given that this portion of the analysis is intended to address the second objective, and this section is focused on addressing the first objective, the stated preference portion of the survey will be discussed later in this chapter.

3.3. Description of econometric models used to address first objective

Several different models are used for the various analyses on the two data sets to obtain comparable outputs which can be used to address the first objective. The first objective of this study is to determine how demographic and health

characteristics predict milk and yogurt consumption, being that these characteristics represent internal consumer factors. To address the first objective, dairy consumption by demographic and health characteristics will be analyzed using both the CCHS 2.2 data and the NDS data. While the CCHS 2.2 analysis examines the factors involved in whether or not individuals consumed a given product and how much of a given product they consumed within a designated 24-hour window, the analysis from the NDS considers which product an individual claims to purchase most of the time and the frequency with which they claim to consume it. By doing similar analyses with two different data sets, the comparison of the results can provide some information about how dairy consumption patterns have changed over time (CCHS 2.2 was in 2004, NDS was in 2011).

In this section, the econometric methods that can be used to analyze these two data sets in order to address the first objective will be described. The goals in selecting the models to be used for analysis are to choose models which effectively describe the interactions while maximizing efficiency and keeping the analysis as similar as possible for the different data sets for the purpose of comparison.

3.3.1. Two-stage estimation methods

When modeling food consumption using data reported by individuals or households, zero consumption is an issue that needs to be considered. Zero consumption levels are common in 24-hour dietary recall data, as some individuals won't consume a product every day. In the case of the CCHS 2.2 data, many of the dairy products have a high incidence of zero consumption responses. Figure 3.1 shows the percentage of respondents who consumed each product during the 24-hour dietary recall. Similarly, for the NDS, the percent of respondents who claim to never drink milk or eat yogurt are shown in Figure 3.2, the frequency with which milk and yogurt are consumed are shown in Figure 3.3 and the percentage of respondents who claim to typically purchase each product are shown in Figure 3.4.

Figure 3.1: Percentage of respondents who consumed milk and yogurt in the CCHS 2.2

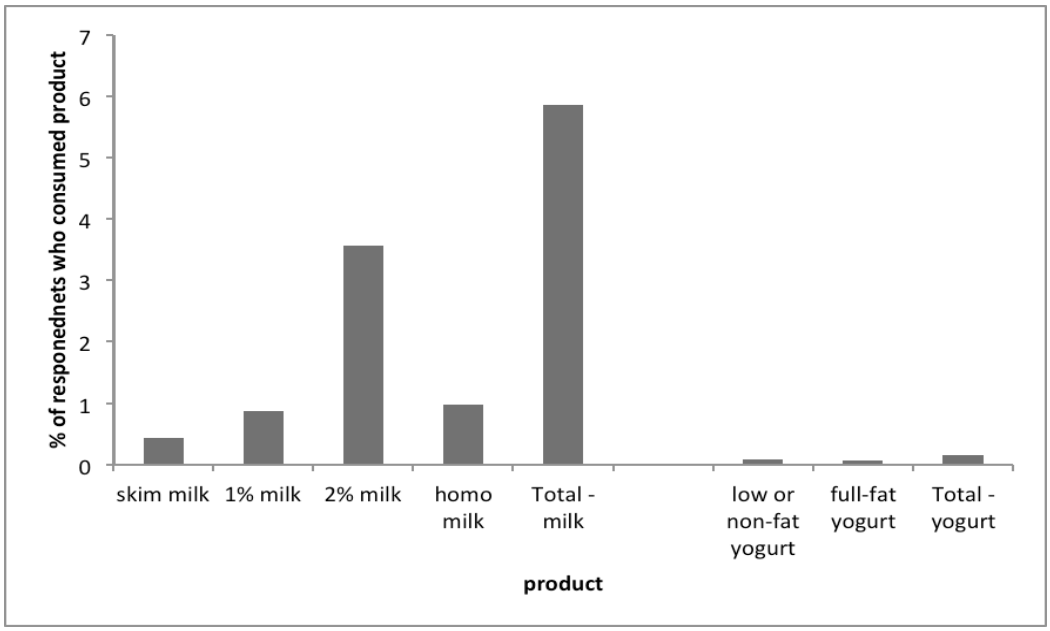


Figure 3.2: Whether or not respondents consume milk or yogurt from NDS

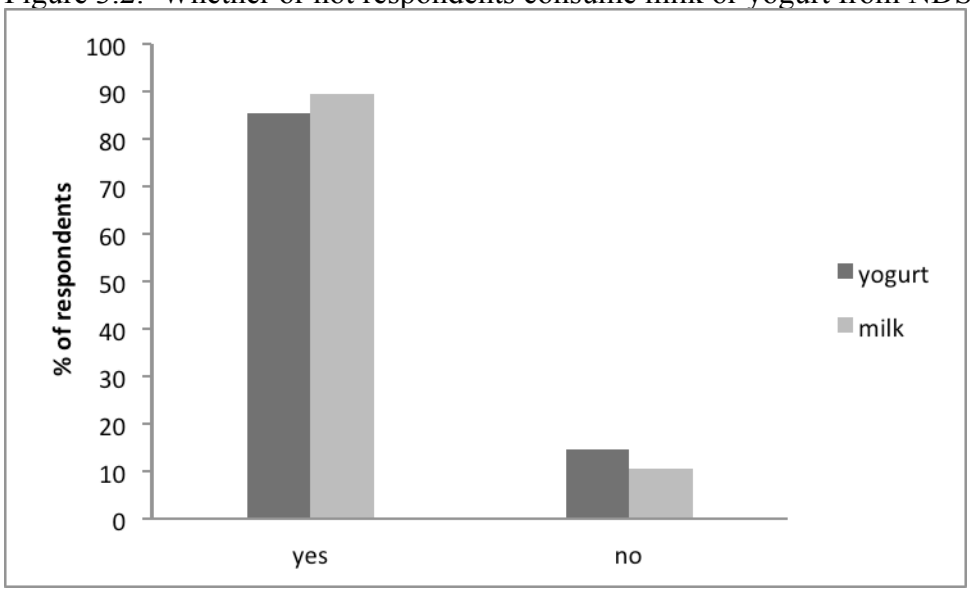
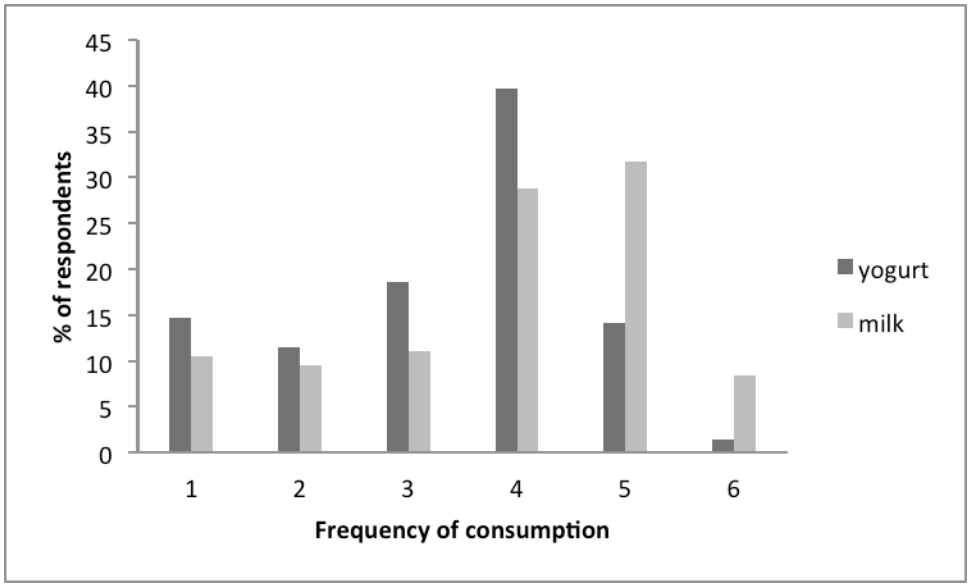
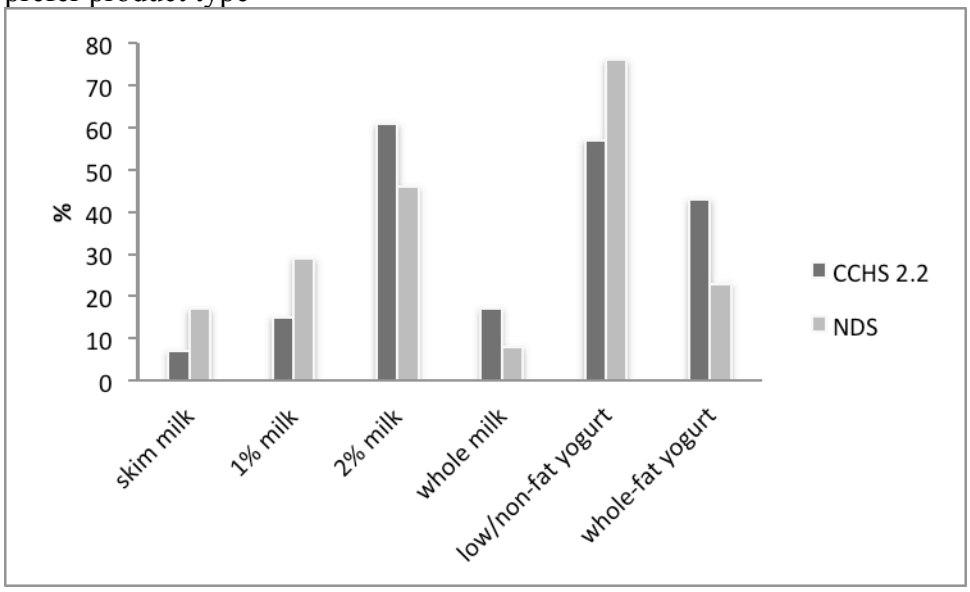


Figure 3.3: Total frequency of respondents' milk and yogurt consumption from NDS



(1=never, 2=less than one time per month, 3=1-5 times per month, 4=1-5 times per week, 5=1-2 times per day, 6=more than 2 times per day)

Figure 3.4: Percentage of respondents (who actually consume milk/yogurt) who prefer product type



In order to address the issue of high rates of zero consumption, two-step estimation can be employed. The consumption of dairy products can be classified as a two-step decision process. The first step (the participation step) is comprised

of the consumer choice of whether or not to consume a particular dairy product. The second step (the quantity step) involves the consumer deciding how much of or how frequently to consume the particular dairy product. This section compares several two-step approaches to determine the type of analysis most suitable for this study.

3.3.1.1. Tobit Model

The Tobit model was proposed by Tobin in 1958, and is primarily used to estimate whether or not an individual chooses to participate in the consumption of a good and how much of the good they choose to consume. In cases where the observations of the dependent variable are censored, this particular specification can provide efficient and consistent results (Tobin 1958; Kinsey 1981; Cornick et al 1994). The general form for the Tobit model is shown below (Greene 2003 p.764):

$$y_i^* = \beta x_i + \varepsilon_i, \ |\varepsilon_i \sim N(0,\sigma^2),$$
$$y_i = y_i^* \text{ if } y_i^* > 0,$$
$$y_i = 0 \text{ if } y_i^* \leq 0;$$

where y_i* is the i^{th} observation of the dependent variable, x_i represents the explanatory variables, β represents the vector of parameters, and ε_i is the random error term. The conditional mean is shown below (Greene 2003 p.764),

$$E[y_i] = \Phi(x_i'\beta/\sigma)\,(x_i'\beta + \sigma\lambda_i)$$

where $$\lambda_i = [\phi(0 - x_i'\beta/\sigma)]/[1 - \Phi(0-x_i'\beta/\sigma)] = \phi(x_i'\beta/\sigma)/\Phi(x_i'\beta/\sigma)$$

The main drawback of the Tobit model is that only a single estimate is generated for each parameter, implying that the explanatory variables have the same effects on the participation decision as they do on the expenditure decision. This is not necessarily a valid restriction, especially with concern to food products where internal factors such as culture and preferences can determine whether or not a particular food is consumed while external or product factors such as price or fat content determine how much of a product is consumed.

3.3.1.2. Probit Model

When the outcome of an event is binary (yes or no, as is the participation step) a binary choice model can be employed. The probit model is one of the

commonly used binary choice models it is based on an assumption of a standard normal distribution. It is appropriate for modeling the factors involved in a consumer's choice of whether or not to participate in the consumption of a given product. It is important to note that it does not take into account the amount or frequency of consumption, only whether or not they consume it (Verbeek 2008 pg.201):

$$\Pr(y_i = 1|x_i) = \Phi(x_i\beta)$$

where Pr denotes probability that individual i consumes the product in question and Φ is the cumulative distribution function. β represents the parameters estimated by maximum likelihood and x_i represents individual i's characteristics. In this study, Pr is the probability that individual i consumes a particular dairy product (skim milk, 1% milk, etc) which is a function of demographic and health indicator variables.

As the probit model only models participation, it is used in several two-step estimation techniques as the first (participation) step with another model being used for the second step as demonstrated in the following models.

3.3.1.3. Double-Hurdle Model

The double-hurdle model was first proposed by Cragg in 1971. It was developed by generalizing the Tobit model, and uses two steps to model the consumer's purchasing decision. The advantage of the double-hurdle model is that it accounts for the different latent variables involved in the two decisions; whether or not to purchase, then how much to purchase. Instead of a tobit model, a probit model is employed in the first step to estimate the probability of participation (Verbeek 2008 p.201):

$$\Pr(y_i = 1|x_i) = \Phi(x_i\beta)$$

For the second step, y_i is considered to be truncated at zero with a normal density. Therefore a truncated normal estimator is used to estimate σ and β in the equation shown below (Greene 2003 p.750):

$$f(y_i|y_i^* > 0) = \{1 / \sigma\varphi([y_i - x_i\beta_2] / \sigma)\} / \varphi(x_i\beta_2 / \sigma).$$

The double hurdle model is limited, however, by its assumption of bivariate normality for the error distribution. If the normality assumption is violated, it can cause issues of inconsistency in the model (Arabmazar and Schmidt 1982).

3.3.1.4. Heckman Procedure

In 1979, Heckman proposed another two-step estimation model to account for the zero consumption issue which provides consistent parameter estimates. The first step in the Heckman procedure is to employ a probit model to estimate the probability that an individual will participate in the consumption of a good. The model is shown below (Greene 2003 p.784):

$$y_i^* = X_i\beta + \varepsilon_i \,,\; d_i^* = z_i'\alpha + \upsilon_i$$

$$[\varepsilon_i,\ \upsilon_i] \sim \text{bivariate normal } [0,\ 0,\ \sigma_2,\ p,\ 1]$$

$$d_i = 1 \text{ if } d_i^* > 0$$

$$d_i = 0 \text{ if } d_i^* \leq 0$$

$$y_i = d_i y_i^* \,,\ (i=1,\ 2,\ \ldots,\ n)$$

Once the probit estimate has been completed, the Inverse Mills Ratio (IMR) is generated. The formula for the IMR is shown below (Greene 2003 p.784):

$$IMR_i = \varphi(z_i'\hat{a}_i)/\Phi(z_i'\hat{a}_i)$$

The second step is to regress the dependent variable (y_i) on the explanatory variables (X_i) and the IMR for all the non-zero observations (Greene, 2003 p.784):

$$E[y_i^* | x_i, d_i = 1] = x_i'\beta + E[\varepsilon_i | x_i, d_i = 1] = x_i'\beta + \theta IMR_i$$

The downside of the Heckman two-step procedure is that by it's very definition, it only includes the participating individuals in the second step of the procedure, thereby reducing the overall efficiency of the model.

3.3.1.5. Heien and Wessells Procedure

The Heien and Wessells (HW) two-step procedure is based on Heckman's (1979) procedure. The main difference between the two is that in Heckman's model, only observations with a non-zero value are used in the second step of the analysis. In the HW procedure, the first step probit estimation is the same as in the Heckman model. However, an IMR is calculated for all observations as shown below (Heien and Wessells 1990 p.365):

$$IMR_i = \varphi(z_i' \hat{a}_i)/\Phi(z_i' \hat{a}_i) \text{ if } d_i=1,$$

$$IMR_i = \varphi(z_i' \hat{a}_i)/[1-\Phi(z_i' \hat{a}_i)] \text{ if } d_i=0.$$

The IMR is then included as an explanatory variable in a system of equations which can be estimated using a variety of models in the second stage. Byrne et al (1996) use a non-linear regression to estimate the second stage of a Heien and Wessells model to examine food away from home consumption in the US. In a study examining dairy product expenditures, Heien and Wessells (1988) use an AIDS model to estimate the second stage of the model. Saha et al (2006) state that when estimating more than one equation in the second stage of the estimation, using the Seemingly Unrelated Regression (SUR) model is appropriate because the disturbance terms of the equations may be correlated. Given that this study is not estimating a demand system, the AIDS model is not applicable, but the SUR model would be an efficient way of simultaneously estimating equations modeling milk and yogurt consumption. The Heien and Wessells approach not only solves the efficiency problem of the Heckman model but also improves results based on goodness of fit values (Heien and Wessells 1990) and is consistent (Bryne et al 1996).

3.3.2. SUR

The seemingly unrelated regression (SUR) model is a generalization of a linear regression model that is made up of multiple regression equations. Each equation has a different dependent variable and several explanatory variables which could be the same or different for the various equations. Although each equation could be estimated independently, it is more efficient to estimate them as a system (Greene 2003 pg.342) as the error terms of the equations are assumed to be correlated.

If there are m equations:

$$Y_i = X_i\beta_i + \varepsilon_i,\ i = 1,\ldots,m$$

Then these equations are stacked, giving the following system:

$$\begin{bmatrix} y_1 \\ y_2 \\ \vdots \\ y_m \end{bmatrix} = \begin{bmatrix} X_1 & 0 & \cdots & 0 \\ 0 & X_2 & \cdots & 0 \\ & & \vdots & \\ 0 & 0 & \cdots & X_m \end{bmatrix} \begin{bmatrix} \beta_1 \\ \beta_2 \\ \vdots \\ \beta_m \end{bmatrix} + \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \vdots \\ \varepsilon_m \end{bmatrix} = X\beta + \varepsilon$$

A SUR will be used to do the second stage of the Heien and Wessells (1990) two-step analysis for the CCHS 2.2. The SUR will use the same explanatory variables as the first step as well as the IMR generated as part of the first step. The dependent variables will be total milk, yogurt, and cheese expenditures. While the first stage of the analysis determines the factors involved in whether or not to consume a given dairy product, the seconds stage using a SUR will determine the factors involved in how much of a given dairy product is consumed. Consumer specific internal factors were identified in the conceptual framework as impacting product choice. This analysis considers how two of these factors, demographic and health characteristics, impact dairy product choice. This analysis will therefore address the first objective of this study which is to determine how demographic and health characteristics affect milk and yogurt consumption.

3.3.3. Ordered Probit Model

An ordered probit is similar to the probit model but is used in situations where the dependant variable is ordinal rather than binary. (Verbeek 2008 pg.213)

$$y_i^* = x'_i\beta + \varepsilon_i$$

$$y_i = j \text{ if } \gamma_{j-1} < y_i^* \leq \gamma_j$$

We observe individual i's choice y_i if their actual y^*, which is a function of their characteristics and a set of parameters, falls within a designated range. This model assumes a standard normal distribution. So, in this study, the ordinal frequency of milk or yogurt consumption could fall into one of six ranges which would give a y_i of 1 to 6. Therefore the frequency with which individual i

consumes milk or yogurt is modeled as a function of demographic and health indicator variables.

To model frequency of consumption when it is by category rather than continuously (ie: consumes milk 1 to 5 times per week as opposed to consumes 1.7 litres of milk per week), as is the case in the NDS consumption data, an ordered probit model is appropriate. Therefore, while the HW model will be used to model the level of dairy consumption in the CCHS 2.2, an ordered probit will be employed to analyze frequency of dairy consumption in the NDS, again addressing the first objective of this study which is to determine how demographic and health characteristics affect milk and yogurt choices.

3.3.4. Econometric Method Selection

3.3.4.1. CCHS 2.2 Demographic Analysis

Based on the high incidence of zero-consumption in the data set and the efficiency and consistency of the HW model for such data sets, the Heien and Wessells two-step procedure is used to analyze the consumption of dairy products in the CCHS 2.2 data for this study which will include a probit regression for the first stage and a SUR model for the second stage. The benefit of using a SUR model for the second stage is that if the equations (milk and yogurt) have the same regressors, which they will in this case, the overall efficiency of the model improves (Verbeek 2008). This analysis will generate regression coefficients, several different regression diagnostics, and marginal effects which will be used for comparisons between estimations. The dependent and explanatory variables used are listed in Tables 3.1 and 3.2.

3.3.4.2. NDS Demographic Analysis

For the first step of the consumption analysis of the NDS to be both valid and comparable to the CCHS 2.2 consumption analysis, a probit regression will be used to model demographic and health characteristics against type of dairy product most typically consumed. In the second step, an ordered probit will be used to model frequency of milk and yogurt consumption against demographic and health characteristics. This will generate regression coefficients, several

different regression diagnostics, and marginal effects which will be used for comparisons between estimations. The dependent and explanatory variables used in the NDS consumption analysis are listed in Tables 3.4, 3.5, and 3.6. Table 3.9 lists all variables used in the various steps of the different consumption analyses.

Table 3.9: Dependent and explanatory variables used in the dairy consumption analyses.

CCHS 2.2 - stage 1	CCHS 2.2 - stage 2	NDS - stage 1	NDS - stage 2
Dependent variables:			
(binary) Whether or not respondent consumed:	(continuous) Quantity respondent consumed of:	(binary) Whether respondent typically consumes:	(ordinal) Frequency with which respondent consumes:
milk	milk		milk
yogurt	yogurt		yogurt
cheese	cheese		
skim milk	skim milk	skim milk	
1% milk	1% milk	1% milk	
2% milk	2% milk	2% milk	
whole milk	whole milk	whole milk	
low/non-fat yogurt	low/non-fat yogurt	low/non-fat yogurt	
whole-fat yogurt	whole-fat yogurt	whole-fat yogurt	
Explanatory variables:			
age (c)	age (c)	age (c)	age (c)
gender (d)	gender (d)	gender (d)	gender (d)
language (d)	language (d)	language (d)	language (d)
education (c)	education (c)	education (c)	education (c)
income (c)	income (c)	income (c)	income (c)
children (d)	children (d)	children (d)	children (d)
urban (d)	urban (d)	urban (d)	urban (d)
self-rated health (c)	self-rated health (c)	self-rated health (c)	self-rated health (c)
physical activity level (c)	physical activity level (c)		
smoking status (d)	smoking status (d)		
chronic health condition (d)	chronic health condition (d)		
BMI (c)	BMI (c)	BMI (c)	BMI (c)
food security status (c)	food security status (c)		

dairy other than milk (d)	dairy other than milk (d)		
dairy other than yogurt (d)	dairy other than yogurt (d)		
milk price (c)			
milk advertising (c)			
yogurt price (c)			
yogurt advertising (c)			
cheese price (c)			
cheese advertising (c)			
Maritimes region (d)	Maritimes region (d)	Maritimes region (d)	Maritimes region (d)
Quebec region (d)	Quebec region (d)	Quebec region (d)	Quebec region (d)
Ontario region (d)	Ontario region (d)	Ontario region (d)	Ontario region (d)
Prairies region (d)	Prairies region (d)	Prairies region (d)	Prairies region (d)
British Columbia region (d)	British Columbia region (d)	British Columbia region (d)	British Columbia region (d)
	Inverse Mills Ratio (c)		
		Never consumes milk/yogurt (d)	

(c)=continuous variable, (d)=dummy variable

These explanatory variables are either demographic (age, gender, region, etc.) or health (self-rated health, smoking status, physical activity level, etc.) characteristics which have been identified in the conceptual framework as internal factors affecting product choices and are hence being included to address the first objective of this research which is to determine how demographic and health characteristics affect milk and yogurt choices. There are several health characteristics (physical activity, smoking status, and the presence of a chronic health condition) which were included in the CCHS 2.2 which were not included in the NDS. As such, not all of the health characteristic variables are consistent between analyses.

These estimations result in several outputs, including regression coefficients, regression diagnostics such as R^2, pseudo R^2, log likelihood ratio, root mean squared error (RMSE), and chi^2, as well as marginal effects which can be used to compare results between estimations.

3.4. Data source for stated preference analysis addressing second objective

Two choice experiments were included as part of the NDS in order to elicit data about individual preferences for various attributes in milk and yogurt in order to address the second objective. As outlined in the conceptual framework, there are several product factors which can affect product choice. The product factors being considered in this study are product attributes, information provided on food packaging, and price. Several attributes will be used to represent these types of product factors, thereby explaining how product factors affect overall choices and addressing the second objective. To explore whether the same attributes would be desirable for milk and yogurt, the same attributes were included for both products in the choice experiment.

Price is necessary to include in order to establish the monetary trade-off respondents are willing to make in order to obtain the other attributes. Fat content is currently one of the distinguishing factors between dairy products at the retail level, and as many consumers consider it when choosing a product (Topcu and Isik 2008), it is included as an attribute of interest in the choice experiments. In this study, fat content is the same as what is currently available for milk in the retail marketplace: skim (0% milk fat), 1% milk fat, 2% milk fat, and whole (3.25% milk fat). The fat content of yogurts currently for sale is more varied, but most fall between 0 and 3.5% fat. The other attributes are either of a functional or informational nature.

As functional foods are currently experiencing such remarkable growth, understanding how consumers would react to functional attributes (or combinations thereof) in milk or yogurt would be valuable information. The functional attributes used in this study are probiotic and vitamin-enhanced. For the vitamin-enhanced product, the levels of vitamins B_2, B_{12}, and D are increased beyond the mandatory level of fortification by 50% for milk and 100% for yogurt. There are currently no milk or yogurt products with enhanced B vitamins but there are both with additional calcium and some yogurts with additional vitamin D. In both cases, the calcium content was three times the amount the regular

product and the vitamin D content in the yogurt was doubled. As such, the vitamin B_2, B_{12}, and D content of the vitamin-enhanced yogurt in the choice experiment was doubled. The vitamin content of the vitamin-enhanced milk was only increased by 50% for the choice experiment rather than by 100% to avoid getting too close to the tolerable upper intake limits of the vitamins in question. For more information about the vitamin content of the products in the choice experiment, please see Table 6.2. Please note that according to current regulations, fluid milk in Canada must be fortified with vitamin D and fluid milk which has been skimmed (skim, 1%, and 2%) must be fortified with vitamin A. The values shown for regular milk reflect the current regulations. The probiotic attribute is simply whether or not the product contains a probiotic. There are currently many probiotic yogurts available at most grocery stores and a small number of probiotic milks available at some health food stores in Canada. Given the considerable growth of probiotic yogurts in recent years (Granato et al 2008), eliciting values for a probiotic milk product seems appropriate.

As consumers become more health conscious, they may seek out additional information when purchasing products, therefore potentially putting a premium on products whose labels provide more than the required amount of information. The informational attributes used in this study are a voluntary nutrition facts panel (provides information on more than the required nutrients) and a Health Check™ symbol. Nutrition information panels have been mandatory in Canada since 2005, but the only micronutrients that must be included are vitamin A, vitamin C, calcium, and iron. Some companies choose to include information about how much of other vitamins and minerals their product contains. In the case of dairy products, many yogurts have information about how much vitamin B_2, B_{12}, and D they contain in addition to several minerals, but most milk containers do not. This possibly suggests to the consumer that reads labels that yogurt is richer in micronutrients than milk. The Health Check™ symbol is widely used on food products in Canada, and is intended to serve as an indicator of a healthy choice. Most plain milk (other than whole milk) and some yogurts would qualify for a Health Check™ symbol (Heart & Stroke Foundation, 2011). It should be noted

that in the choice experiment, the Health Check™ symbol was only shown on products which would actually qualify for it. For more information on nutritional requirements to qualify for a Health Check™ symbol, please see Table 6.1.

3.4.1. Section V of NDS: Stated Preference Experimental Design

There are several types of stated preference experiments which are typically used to estimate values for goods or attributes which are not available in the marketplace. Choice experiments are a type of stated preference experiment, and offer the respondent alternative bundles of attributes to choose between, typically with different costs associated with each option. Two choice experiments (one for milk and one for yogurt) were included in the NDS in order to address the second objective of determining how product attributes affect intended consumption behaviour. The design of the choice experiments is now described.

For each question, the respondent will have a choice set of two products to choose between, as well as a no participation option, as suggested by the literature reviewed in chapter 2. There are a total of 32 milk choice sets and 32 yogurt choice sets which were based on a fractional factorial design generated by SAS, all of which are shown as the product package's front and back images with the attribute levels included as part of the food packaging. Each respondent is given four milk choice sets and four yogurt choice sets to complete, so boredom and fatigue are unlikely to be an issue. For each product, there are six attributes shown, which are price, fat content, probiotic content, vitamin enhancement, voluntary nutrition facts panel, and a Health Check™ symbol. By including different types of attributes, differences and similarities between WTP for functional attributes vs. information attributes, as well as differences and similarities between the same attributes in milk vs. yogurt can be compared.

Price levels for the milk choice sets (for a 2L carton) are $3.50, $4.00, $4.50, and $5.00, for the yogurt choice sets (for an 8 x 100g package) price levels are $4.50, $5.50, $6.50, $7.50. For both cases, levels for fat content are 0% (skim), 1%, 2%, and 3.25% (whole), and levels for probiotics, vitamin-enhanced, and the Health Check™ symbol are yes or no. In an effort to avoid impossible scenarios,

only products that could actually qualify for a Heart & Stroke Foundation Health Check™ symbol are shown with one in the choice experiment (Heart & Stroke Foundation, 2011). Table 3.10 shows the criteria for milk and yogurt to qualify for a Health Check™ symbol. Table 3.11 shows the levels of vitamins in the regular and enhanced products. Table 3.12 shows the attributes and levels used in the choice experiment.

Table 3.10: Criteria for milk and yogurt to bear a Health Check™ symbol on the package (Heart and Stroke Foundation, 2010)

Milk (per 250mL)	**Yogurt (per 175g)**
2% milk fat or less	2% milk fat or less
Minimum 25% of daily calcium	Minimum 15% of daily calcium
240mg or less of sodium	140mg or less of sodium
No added sugar	No added sugar

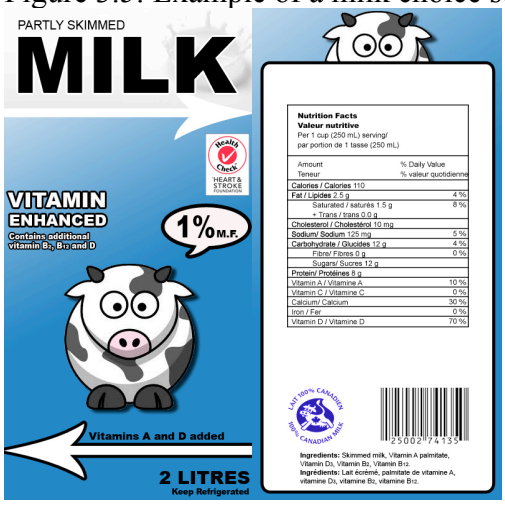
Table 3.11: Vitamin content of products shown in choice experiments. (%DV = percent daily value)

	Milk - regular	Milk - enhanced	Yogurt - regular	Yogurt - enhanced
Vitamin D	45% DV	70% DV	15% DV	30% DV
Vitamin B2	35% DV	50% DV	10% DV	20% DV
Vitamin B12	50% DV	75% DV	20% DV	40% DV

Table 3.12: Experimental Design for Choice Experiment.

Price (milk)	Price (yogurt)	Fat content	Nutrition label	Health Check™	Probiotic	Vitamin enhanced
$3.50	$4.50	0% (skim)	Mandatory	No	No	No
$4.00	$5.50	1%	Voluntary	Yes	Yes	Yes
$4.50	$6.50	2%				
$5.00	$7.50	3.25% (whole)				

Figure 3.5: Example of a milk choice set from the NDS.



Price: $3.50

A) I would choose this option.

☐

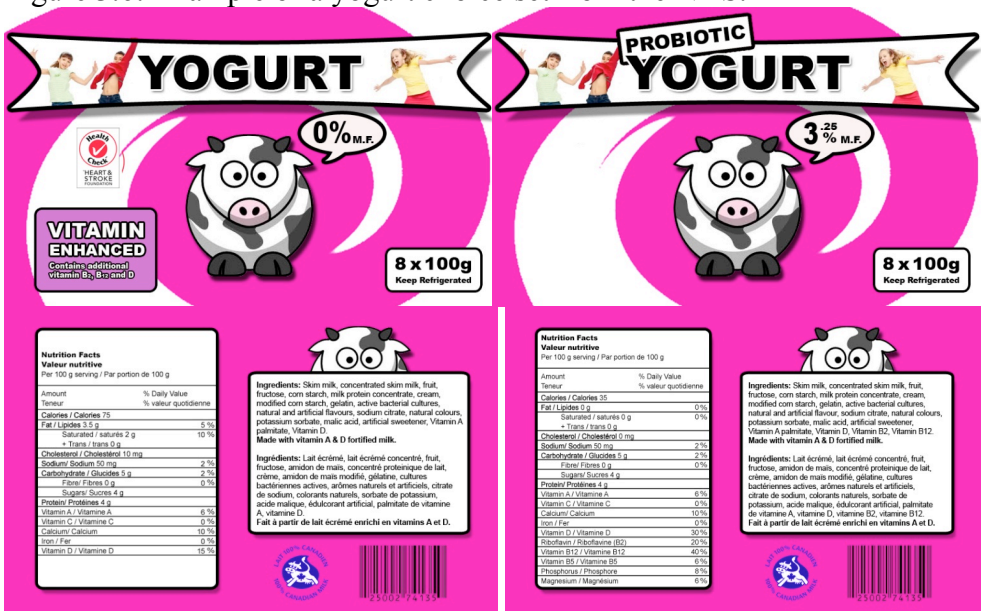
Price: $5.00

B) I would choose this option

☐

C) I would choose neither option. ☐

Figure 3.6: Example of a yogurt choice set from the NDS.



Price: $7.50

A) I would choose this option.

☐

Price: $6.50

B) I would choose this option

☐

C) I would choose neither option. ☐

3.5. Analysis of Choice Experiment Data

3.5.1. RUM

The theory behind choice experiment analysis is the random utility model (RUM) (Verbeek 2008 pg.220-223). Random utility theory is used to elicit non-market valuations for attributes which cannot be purchased independently of each other. It builds on Lancaster's (1966) theory which considers goods to be bundles of attributes rather than homogeneous. The main assumption of the RUM is that each respondent will select the option from the set of alternatives that gives them the most utility. The attributes of which the chosen alternative is comprised determines the utility derived from the given option. This utility can be expressed as:

$$U_j = U(X_j)$$

where X is the vector of attributes in an alternative. Alternative j will be chosen if $U_j > U_i$ for all $j \neq i$. The researcher will have information about the attributes (X) and some information about the respondent's (n) characteristics (A_n). The researcher will not, however, have complete knowledge of the individual's decision-making process. The systematic utility (V_j) will be expressed as:

$$V_{nj} = V(X_j, A_n)$$

where $(U_{nj} \neq V_{nj})$. Therefore, utility must be distilled down to a systematic component (V_{nj}) and a random component (ε_{nj}) which is expressed as:

$$U_{nj} = V(X_j, A_n) + \varepsilon_{nj}$$

3.5.2. Multinomial logit model

The above random utility estimation can be conducted using a multinomial logit model where utility from the n^{th} individual facing a choice among j alternatives can be represented as (Verbeek 2008 pg.221):

$$U_{nj} = \beta'_n V_{nj} + \varepsilon_{nj}$$

where β_n is a vector of parameters and V_{nj} is the systematic portion of the individual's utility function. ε_{nj} is the error term.

The most general form of the multinomial logit probability is (Greene 2007 pg. N3-18):

$$P(j|y_i) = \frac{exp\,(\alpha_{ji} + \Theta'_i z_i + \Phi'_i f_{ji} + \beta'_{ji} x_{ji})}{\Sigma_{j=1}^{J}\, exp\,(\alpha_{ji} + \Theta'_i z_i + \Phi'_i f_{ji} + \beta'_{ji} x_{ji})}$$

Where $U(j,i) = \alpha_{ji} + \Theta'_i z_i + \Phi'_i f_{ji} + \beta'_{ji} x_{ji}$, $j=1,\ldots,J_i$ alternatives in individual *i*'s choice set,

α_{ji} is an alternative specific constant which may be fixed or random, $\alpha_{ji} = 0$,

Θ_j is a vector of nonrandom (fixed) coefficients, $\theta'_i = 0$,

ϕ_j is a vector of nonrandom (fixed) coefficients,

β_{ji} is a coefficient vector that is randomly distributed across individuals;

v_i enters β_{ji},

z_i is a set of choice invariant individual characteristics such as age or income,

f_{ji} is a vector of *M* individual and choice varying attributes of choices, multiplied by ϕ_j,

x_{ji} is a vector of *L* individual and choice varying attributes of choices, multiplied by β_{ji}.

3.5.3. Mixed Logit Model

In some cases, a mixed logit model is used rather than a multinomial logit model as it can sometimes describe the unobserved heterogeneity in a data set. In a mixed logit model, the choice specific constants are randomly distributed across individuals. For further detail about the mixed logit model, see Greene (2007 pg.N3-18).

3.5.4. Latent Class Model

In a latent class logit model, parameter heterogeneity across individuals is modeled with a discrete distribution, otherwise known as a set of classes. Every respondent belongs to a latent class (of which there is a fixed number *C*), which is unknown to the researcher. Estimates are for the class specific parameters and for

each individual. A set of probabilities are defined for the classes. Individual *i*'s choice among *J* alternatives at choice situation *t* given that individual *i* belongs to class *c* is the one with the most utility. For further detail about the latent class model, see Greene (2007 pg. N3-20).

3.5.5. Choice Experiment Analysis

A multinomial logit model run on the choice experiment data will be used to estimate the parameters characterizing the relationships between the product attributes and the respondent characteristics. Under certain conditions, the multinomial logit model provides consistent, efficient, and asymptotically normal estimators (Verbeek 2008). It can also be used to model observed heterogeneity through the use of interaction variables. The one drawback of this model is that it implies that the utility levels of any two alternatives are independent, which may not be the case (Verbeek 2008).

The estimated coefficients are used to identify general trends in the desirability of the various attributes and relationships between the attributes and individual respondents' characteristics. For example, if the coefficient for the age/probiotic interaction in the milk regression were negative, it would imply that younger individuals are more likely to purchase probiotic milk.

The estimated parameters from the multinomial logit model will then be used to calculate respondents' willingness to pay for the attributes in question. The second objective of this research is to determine how various combinations of product attributes, identified in the conceptual framework as factors affecting product choices, affect intended consumption of milk and yogurt. By generating WTP values for the attributes in question, consumer preferences for various attributes can be identified and compared, thereby addressing the second objective.

According to Alpizar et al (2001) (pg.30), assuming a linear utility function, the marginal rate of substitution between two different attributes is the ratio of the coefficients of the two attributes, so marginal WTP is calculated as follows:

$$MWTP_x = -\beta_x / \beta_p$$

where β_x is the estimated coefficient for attribute *x* and β_p is the estimated price coefficient.

When estimating a regression with interacted variables, the interaction coefficients must also be included in WTP calculations. To incorporate the interacted variables in calculating mean WTPs, the coefficients for all the interactions are first multiplied by the sample means of the characteristic in question to generate a value *v* (ie: *v*(probiotic/age) = β(probiotic/age) x mean age). Next, all of the coefficient times mean values for attribute *x* are summed along with the coefficient for attribute *x* (ie: βprobiotic + *v*(probiotic/age) + *v*(probiotic/gender) + …) to generate an overall coefficient for that attribute (as is done to calculate Hanemann's (1989) grand constant). The negative of the overall attribute coefficient is then divided by the price coefficient to get the mean WTP.

$$\text{Mean WTP}_x = -[\beta_x + \mathbf{\Sigma}\ \beta_{xi}(i)] / [\beta_p]$$

where β_{xi} is the estimated coefficient for the interaction between attribute *x* and characteristic *i*, β_x is the estimated coefficient for attribute *x*, β_p is the estimated price coefficient, *x* is the attribute, and *i* is the sample mean of the characteristic.

In order to better understand the distributions of WTP through the sample population, WTP for each attribute is calculated at actual demographic levels for each respondent. (To calculate the individual level WTP, *i* becomes each individual's value for characteristic *i* instead of the sample mean.) The individual WTPs are then sorted into groups by value range to determine frequencies, and finally illustrated in graphs. By evaluating individual WTPs in addition to the mean WTPs, it becomes clear which attributes have similar WTPs across respondents and which ones have large differences across respondents. It is important to determine which attributes have segments of the population who see them differently as this may have implications in market applications. In addition, although the purpose of this portion of analysis is to address the second objective, by examining individual WTPs, the first objective of determining how demographic characteristics affect milk and yogurt consumption will also be addressed.

3.6. Descriptive Statistics

Descriptive statistics for both data sets are discussed in the following section. For complete numerical information on both data sets and the Canadian 2001 and 2006 census (Statistics Canada 2001, Statistics Canada 2006), please see Table 3.13.

3.6.1. Micronutrient intake

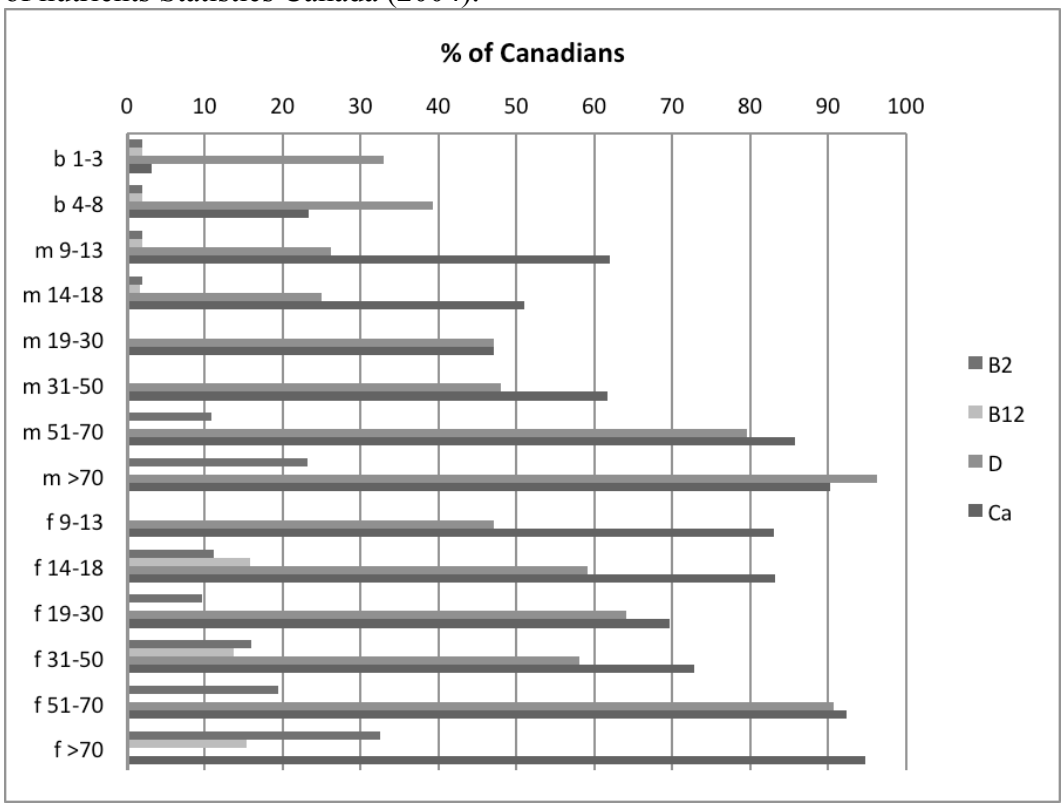
One of the concerns highlighted in the previous chapter associated with declining dairy consumption is the potential for micronutrient deficiencies in the Canadian population which could result in other health complications. As such, the first step in the analysis of the CCHS 2.2 dietary recall data was to compare actual intake of calcium and vitamins B_2, B_{12}, and D from the diet with recommended intakes in order to determine whether micronutrient consumption is in fact a public health concern. As the CCHS 2.2 was conducted in 2004, recommended nutrient intakes from 2004 were also used for the comparison. It should be noted that Health Canada has subsequently adjusted the recommended intakes of calcium and vitamin D in 2010, and the current recommended values are higher than they were in 2004.

Figure 3.3 shows that while there are large percentages of many population groups consuming inadequate amounts of calcium and vitamin D, there are also some groups with lower than adequate B vitamin consumption. Women over the age of 14 and men over the age of 50 have at least 10% of individuals consuming inadequate levels of vitamin B_2 and about 15% of women over the age of 14 are consuming inadequate levels of vitamin B_{12}. (While the data for the women aged 19-30 and 51-70 was not statistically significant and therefore not included in the graph, mean intakes and 5^{th} and 95^{th} percentile intakes were very similar to the statistically significant groups which had about 15% incidence of inadequate B_{12} intake.)

This data includes nutrients obtained from all food sources, not only from dairy products since the nutrients are available from a number of sources. However, if there is a public health desire to increase the intake of these under-consumed micronutrients, then dairy products are an easy way to access them.

Figure 3.3 highlights the importance of increasing the consumption of dairy products in several population groups, which can only be achieved by understanding how consumers make decisions with regards to choosing food products as outlined in the conceptual framework, hence the objectives of determining how demographic and health characteristics as well as product attributes affect milk and yogurt choices.

Figure 3.7: Percentage of Canadians consuming less than recommended amount of nutrients Statistics Canada (2004).



3.6.2. Milk and yogurt consumption

During the 24-hour recall period of the CCHS 2.2, just over 2000 people (6%) drank milk, 7% of which drank skim milk, 15% drank 1% milk, 61% drank 2% milk, and 17% drank whole milk. These numbers are roughly consistent with what the CDIC reports on the relative levels of per capita sales with the exception of 1% milk having a higher level of consumption than whole milk. The CCHS 2.2 also recorded 53 individuals (0.2%) who had consumed yogurt during the 24 hours in

question, 57% of which ate low or non-fat yogurt and 43% of which ate whole fat yogurt. Due to the low consumption levels of milk and yogurt in the CCHS 2.2, the percentage of respondents who consume milk but not yogurt, yogurt but not milk, both yogurt and milk, and neither yogurt nor milk could be reported.

In the NDS, of the 1705 respondents, 2.4% say they do not eat dairy while 10.5% claim to never drink milk and 14.7% claim to never eat yogurt. 3% of the respondents are people who do not drink milk or eat yogurt. That works out to 11.6% people who do drink milk but do not eat yogurt and 7.4% people who do eat yogurt but do not drink milk. Of the people who did drink milk, approximately 17% of the respondents from the survey claimed to typically purchase skim milk, while 29% purchase 1% milk, 46% purchase 2% milk, and 8% purchase whole milk. Having the largest portion consuming 2% milk followed by the next largest group choosing 1% is consistent with per capita consumption data from the CDIC, but having more people purchase skim milk than whole milk is not. Since the CDIC data is not consumption but disappearance (quantity being sold at the retail level), it is possible that data on real individuals might vary. In addition, these responses do not collect any information about variety in milk consumption or about milk used in cooking vs. as a beverage. Of the respondents who do eat yogurt, around 76% of them claim to purchase low- or non-fat yogurts as opposed to whole-fat yogurts. This is about 23% higher than the portion of people choosing low or non-fat yogurts in the CCHS 2.2, but it is important to keep in mind that the two surveys were conducted seven years apart. About 37% of the national sample chose probiotic yogurts while 46% consume conventional yogurts and 17% are not sure which one they typically purchase.

3.6.3. Age

When compared with the 2001 census, people under 25 were over-represented in the CCHS 2.2, as were those over 75. People between the ages of 25 and 54 were under-represented in the CCHS 2.2. The NDS did not include individuals under the age of 19, so people under 25 were greatly under-

represented when compared with the 2006 census. People aged 25-34 and 45-75 were over-represented by the NDS, while people over 75 were under-represented.

3.6.4. Gender

Forty-seven percent of the CCHS 2.2 respondents were male, while according to the 2001 census 49% of Canadians are male. The 2006 census recorded the population again as 49% male, while 50% of the NDS respondents were male.

3.6.5. Children in the Household

The percentage of respondents for the CCHS 2.2 with children in the home was 34%, just slightly less than the Canadian average in 2001 which was 36%. People with children in the household were under-represented in the NDS (about 26%) when compared to the 2006 census estimate of 37%.

3.6.6. Province

Neither the CCHS 2.2 nor the NDS surveyed people living in the territories. When compared to the 2001 census, the CCHS 2.2 over-represented residents of the Maritimes, Manitoba, and Saskatchewan, while under-representing residents of Quebec, Ontario, Alberta, and British Columbia. The NDS over-represented residents of Ontario and under-represented residents of Alberta when compared to the 2006 census.

3.6.7. Education Level

When compared to the 2001 census, the CCHS 2.2 under-represented people with no high school diploma and university degrees. The CCHS 2.2 over-represented people with high-school, technical school, and college diplomas. When compared to the 2006 census, the NDS under-represented people without a high school diploma and people with a college diploma, while over-representing people with high school and technical school diplomas and people with university degrees.

3.6.8. Household Income

The CCHS 2.2 under-represented individuals with a household income of $80,000 or more, but otherwise had good representation when compared to the 2001 census. When compared to the 2006 census, the NDS under-represented individuals with a household income of less than $15,000 and slightly over-represented individuals with a household income of $40,000 to $80,000.

Table 3.13: Descriptive statistics from both data sets and Canadian census.

		2001 census	CCHS 2.2 (2004)	2006 census	NDS (2011)
Age	under 25	32.44	48.34	31.00	4.40
	25-34	13.31	7.96	12.67	15.84
	35-44	17.00	7.75	15.24	15.31
	45-54	14.73	10.12	15.75	24.99
	55-64	9.56	9.02	11.62	25.40
	65-75	7.14	7.82	7.24	11.67
	75 +	5.82	9.00	6.47	2.40
Gender	Male	49.01	47.09	48.95	50.32
	Female	50.99	52.91	51.05	49.68
Children in household	Yes	36.23	34.06	37.27	26.45
	No	63.77	65.94	62.73	73.55
Province	Newfoundland	0.51	4.94	1.60	1.70
	P.E.I	0.45	4.07	0.43	0.12
	Nova Scotia	3.03	4.86	2.89	2.35
	New Brunswick	2.43	4.65	2.31	1.64
	Quebec	24.12	13.62	23.87	22.11
	Ontario	38.02	31.11	38.47	43.40
	Manitoba	3.73	11.95	3.63	3.70
	Saskatchewan	3.26	5.81	3.06	2.99
	Alberta	9.91	8.61	10.41	7.74
	British Columbia	13.02	10.39	13.01	14.25
	Yukon Territories	0.10	-	0.10	-
	Northwest Territories	0.12	-	0.13	-
	Nunavut	0.09	-	0.09	-
Education level	No high school diploma	22.70	16.58	15.44	0.84
	High school diploma	23.93	30.74	23.91	30.28
	Tech. school or apprenticeship	12.88	15.36	12.40	17.12
	College graduate	17.91	19.47	20.33	17.47

	University graduate	22.57	17.85	27.92	34.29
Income	less than $15,000	10.71	9.94	9.42	6.51
	$15,000 to $29,999	16.73	18.49	16.31	14.08
	$30,000 to $39,999	10.29	11.89	10.97	10.85
	$40,000 to $49,999	10.00	10.58	9.93	11.44
	$50,000 to $59,999	9.02	10.28	8.80	11.03
	$60,000 to $79,999	14.96	15.75	14.72	17.89
	$80,000 or more	28.30	23.07	29.85	28.21

3.7. Summary

In this chapter, the methods to be used for the empirical analysis of this study were described. In order to address the first objective, the CCHS 2.2 data will be analyzed using the Heien and Wessells (1990) two step procedure to explain both the factors affecting whether or not individuals consume milk or yogurt as well as the factors affecting how much milk and yogurt people consume. Given the somewhat different format, the NDS data will be analyzed using both a probit model for product choice and an ordered probit model for consumption frequency, also addressing the first objective. In order to address the second objective of this study, a multinomial logit model is used to analyze the stated preference data, and WTP will subsequently be calculated from the estimated parameters. These analyses are found in the following chapters. Chapter 4 focuses on the analysis of the CCHS 2.2 data addressing the first objective. Chapter 5 focuses on the analysis of the NDS data addressing the first objective. Chapter 6 focuses on the analysis of the stated preference data from the NDS addressing the second objective.

Chapter 4: CCHS 2.2 Consumption Analysis

4.1. Introduction

One of the objectives of this study is to determine how demographic and health characteristics (identified as internal factors affecting product choice in the conceptual framework) play a role in milk and yogurt consumption among Canadians. In order to address this objective, data collected by Statistics Canada in "The Canadian Community Health Survey (CCHS) Cycle 2.2 (2004) Nutrition: General Health File (including vitamin and mineral supplements) and 24-Hour Dietary Recall" (Statistics Canada 2004) is analyzed. Despite the fact that this data set is somewhat dated and has some representation issues, it is the only national level data set since 1969 that includes dietary intakes. In the analysis of this data, the effects of several socio-demographic and health status characteristics on milk, yogurt, and cheese consumption are examined. The same analysis is then performed for the groups previously identified as at-risk for low dairy consumption (adolescents and older women) to determine if there are any important differences between these groups and the population as a whole.

In this section the data setup is explained and descriptive statistics are provided. The model specifications and econometric methods are then described. The results of the whole sample analysis are followed by the analysis on adolescents and older women. Finally, a comparison of the results by group and a summary conclude this chapter.

4.2. Data Setup and Descriptive Statistics

This section analyzes the individual level data collected by Statistics Canada through "The Canadian Community Health Survey (CCHS) Cycle 2.2 (2004) Nutrition: General Health File (including vitamin and mineral supplements) and 24-Hour Dietary Recall" (Statistics Canada, 2004). For a demographic description of this data, refer to chapter 3.

The data was recoded as necessary in SPSS version 17 (for example, adjusting provincial codes to regional dummies, gender codes to gender dummies, birth year to

age in years, and rescaling income into thousands and advertising dollars into millions) and compiled into one file containing all the demographic and health characteristics in addition to the total amounts of the various dairy products consumed (in grams) during the 24-hour period in question. Retail prices (from the CDIC 2011) and advertising expenditures (from Nielsen 2009) in 2004 were also added to the data file. The analysis was then performed using STATA version 10.

The analysis was performed on both aggregate dairy categories (milk, yogurt, and cheese) as well as on disaggregated categories (skim milk, 1% milk, 2% milk, whole milk, low/non-fat yogurt, and whole-fat yogurt) to determine if there were differences in characteristics between different products (milk vs. yogurt) in addition to determining differences between varying types of the same product (skim milk vs. 2% milk). Analysis was initially done on the whole sample, then on adolescents (aged 13-19 years old) of both genders, and women over 50. Due to the low incidence of non-zero consumption, analysis on yogurt by category (low/non-fat and whole-fat) was not possible for the older women group.

Table 4.1: Quarterly average retail milk prices ($/2L carton) by province in 2004.

Province	1st quarter	2nd quarter	3rd quarter	4th quarter	2004 average
NL	3.12	3.18	3.23	3.23	3.19
PE	2.81	2.87	2.87	2.87	2.86
NS	3.23	3.27	3.27	3.27	3.26
NB	3.07	3.10	3.10	3.10	3.09
QC	2.64	2.68	2.67	2.68	2.67
ON	3.41	3.44	3.44	3.45	3.43
MB	2.02	2.01	2.04	2.03	2.03
SK	1.93	1.95	1.93	1.96	1.94
AB	1.92	1.96	1.94	1.98	1.95
BC	2.51	2.48	2.46	2.49	2.49
Average	2.67	2.69	2.70	2.71	2.69

Table 4.2: Quarterly average retail yogurt prices ($/500g) by province in 2004.

Province	1st quarter	2nd quarter	3rd quarter	4th quarter	2004 average
NL	1.94	1.96	1.95	1.96	1.95
PE	1.94	1.99	2.02	2.01	1.99
NS	1.84	2.01	1.98	1.97	1.95
NB	1.95	2.08	2.03	2.00	2.02
QC	2.00	2.10	2.03	1.97	2.02
ON	1.83	1.81	1.82	1.89	1.84
MB	1.56	1.63	1.59	1.63	1.60
SK	1.57	1.63	1.59	1.64	1.61
AB	1.61	1.60	1.63	1.65	1.62
BC	1.84	1.82	1.79	1.82	1.82
Average	1.81	1.86	1.84	1.85	1.84

Table 4.3: Average retail cheese prices ($/kg) by region in 2004.

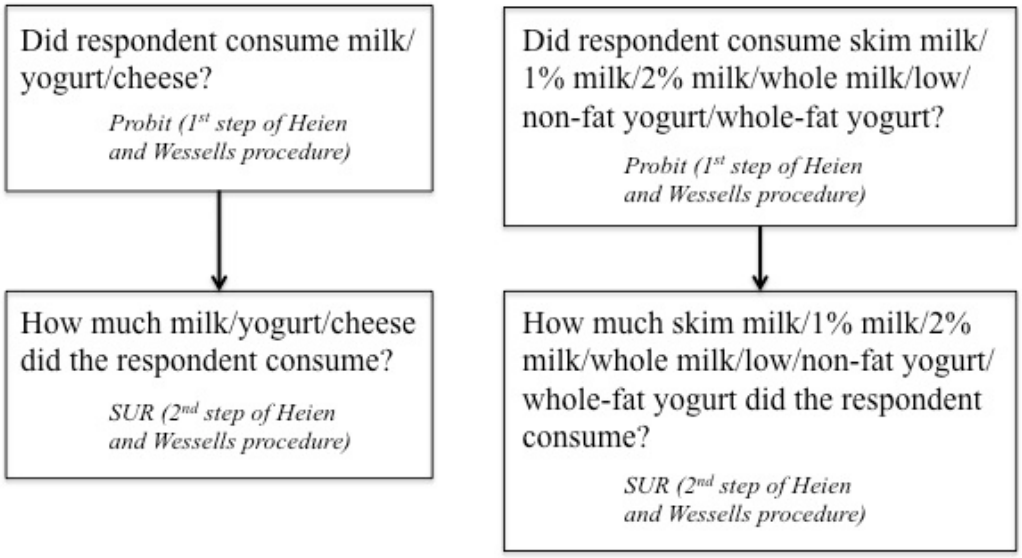
Region	2004 Price
Maritimes	10.79
QC	12.00
ON	11.04
Prairies	10.77
BC	12.02
Canada	11.34

Table 4.4: Spending on advertising for milk, yogurt, and cheese in Canada 2004 by province (in millions of $)

Region	Milk 2004	Yogurt 2004	Cheese 2004
Maritimes	20.134	18.088	18.636
QC	20.043	18.088	18.499
ON	20.695	18.089	18.636
MB	20.695	18.088	18.636
SK	20.695	18.088	18.636
AB	20.695	18.088	18.636
BC	20.695	18.088	18.636

4.3. Methods and Model Specification

Figure 4.1: Outline of process used for analysis of CCHS 2.2 data



The analysis of the CCHS 2.2 24-hour dietary recall data was done following the Heien and Wessells (1990) two-step procedure to describe expenditures on milk and yogurt. This analysis was performed on both aggregated (milk and yogurt) and disaggregated (skim milk, 1% milk, 2% milk, whole milk, low/non-fat yogurt, and full-fat yogurt) data. This model is specified with two stages – the first stage explains the binary decision of intake or no intake, the second regression distinguishes the level of intake. This two-stage process is necessary for two reasons. The first is that the data has a very high level of zero consumption observations, and a two-stage estimation is an appropriate way of dealing with this problem (Heien and Wessells 1990). The second reason is that the factors involved in whether or not to consume a food are not necessarily the same as the factors involved in how much of a food to consume and vice versa. For more information about the specification of this analysis, refer to chapter 3.

Prices for milk and yogurt were coded by province and quarter from retail price data, then multiplied by consumption quantity to generate expenditure. A demand function is commonly expressed as the quantity demanded as a function of price and other factors (Deaton and Muellbauer 1980 pg.19):

$q_i = g_i(x,p)$

which becomes

$q_i = g_i*(x)$

if prices are absorbed into the functional form. This is commonly known as the Engel curve. This equation can be multiplied by price (p_i) to give expenditures ($p_i q_i$) as functions of x, also considered an Engel curve (Deaton and Muellbauer 1980), which is what was done in this case. Advertising expenditures were also included by province using data from Neilsen (2005). Unfortunately, regional prices by quarter were the only retail prices available for this analysis. Individual prices would have been preferable as they would have created some variability in household prices, but with the available data, the prices only vary between provinces.

The econometric model for the aggregated categories was therefore as follows, with only the portion in brackets included in the second step of the analysis:

$$emilk = \beta_0 + \beta_1 age + \beta_2 sex + \beta_3 lang + \beta_4 ed + \beta_5 inc + \beta_6 child + \beta_7 urban + \beta_8 SRH + \beta_9 PA + \beta_{10} SS + \beta_{11} CHC + \beta_{12} BMI + \beta_{13} FSS + \beta_{14} otmilk + \beta_{15} MPrice + \beta_{16} MAd + \beta_{17} YPrice + \beta_{18} YAd + \beta_{19} CPrice + \beta_{20} CAd + \beta_{21} provMAR + \beta_{22} provQC + \beta_{23} provON + \beta_{24} provPRA + \beta_{25} provBC (+\beta_{26} IMRm)$$

$$eyog = \beta_0 + \beta_1 age + \beta_2 sex + \beta_3 lang + \beta_4 ed + \beta_5 inc + \beta_6 child + \beta_7 urban + \beta_8 SRH + \beta_9 PA + \beta_{10} SS + \beta_{11} CHC + \beta_{12} BMI + \beta_{13} FSS + \beta_{14} otyog + \beta_{15} MPrice + \beta_{16} MAd + \beta_{17} YPrice + \beta_{18} YAd + \beta_{19} CPrice + \beta_{20} CAd + \beta_{21} provMAR + \beta_{22} provQC + \beta_{23} provON + \beta_{24} provPRA + \beta_{25} provBC (+\beta_{26} IMRy)$$

$$echs = \beta_0 + \beta_1 age + \beta_2 sex + \beta_3 lang + \beta_4 ed + \beta_5 inc + \beta_6 child + \beta_7 urban + \beta_8 SRH + \beta_9 PA + \beta_{10} SS + \beta_{11} CHC + \beta_{12} BMI + \beta_{13} FSS + \beta_{15} MPrice + \beta_{16} MAd + \beta_{17} YPrice + \beta_{18} YAd + \beta_{19} CPrice + \beta_{20} CAd + \beta_{21} provMAR + \beta_{22} provQC + \beta_{23} provON + \beta_{24} provPRA + \beta_{25} provBC (+\beta_{26} IMRc)$$

The econometric model for the disaggregated categories did not include the price and advertising data or the 'other dairy' dummies but was otherwise the same as for the aggregated categories. The model was identical for each product and is shown below, with the portion in brackets only included in the second step of the analysis:

$$y_x = \beta_0 + \beta_1 age + \beta_2 sex + \beta_3 lang + \beta_4 ed + \beta_5 inc + \beta_6 child + \beta_7 urban + \beta_8 SRH + \beta_9 PA + \beta_{10} SS + \beta_{11} CHC + \beta_{12} BMI + \beta_{13} FSS + \beta_{14} provMAR + \beta_{15} provQC + \beta_{16} provON + \beta_{17} provPRA + \beta_{18} provBC\ (+\beta_{19} IMRx)$$

where y_x is the total amount of product x consumed and $IMRx$ is the IMR generated from the first step in the analysis of product x. The IMR incorporates the censoring latent variables from the participation step into a single variable to be used in the expenditure step (Heien and Wessells 1990). The limitation of this is that the same explanatory variables have gone into the model which generated the IMR that are being used as the explanatory variables in the second stage along with the IMR causing potential redundancy.

4.4. Results

For the purposes of consistency and comparison between groups, the same explanatory variables are used in the regressions for all 3 groups rather than just maintaining the significant variables for each group which would result in less comparable estimates.

4.4.2. Estimation Results – Whole Sample

Only coefficients or marginal effects with statistical significance at a level of 10% or lower are discussed. For detailed numerical results, see Tables 4.5 to 4.9. Results from the first-step analysis of the aggregated data showed that households with children, lower incomes, non-smokers, lower self-rated health status, and lower physical activity levels were more likely to purchase milk. There was also evidence of substitution between milk and other dairy products as people who did consume other dairy products were less likely to consume milk. People who lived in urban areas and who had lower self-rated health were more likely to purchase yogurt. Younger individuals, those with a higher income, and those with higher self-rated health were more likely to eat cheese. The second-step analysis showed that younger individuals, individuals without children in the household, and individuals with higher levels of physical activity consumed more milk. Men, people with less education, higher self-rated health, and lower BMI consumed more yogurt. Older people, men, people with lower self-rated health

and individuals with higher levels of physical activity ate more cheese. What this implies is that milk consumers and yogurt consumers may not be the same people and that people who drink milk (yogurt, cheese) more frequently differ from people who drink more milk (yogurt, cheese) in volume.

The disaggregated data (by fat content) revealed some other trends. Results from the first-step analysis showed that women, people whose first language is English, people from the Maritimes, and people from the Prairies were more likely to purchase skim milk. Younger people, people with kids in the house, people with higher income, people whose first language is English, people from the Maritimes, and non-smokers were more likely to purchase 1% milk. Individuals who live in a rural area, have kids in the house, have less education, or live in the Maritimes were more likely to purchase 2% milk. Younger people, people living in urban areas, people with kids in the home, people with lower income, higher BMI, and lower levels of physical activity were more likely to purchase whole milk. People from BC were less likely to purchase whole milk. Individuals whose preferred language is French and non-smokers were more likely to purchase low or non-fat yogurt while people from Quebec are less likely to. People with children in the house or whose first language is English were more likely to purchase full-fat yogurt.

The second stage of the disaggregated data analysis indicated that men, people whose first language is English, smokers, and people with a lower BMI consumed more skim milk. Men, individuals without kids in the house, and people with lower incomes consumed more 1% milk while people from the Maritimes consumed less 1% milk. Younger people, men, people living in urban areas, people whose preferred language is French, people living with a chronic health condition, and people with higher levels of physical activity consumed more 2% milk while people living in the Maritimes and Quebec consume less of it. Women, people living in rural areas, people without kids in the home, individuals with higher income, people with higher self-rated health, and individuals with higher levels of physical activity consumed more whole milk. People whose preferred language is English, people with a higher BMI, and people from Quebec

consume more low or non-fat yogurt. Men, people whose preferred language is French, smokers, and people with a lower BMI consume more full-fat yogurt.

These results indicate that the type of milk or yogurt product chosen is a factor of age, region, income, preferred language, whether or not there are children in the house, and several health indicators including self-rated health, smoking status, and level of physical activity. How much a person consumes of milk or yogurt is also affected by these factors in addition to gender, which appears to play a major role. Overall, these results indicate that milk and yogurt consumers are not the same people and that consumers of individual dairy products fall into different demographic categories.

All probit regressions were tested for heteroscedasticity. The chi-squared values were large enough to reject the null hypothesis of homoscedasticity for both the 2% and whole milk regressions.

Table 4.5: First-step probit estimates and marginal effects for factors affecting whether or not respondents consume milk, yogurt, and cheese - whole sample, aggregated groups, CCHS2.2

Variables	milk	yogurt	cheese	milk ME's	yogurt ME's	cheese ME's
milk price	-0.303	1.928*	0.176	-0.041	0.019*	0.011
	(0.309)	(1.150)	(0.443)	(0.041)	(0.011)	(0.027)
yogurt price	-1.147	8.087	0.126	-0.153	0.078	0.008
	(2.145)	(6.641)	(2.999)	(0.287)	(0.064)	(0.184)
cheese price	-0.369	1.796*	0.255	-0.049	0.017*	0.016
	(0.291)	(1.089)	(0.416)	(0.039)	(0.010)	(0.026)
milk advertising	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
yogurt advertising	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)
	---	---	---	---	---	---
cheese advertising	0.000	0.000*	0.000	0.000	0.000*	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
other dairy dummy	-0.222***	-0.104	(omitted)	-0.025***	-0.001	(omitted)
	(0.080)	(0.117)	---	(0.008)	(0.001)	---
age	0.000	-0.003	-0.008***	0.000	0.000	-0.000***

	(0.001)	(0.002)	(0.001)	(0.000)	(0.000)	(0.000)
gender dummy	-0.036	0.100	0.014	-0.005	0.001	0.001
	(0.022)	(0.063)	(0.030)	(0.003)	(0.001)	(0.002)
urban dummy	-0.012	0.201**	-0.032	-0.002	0.002**	-0.002
	(0.027)	(0.091)	(0.037)	(0.004)	(0.001)	(0.002)
children dummy	0.109***	0.041	-0.010	0.015***	0.000	-0.001
	(0.037)	(0.105)	(0.048)	(0.005)	(0.001)	(0.003)
education	-0.004	0.020	0.005	0.000	0.000	0.000
	(0.004)	(0.012)	(0.006)	(0.001)	(0.000)	(0.000)
income	-0.001*	0.002	0.001*	-0.000*	0.000	0.000*
	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)
language dummy	-0.006	0.142	-0.053	-0.001	0.002	-0.003
	(0.066)	(0.183)	(0.093)	(0.009)	(0.002)	(0.005)
food security status	-0.006	-0.052	0.024	-0.001	0.000	0.001
	(0.017)	(0.075)	(0.021)	(0.002)	(0.001)	(0.001)
provMAR dummy	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)
	---	---	---	---	---	---
provQC dummy	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)
	---	---	---	---	---	---
provON dummy	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)
	---	---	---	---	---	---
provPRA dummy	-0.810	4.590	0.322	-0.084	0.739	0.023
	(0.865)	(2.967)	(1.223)	(0.071)	(0.706)	(0.102)
provBC dummy	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)
	---	---	---	---	---	---
CHC dummy	0.032	0.043	0.002	0.004	0.000	0.000
	(0.027)	(0.076)	(0.037)	(0.004)	(0.001)	(0.002)
smoking dummy	-0.059*	-0.068	-0.052	-0.008*	-0.001	-0.003
	(0.031)	(0.101)	(0.042)	(0.004)	(0.001)	(0.003)
SR health status	-0.028**	-0.142***	0.032**	-0.004***	-0.001***	0.002**
	(0.011)	(0.037)	(0.016)	(0.002)	(0.000)	(0.001)
Physical activity	-0.022*	0.053	-0.021	-0.003*	0.001	-0.001
	(0.012)	(0.033)	(0.016)	(0.002)	(0.000)	(0.001)

BMI	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
constant	39.850	-253.161*	-20.818	---	---	---
	(42.840)	(149.370)	(60.902)	---	---	---
Pseudo R^2	0.0085	0.0372	0.0157	0.0080	0.0367	0.0157
Log likelihood	-7760.134	-792.138	-3861.232	-7764.289	-792.553	-3861.232

Table 4.6: First-step probit estimates for factors affecting milk and yogurt type consumed - whole sample, disaggregated groups, CCHS2.2

Variables	skim milk	1% milk	2% milk	whole milk	yogurt <2%	yogurt >2%
age	-0.003	-0.007***	0.009***	-0.130***	-0.006	-0.011
	(0.002)	(0.002)	(0.001)	(0.027)	(0.004)	(0.009)
gender dummy	0.157***	0.066	-0.005	-0.026	0.022	0.160
	(0.061)	(0.047)	(0.012)	(0.045)	(0.124)	(0.145)
urban dummy	-0.001	0.037	-0.053***	0.155**	0.020	0.046
	(0.073)	(0.059)	(0.016)	(0.067)	(0.157)	(0.194)
children dummy	-0.053	0.150**	0.040*	0.348**	-0.042	0.467**
	(0.098)	(0.070)	(0.023)	(0.141)	(0.191)	(0.201)
education	0.012	-0.005	-0.012*	0.083*	-0.005	0.028
	(0.011)	(0.010)	(0.006)	(0.044)	(0.024)	(0.037)
income	0.002	0.003***	-0.000	0.001	0.000	0.002
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)
language dummy	-0.378*	-0.443**	-0.046	-0.054	0.446*	-0.876*
	(0.214)	(0.180)	(0.035)	(0.123)	(0.254)	(0.454)
provMAR dummy	0.210**	0.135**	0.117***	0.090	-0.184	-0.202
	(0.086)	(0.065)	(0.025)	(0.070)	(0.188)	(0.244)
provQC dummy	0.173	0.062	-0.002	0.117	-0.564*	0.521
	(0.222)	(0.186)	(0.038)	(0.131)	(0.305)	(0.381)
provON dummy	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)
	---	---	---	---	---	---
provPRA dummy	0.153**	-0.046	-0.010	-0.075	-0.174	-0.050
	(0.078)	(0.060)	(0.016)	(0.061)	(0.161)	(0.166)
provBC dummy	-0.024	-0.075	-0.009	-0.229**	-0.379	-0.302
	(0.118)	(0.085)	(0.023)	(0.103)	(0.298)	(0.308)
CHC	0.056	0.071	0.000	-0.050	-0.044	-0.233

dummy						
	(0.071)	(0.056)	(0.014)	(0.068)	(0.158)	(0.222)
smoking dummy	-0.095	-0.175**	0.017	0.119	-0.407*	0.091
	(0.086)	(0.075)	(0.016)	(0.154)	(0.244)	(0.228)
SR health status	-0.034	0.002	0.041***	0.058	-0.081	0.007
	(0.031)	(0.025)	(0.014)	(0.103)	(0.070)	(0.086)
Physical activity	0.010	0.006	0.007	-0.085	0.026	0.067
	(0.030)	(0.025)	(0.007)	(0.052)	(0.064)	(0.080)
BMI	0.000	0.000	-0.000	0.000***	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
constant	-3.020***	-2.359***	-1.394***	-2.233***	-2.782***	-3.406***
	(0.215)	(0.169)	(0.119)	(0.421)	(0.425)	(0.562)
Pseudo R^2	0.0216	0.0381			0.0438	0.0912
Log likelihood	-858.210	-1467.758	-4631.255	-1432.993	-186.939	-144.700

Table 4.7: Marginal effects of probit estimates for factors affecting milk and yogurt type consumed - whole sample, disaggregated groups, CCHS2.2

Variables	skim milk	1% milk	2% milk	whole milk	yogurt <2%	yogurt >2%
age	0.000	-0.000***	0.000	-0.000***	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
gender dummy	0.002***	0.001	-0.001	-0.001	0.000	0.000
	(0.001)	(0.001)	(0.002)	(0.001)	(0.000)	(0.000)
urban dummy	0.000	0.001	-0.009***	0.002***	0.000	0.000
	(0.001)	(0.001)	(0.003)	(0.001)	(0.000)	(0.000)
children dummy	-0.001	0.003**	0.006*	0.003**	0.000	0.000**
	(0.001)	(0.002)	(0.004)	(0.002)	(0.000)	(0.000)
education	0.000	0.000	-0.002***	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
income	0.000	0.000***	0.000	-0.000***	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
language dummy	-0.003*	-0.006**	-0.009	0.000	0.002*	-0.000*
	(0.001)	(0.002)	(0.005)	(0.002)	(0.001)	(0.000)
provMAR dummy	0.003**	0.003**	0.020***	0.002*	0.000	0.000
	(0.001)	(0.002)	(0.004)	(0.001)	(0.000)	(0.000)
provQC	0.002	0.001	0.000	0.001	-0.001*	0.001

dummy						
	(0.004)	(0.004)	(0.007)	(0.002)	(0.000)	(0.001)
provON dummy	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)
	---	---	---	---	---	---
provPRA dummy	0.002**	-0.001	-0.004	-0.001	0.000	0.000
	(0.001)	(0.001)	(0.003)	(0.001)	(0.000)	(0.000)
provBC dummy	0.000	-0.001	-0.003	-0.002*	0.000	0.000
	(0.001)	(0.001)	(0.004)	(0.001)	(0.000)	(0.000)
CHC dummy	0.001	0.001	0.001	-0.001	0.000	0.000
	(0.001)	(0.001)	(0.003)	(0.001)	(0.000)	(0.000)
smoking dummy	-0.001	-0.003**	0.000	0.002	-0.001*	0.000
	(0.001)	(0.001)	(0.003)	(0.001)	(0.000)	(0.000)
SR health status	0.000	0.000	0.001	0.000	0.000	0.000
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)
Physical activity	0.000	0.000	0.001	-0.001*	0.000	0.000
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)
BMI	0.000	0.000	0.000	0.000***	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Pseudo R^2	0.0216	0.0381	0.0212	0.1268	0.0733	0.0438
Log likelihood	-858.210	-1467.758	-4629.387	-1523.180	-361.170	-186.939

Table 4.8: Second-step SUR estimates for factors affecting how much milk, yogurt, or cheese respondents consumed - whole sample, aggregated group, CCHS2.2

Variables	milk	yogurt	cheese
milk price	0.007	-0.004	0.002
	(0.005)	(0.004)	(0.005)
yogurt price	-0.004	-0.018	-0.004
	(0.004)	(0.025)	(0.003)
cheese price	0.002	-0.004	0.004
	(0.005)	(0.003)	(0.005)
milk advertising	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
yogurt advertising	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
cheese advertising	0.000	0.000	0.000

	(0.000)	(0.000)	(0.000)
other dairy dummy	0.004	0.000	(omitted)
	(0.003)	(0.000)	---
age	-0.000***	0.000	0.000***
	(0.000)	(0.000)	(0.000)
gender dummy	-0.001	0.000	-0.001*
	(0.001)	(0.000)	(0.001)
urban dummy	-0.001	-0.001***	0.000
	(0.001)	(0.000)	(0.001)
children dummy	-0.006***	-0.001	-0.001
	(0.002)	(0.000)	(0.001)
education	0.000	-0.000**	0.000
	(0.000)	(0.000)	(0.000)
income	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
language dummy	-0.001	-0.001	0.000
	(0.003)	(0.001)	(0.002)
food security status	-0.001	0.000	-0.001
	(0.001)	(0.000)	(0.001)
provMAR dummy	(dropped)	(dropped)	(dropped)
	---	---	---
provQC dummy	(dropped)	(dropped)	(dropped)
	---	---	---
provON dummy	(omitted)	(omitted)	(omitted)
	---	---	---
provPRA dummy	0.003	-0.010	0.003
	(0.008)	(0.010)	(0.008)
provBC dummy	(dropped)	(dropped)	(dropped)
	---	---	---
CHC dummy	-0.001	0.000	0.000
	(0.001)	(0.000)	(0.001)
smoking dummy	0.001	0.000	0.001
	(0.001)	(0.000)	(0.001)
SR health status	-0.000	0.001***	-0.001*
	(0.001)	(0.000)	(0.000)
Physical activity	0.001**	-0.000	0.001***
	(0.001)	(0.000)	(0.000)

BMI	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
IMR	0.125***	0.147***	0.145***
	(0.001)	(0.001)	(0.001)
constant	(dropped)	(dropped)	(dropped)
RMSE	0.0872	0.0219	0.0654
R^2	0.2975	0.6052	0.3930
Chi^2	12904	46703	19731

Table 4.9: Second-step SUR estimates for factors affecting quantity of milk and yogurt types consumed - whole sample, disaggregated groups, CCHS2.2

Variables	skim milk	1% milk	2% milk	whole milk	yogurt <2%	yogurt >2%
age	-0.005	-0.007	-0.159***	0.003	0.002	-0.001
	(0.006)	(0.012)	(0.017)	(0.010)	(0.003)	(0.001)
gender dummy	-0.374*	-1.236***	-1.575***	0.573*	0.015	-0.064
	(0.203)	(0.391)	(0.545)	(0.319)	(0.103)	(0.044)
urban dummy	-0.286	-0.115	2.588***	-1.246***	0.085	-0.107**
	(0.250)	(0.483)	(0.672)	(0.394)	(0.127)	(0.054)
children dummy	-0.281	-1.655**	-1.462	-1.934***	-0.133	-0.223***
	(0.340)	(0.657)	(0.915)	(0.536)	(0.173)	(0.074)
education	-0.025	-0.013	0.044	-0.007	-0.027	0.001
	(0.038)	(0.073)	(0.102)	(0.060)	(0.019)	(0.008)
income	-0.003	-0.022***	-0.011	0.011*	0.002	0.000
	(0.004)	(0.007)	(0.010)	(0.006)	(0.002)	(0.001)
language dummy	1.052*	1.899	3.489**	-0.975	-0.765**	0.223*
	(0.606)	(1.170)	(1.629)	(0.955)	(0.308)	(0.132)
provMAR dummy	-0.205	-1.510**	-7.940***	-0.615	-0.010	0.001
	(0.306)	(0.591)	(0.824)	(0.482)	(0.155)	(0.067)
provQC dummy	-0.895	-0.502	-4.223**	1.027	0.650**	-0.184
	(0.650)	(1.254)	(1.746)	(1.023)	(0.330)	(0.141)
provON dummy	0	0	0	0	0	0
	---	---	---	---	---	---
provPRA dummy	0.048	0.091	0.163	0.268	-0.077	0.072
	(0.268)	(0.516)	(0.719)	(0.421)	(0.136)	(0.058)
provBC dummy	0.120	-0.137	-0.422	0.375	0.082	0.057

	(0.368)	(0.710)	(0.989)	(0.580)	(0.187)	(0.080)
CHC dummy	0.046	-0.507	1.215*	1.012	0.020	0.048
	(0.245)	(0.473)	(0.658)	(0.386)	(0.124)	(0.053)
smoking dummy	0.688**	-0.311	-0.212	0.044	0.127	-0.048
	(0.274)	(0.528)	(0.736)	(0.431)	(0.139)	(0.060)
SR health status	-0.009	0.233	0.099	0.295*	0.048	-0.015
	(0.102)	(0.197)	(0.274)	(0.161)	(0.052)	(0.022)
Physical activity	0.098	-0.141	0.656**	0.797***	0.006	0.007
	(0.104)	(0.201)	(0.280)	(0.164)	(0.053)	(0.023)
BMI	-0.001**	0.000	-0.001	-0.009**	0.000**	0.000
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)
constant	0.476	0.989	2.257	1.832	-0.107	0.105
	(0.724)	(1.398)	(1.950)	(1.140)	(0.368)	(0.157)
IMR	78.751***	105.077***	80.645***	113.823***	73.581***	42.523***
	(0.522)	(0.797)	(0.697)	(0.665)	(0.544)	(0.266)
RMSE	17.462	33.701	46.931	27.502	8.865	3.797
R^2	0.4284	0.3646	0.3105	0.4940	0.3758	0.4573
Chi^2	22840.4	17484.3	13722.3	29748.6	18346.5	25672.6

4.4.3. Estimation Results – Adolescents

Only coefficients or marginal effects with statistical significance at a level of 10% or lower are discussed. For detailed numerical results, see Tables 4.10 to 4.14. Results from the first-step analysis of the aggregated data showed that adolescents living in households with children and lower incomes, non-smokers, and those with lower self-rated health and physical activity levels were more likely to drink milk. Adolescents living in urban areas and who had lower self-rated health were more likely to purchase yogurt. Younger adolescents, those living in higher-income households, and those with higher self-rated health were more likely to eat cheese. The second-step analysis showed that younger adolescents, adolescents living without children in the household, and adolescents with higher levels of physical activity consumed more milk. Adolescents living in a rural area, with lower education, and higher self-rated health consumed more yogurt. Older adolescents, males, and those with lower self-rated health and

higher physical activity levels consumed more cheese. Again, this demonstrates that milk, yogurt, and cheese consumers may not be the same people and that people who consume milk (yogurt, cheese) more frequently differ from people who consume more milk (yogurt, cheese) in volume. There was evidence of substitution between milk and other dairy products as the negative coefficient in the first step implies that adolescents who consumed other dairy products were less likely to consume milk. However, in the second step there was a positive coefficient implying that adolescents who consume other dairy products consume greater quantities of milk, perhaps signifying complementarities between dairy products.

In terms of the disaggregated categories, several trends were noted among adolescents. Adolescents who do not live in a household with children, who have a higher household income and higher physical activity levels, in addition to adolescents living in the Maritimes and in BC were more likely to drink skim milk. Adolescents living in a higher income household and non-smokers were more likely to drink 1% milk. Younger adolescents, males, and adolescents who have lower levels of physical activity, lower BMI's, and are living with a chronic health condition were more likely to drink 2% milk. Adolescents living in a lower income household were more likely to drink whole milk. Adolescents with more education were more likely to eat low and non-fat yogurt, and those living in a home with children and who have higher self-rated health were more likely to eat whole-fat yogurt.

In the second stage of the analysis, it was found that adolescents who live in a house with children, males, older adolescents, and those with lower education and income drank more skim milk. Non-smoking adolescents, those with higher self-rated health, lower levels of physical activity, and lower BMI's also drank more skim milk. Adolescents living in a lower income household and those with lower self-rated health drank more 1% milk. Adolescents with higher levels of physical activity drank more 2% milk. Male adolescents drank more whole milk. Older adolescents, those living in a rural area, in a house with no children, with lower education, lower levels of physical activity and lower BMI's consumed

more low and non-fat yogurt. Older adolescents, males, those living in urban areas and in households without children, as well as those with less education and lower income consumed more whole-fat yogurt. In addition, adolescents who are non-smokers, who have lower self-rated health, lower levels of physical activity, and higher BMIs also consumed more whole-fat yogurt.

All probit regressions were tested for heteroscedasticity. None of the chi-squared values in this group were large enough to reject the null hypothesis of homoscedasticity.

Table 4.10: First-step probit estimates and marginal effects for factors affecting whether or not respondents consume milk, yogurt, or cheese - adolescents, aggregated groups, CCHS2.2

Variables	milk	yogurt	cheese	milk ME's	yogurt ME's	cheese ME's
milk price	-0.297	3.792	1.369	-0.030	0.025	0.116
	(0.929)	(5.620)	(1.085)	(0.111)	(0.034)	(0.092)
yogurt price	-2.265	17.800	6.552	-0.219	0.120	0.554
	(6.108)	(23.462)	(6.717)	(0.732)	(0.144)	(0.568)
cheese price	-0.187	3.183	1.424	-0.017	0.022	0.120
	(0.871)	(5.384)	(1.023)	(0.105)	(0.033)	(0.086)
milk advertising	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
yogurt advertising	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)
	---	---	---	---	---	---
cheese advertising	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
other dairy dummy	-0.656***	0.023	(omitted)	-0.049***	0.000	(omitted)
	(0.232)	(0.276)	---	(0.009)	(0.002)	---
gender dummy	-0.102*	0.242	-0.083	-0.013*	0.002	-0.007
	(0.059)	(0.173)	(0.068)	(0.007)	(0.001)	(0.006)
urban dummy	-0.031	0.224	-0.108	-0.004	0.001	-0.010
	(0.073)	(0.259)	(0.082)	(0.009)	(0.001)	(0.008)
children dummy	0.143**	-0.367	-0.115	0.016*	-0.002	-0.009
	(0.070)	(0.263)	(0.088)	(0.009)	(0.001)	(0.007)
education	-0.023	-0.084	-0.029	0.002	0.000	-0.002
	(0.018)	(0.053)	(0.021)	(0.003)	(0.001)	(0.002)
income	0.000	0.003	0.002*	0.000	0.000	0.000*

	(0.001)	(0.003)	(0.001)	(0.000)	(0.000)	(0.000)
language dummy	0.193	-0.208	-0.088	0.023	-0.001	-0.007
	(0.168)	(0.624)	(0.203)	(0.024)	(0.003)	(0.015)
food security status	-0.008	-0.074	0.026	-0.001	0.000	0.002
	(0.039)	(0.222)	(0.040)	(0.005)	(0.001)	(0.003)
provMAR dummy	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)
	---	---	---	---	---	---
provQC dummy	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)
	---	---	---	---	---	---
provON dummy	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)
	---	---	---	---	---	---
provPRA dummy	-1.086	9.142	3.498	-0.086	1.000	0.764
	(2.536)	(13.037)	(2.880)	(0.190)	(0.001)	(0.634)
provBC dummy	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)
	---	---	---	---	---	---
CHC dummy	0.042	-0.224	-0.019	0.005	-0.001	-0.002
	(0.074)	(0.259)	(0.086)	(0.009)	(0.001)	(0.007)
smoking dummy	-0.016	0.220	0.026	0.003	0.002	0.002
	(0.086)	(0.236)	(0.098)	(0.011)	(0.003)	(0.009)
SR health status	-0.045	-0.096	0.024	-0.005	-0.001	0.002
	(0.033)	(0.102)	(0.038)	(0.004)	(0.001)	(0.003)
Physical activity	-0.045	0.151	-0.086**	-0.006	0.001	-0.007**
	(0.034)	(0.108)	(0.037)	(0.004)	(0.001)	(0.003)
BMI	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
constant	15.742	-339.477	-188.108	---	---	---
	(125.237)	(677.812)	(144.722)	---	---	---
Pseudo R^2	0.0136	0.0837	0.0107	0.0136	0.0837	0.0107
Log likelihood	-1095.89	-108.13	-782.79	-1095.89	-108.13	-782.79

Table 4.11: First-step probit estimates for factors affecting type of milk and yogurt consumed - adolescents, disaggregated groups, CCHS2.2

Variables	skim milk	1% milk	2% milk	whole milk	yogurt <2%mf	yogurt >2%mf
age	-0.125	0.022	-0.063**	-0.045	-0.104	-0.044
	(0.081)	(0.048)	(0.032)	(0.072)	(0.108)	(0.155)

gender dummy	0.225	-0.104	-0.141**	0.278	-0.073	0.351
	(0.173)	(0.103)	(0.072)	(0.174)	(0.257)	(0.421)
urban dummy	0.057	-0.035	0.076	0.165	0.219	-0.310
	(0.215)	(0.124)	(0.090)	(0.201)	(0.363)	(0.427)
children dummy	-0.585*	0.182	0.076	0.276	0.181	0.855*
	(0.346)	(0.119)	(0.085)	(0.185)	(0.288)	(0.453)
education	0.123	0.010	0.016	0.057	0.170*	0.252
	(0.078)	(0.051)	(0.033)	(0.070)	(0.098)	(0.170)
income	0.005*	0.005***	-0.001	-0.011***	-0.002	0.007
	(0.003)	(0.002)	(0.001)	(0.003)	(0.004)	(0.007)
language dummy	-0.624	-0.279	-0.082	0.341	0.531	-0.205
	(0.725)	(0.329)	(0.210)	(0.321)	(0.445)	(1.590)
provMAR dummy	0.739***	-0.052	0.137	0.333	0.113	(dropped)
	(0.277)	(0.155)	(0.103)	(0.215)	(0.350)	---
provQC dummy	0.514	0.117	-0.027	-0.054	(dropped)	-0.097
	(0.763)	(0.344)	(0.228)	(0.376)	---	(1.597)
provON dummy	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)
	---	---	---	---	---	---
provPRA dummy	0.269	-0.090	-0.101	(dropped)	0.009	-0.313
	(0.288)	(0.127)	(0.094)	---	(0.326)	(0.444)
provBC dummy	0.550*	-0.125	-0.082	-0.323	0.078	(dropped)
	(0.305)	(0.182)	(0.131)	(0.388)	(0.405)	---
CHC dummy	0.069	0.181	0.265***	0.098	-0.085	(dropped)
	(0.214)	(0.117)	(0.081)	(0.203)	(0.352)	---
smoking dummy	0.099	-0.378*	0.161	0.002	0.077	0.517
	(0.281)	(0.196)	(0.102)	(0.238)	(0.377)	(0.423)
SR health status	-0.143	0.017	-0.054	-0.055	-0.123	0.396*
	(0.110)	(0.058)	(0.038)	(0.100)	(0.148)	(0.217)
Physical activity	0.202*	0.010	-0.082**	0.136	0.049	0.123
	(0.114)	(0.060)	(0.040)	(0.103)	(0.147)	(0.226)
BMI	0.000	0.000	-0.000*	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
constant	-3.283***	-2.732***	-1.167***	-2.433***	-3.675***	-4.469*

	(1.000)	(0.562)	(0.386)	(0.916)	(1.411)	(2.353)
Pseudo R^2	0.1288	0.0318	0.0260	0.1154	0.0664	0.2340
Log likelihood	-107.635	-327.366	-717.479	-117.059	-48.015	-23.022

Table 4.12: Marginal effects of probit estimates for factors affecting milk or yogurt type consumed - adolescents, disaggregated groups, CCHS2.2

Variables	skim milk	1% milk	2% milk	whole milk	yogurt <2%mf	yogurt >2%mf
age	-0.001	0.001	-0.005*	0.000	0.000	0.000
	(0.000)	(0.001)	(0.002)	(0.001)	(0.000)	(0.000)
gender dummy	0.001	-0.003	-0.011*	0.003	0.000	0.000
	(0.001)	(0.003)	(0.005)	(0.002)	(0.001)	(0.000)
urban dummy	0.000	-0.001	0.006	0.001	0.001	0.000
	(0.001)	(0.004)	(0.006)	(0.002)	(0.001)	(0.001)
children dummy	-0.002*	0.006	0.006	0.003	0.001	0.001*
	(0.001)	(0.005)	(0.007)	(0.003)	(0.002)	(0.002)
education	0.001	0.000	0.001	0.001	0.001*	0.000
	(0.000)	(0.002)	(0.003)	(0.001)	(0.000)	(0.000)
income	0.000*	0.000***	0.000	-0.000***	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
language dummy	-0.002	-0.007	-0.006	0.004	0.005	0.000
	(0.001)	(0.007)	(0.014)	(0.005)	(0.007)	(0.001)
provMAR dummy	0.008***	-0.002	0.011	0.004	0.000	(dropped)
	(0.005)	(0.004)	(0.009)	(0.003)	(0.002)	---
provQC dummy	0.005	0.004	-0.002	0.000	(dropped)	0.000
	(0.011)	(0.013)	(0.017)	(0.003)	---	(0.001)
provON dummy	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)
	---	---	---	---	---	---
provPRA dummy	0.002	-0.003	-0.007	(dropped)	0.000	0.000
	(0.002)	(0.004)	(0.007)	---	(0.001)	(0.000)
provBC dummy	0.005*	-0.003	-0.006	-0.002	0.000	(dropped)
	(0.005)	(0.004)	(0.009)	(0.002)	(0.002)	---
CHC dummy	0.000	0.006	0.023***	0.001	0.000	(dropped)
	(0.001)	(0.005)	(0.008)	(0.002)	(0.001)	---

smoking dummy	0.001	-0.009*	0.013	0.000	0.000	0.001
	(0.002)	(0.003)	(0.009)	(0.002)	(0.002)	(0.001)
SR health status	-0.001	0.001	-0.004	-0.001	-0.000	0.000*
	(0.001)	(0.002)	(0.003)	(0.001)	(0.001)	(0.000)
Physical activity	0.001*	-0.000	-0.006**	0.001	-0.000	-0.000
	(0.001)	(0.002)	(0.003)	(0.001)	(0.001)	(0.000)
BMI	0.000	0.000	-0.000*	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Pseudo R^2	0.1288	0.0318	0.0260	0.1154	0.0664	0.2340
Log likelihood	-107.635	-327.366	-717.479	-117.059	-48.015	-23.022

Table 4.13: Second-step SUR estimates for factors affecting quantity of milk, yogurt, or cheese consumed - adolescents, aggregated group, CCHS2.2

Variables	milk	yogurt	cheese
milk price	0.002	-0.009	-0.006
	(0.012)	(0.013)	(0.012)
yogurt price	-0.009	-0.089	-0.006
	(0.013)	(0.084)	(0.012)
cheese price	-0.006	-0.006	-0.005
	(0.012)	(0.012)	(0.013)
milk advertising	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
yogurt advertising	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
cheese advertising	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
other dairy dummy	0.013***	-0.001	---
	(0.005)	(0.001)	---
gender dummy	-0.001	-0.001	0.002
	(0.002)	(0.001)	(0.002)
urban dummy	0.004	-0.003***	0.000
	(0.002)	(0.001)	(0.003)
children dummy	-0.007***	0.002*	0.005*
	(0.002)	(0.001)	(0.003)
education	-0.001	0.001***	0.000

	(0.001)	(0.000)	(0.001)
income	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
language dummy	0.001	0.001	-0.008
	(0.006)	(0.003)	(0.007)
food security status	-0.001	0.000	-0.002
	(0.001)	(0.001)	(0.001)
provMAR dummy	(dropped)	(dropped)	(dropped)
	---	---	---
provQC dummy	(dropped)	(dropped)	(dropped)
	---	---	---
provON dummy	(omitted)	(omitted)	(omitted)
	---	---	---
provPRA dummy	0.003	-0.025	-0.011
	(0.021)	(0.035)	(0.021)
provBC dummy	(dropped)	(dropped)	(dropped)
	---	---	---
CHC dummy	-0.001	0.001	0.002
	(0.002)	(0.001)	(0.003)
smoking dummy	0.004	-0.002*	0.005
	(0.003)	(0.001)	(0.003)
SR health status	-0.001	0.001	-0.001
	(0.001)	(0.000)	(0.001)
Physical activity	0.003**	-0.000	0.002*
	(0.001)	(0.000)	(0.001)
BMI	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
IMR	0.166***	0.211***	0.165***
	(0.002)	(0.002)	(0.003)
constant	(dropped)	(dropped)	(dropped)
RMSE	0.0665	0.0287	0.0750
R^2	0.5487	0.6185	0.4390
Chi^2	5676.94	7568.56	3654.08

Table 4.14: Second-step SUR estimates for factors affecting quantity of milk and yogurt types consumed - adolescents, disaggregated groups, CCHS2.2

Variables	skim milk	1% milk	2% milk	whole milk	yogurt <2%mf	yogurt >2%mf
age	0.126***	0.130	3.516	-0.340	0.047**	0.048**
	(0.011)	(0.475)	(3.960)	(0.384)	(0.019)	(0.021)
gender dummy	-0.239***	0.481	-2.837	-1.684**	0.024	-0.235***
	(0.021)	(0.925)	(7.700)	(0.748)	(0.037)	(0.041)
urban dummy	-0.038	0.013	3.902	-0.201	-0.092*	0.245***
	(0.030)	(1.314)	(10.935)	(1.062)	(0.052)	(0.058)
children dummy	0.407***	1.479	-7.756	1.184	-0.108**	-0.674***
	(0.026)	(1.150)	(9.555)	(0.928)	(0.046)	(0.051)
education	-0.137***	-0.324	-4.940	0.626	-0.087***	-0.169***
	(0.012)	(0.523)	(4.351)	(0.422)	(0.021)	(0.023)
income	-0.005***	-0.034**	0.177	0.014	0.000	-0.005***
	(0.000)	(0.015)	(0.127)	(0.012)	(0.001)	(0.001)
language dummy	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)
	---	---	---	---	---	---
provMAR dummy	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)
	---	---	---	---	---	---
provQC dummy	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)
	---	---	---	---	---	---
provON dummy	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)
	---	---	---	---	---	---
provPRA dummy	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)
	---	---	---	---	---	---
provBC dummy	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)
	---	---	---	---	---	---
CHC dummy	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)
	---	---	---	---	---	---
smoking dummy	-0.072**	2.253	-15.927	0.305	-0.044	-0.535***
	(0.034)	(1.485)	(12.343)	(1.198)	(0.059)	(0.065)
SR health status	0.151***	-1.407***	3.455	-0.235	0.022	-0.295***
	(0.012)	(0.525)	(4.375)	(0.424)	(0.021)	(0.023)

Physical activity	-0.178***	0.026	8.115*	-0.027	-0.058***	-0.104***
	(0.012)	(0.531)	(4.434)	(0.429)	(0.021)	(0.023)
BMI	-0.000***	0.000	-0.011	0.000	-0.000***	0.000*
	(0.000)	(0.001)	(0.009)	(0.001)	(0.000)	(0.000)
IMR	80.519***	124.481***	188.731***	79.277***	36.606***	55.822***
	(0.075)	(1.522)	(10.118)	(2.196)	(0.126)	(0.163)
constant	-0.186	-6.221	3.644	-2.905	0.099	-0.02
	(0.114)	(5.029)	(41.850)	(4.059)	(0.200)	(0.221)
RMSE	0.3267	14.4648	120.2604	11.6830	0.5751	0.6356
R^2	0.9991	0.8673	0.2572	0.5593	0.9879	0.9903
Chi^2	$1.19x10^6$	6784.35	360.31	1316.59	84901.8	118810

4.4.4. Estimation Results – Women over 50

Only coefficients or marginal effects with statistical significance at a level of 10% or lower are discussed in this section. For detailed numerical results, see Tables 4.15 to 4.19. Results from the first-step analysis of the aggregated data showed that older women, non-smokers and those with lower self-rated health were more likely to drink milk. Older women with higher levels of education and physical activity were more likely to consume yogurt. Older women with higher levels of education were also more likely to eat cheese. The second step showed that among older women, younger individuals, smokers, those with higher self-rated health and higher BMI's drank more milk. Older women with less education and lower levels of physical activity consumed more yogurt. Older women who are not living with a chronic health condition consumed more cheese.

In the analysis of the disaggregated categories, it showed that older women who prefer English and who are residents of Quebec and the Prairies were more likely to drink skim milk. Older women who live in the Prairies were less likely to drink 1% milk. Older women who live in a rural area, the Maritimes, or the Prairies, and who have lower levels of physical activity were more likely to drink 2% milk. Older women who smoke were more likely to drink whole milk. The second step of the analysis showed that older women with lower incomes, higher BMI, and higher self-rated health status drank more 1% milk. Older women with lower incomes drank more 2% milk while those living in BC drank

less 2% milk. Older women with higher levels of education, higher self-rated health status, and lower BMI drank more whole milk while those living in BC drank less whole milk.

All probit regressions were tested for heteroscedasticity. None of the chi-squared values in this group were large enough to reject the null hypothesis of homoscedasticity.

Table 4.15: First-step probit estimates and marginal effects for factors affecting whether or not respondents consumed milk, yogurt, or cheese - older women, aggregated groups, CCHS2.2

Variables	milk	yogurt	cheese	milk ME's	yogurt ME's	cheese ME's
milk price	0.643	-1.125	-1.711	0.081	-0.010	-0.068
	(0.761)	(9.371)	(1.254)	(0.095)	(0.080)	(0.050)
yogurt price	1.936	20.928	-7.985	0.243	0.178	-0.318
	(5.315)	(28.800)	(9.159)	(0.667)	(0.249)	(0.364)
cheese price	0.537	-1.442	-1.943*	0.067	-0.012	-0.077*
	(0.715)	(9.088)	(1.178)	(0.090)	(0.077)	(0.047)
milk advertising	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
yogurt advertising	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)
	---	---	---	---	---	---
cheese advertising	0.000	(dropped)	-0.000*	0.000	(dropped)	-0.000*
	(0.000)	---	(0.000)	(0.000)	---	(0.000)
other dairy dummy	-0.036	(dropped)	(omitted)	-0.004	(dropped)	(omitted)
	(0.246)	---	---	(0.029)	---	---
age	0.002	-0.003	0.001	0.000	0.000	0.000
	(0.003)	(0.011)	(0.005)	(0.000)	(0.000)	(0.000)
urban dummy	-0.035	(dropped)	0.039	-0.004	(dropped)	0.002
	(0.066)	---	(0.107)	(0.008)	---	(0.004)
children dummy	-0.465	0.714	0.041	-0.041	0.017	0.002
	(0.413)	(0.514)	(0.426)	(0.023)	(0.024)	(0.019)
education	0.004	0.089***	0.029*	0.000	0.001***	0.001*
	(0.010)	(0.033)	(0.016)	(0.001)	(0.000)	(0.001)
income	-0.002	0.002	0.001	0.000	0.000	0.000

	(0.001)	(0.004)	(0.002)	(0.000)	(0.000)	(0.000)
language dummy	-0.148	0.102	0.026	-0.017	0.001	0.001
	(0.150)	(0.719)	(0.240)	(0.016)	(0.007)	(0.010)
food security status	0.049	(dropped)	0.077	0.006	(dropped)	0.003
	(0.059)	---	(0.079)	(0.007)	---	(0.003)
provMAR dummy	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)
	---	---	---	---	---	---
provQC dummy	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)
	---	---	---	---	---	---
provON dummy	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)
	---	---	---	---	---	---
provPRA dummy	1.321	1.506	-4.406	0.278	0.050	-0.118
	(2.140)	(19.641)	(3.605)	(0.629)	(1.567)	(0.156)
provBC dummy	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)
	---	---	---	---	---	---
CHC dummy	-0.038	0.114	-0.053	-0.005	0.001	-0.002
	(0.068)	(0.227)	(0.104)	(0.009)	(0.002)	(0.004)
smoking dummy	-0.139*	-0.080	0.045	-0.016*	-0.001	0.002
	(0.081)	(0.294)	(0.117)	(0.009)	(0.002)	(0.005)
SR health status	-0.052*	0.046	-0.007	-0.007*	-0.000	-0.000
	(0.028)	(0.099)	(0.045)	(0.004)	(0.001)	(0.002)
Physical activity	-0.036	0.280**	0.020	-0.004	0.002**	0.001
	(0.040)	(0.116)	(0.061)	(0.005)	(0.001)	(0.002)
BMI	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
constant	-74.991	-134.060	294.295	---	---	---
	(105.497)	(366.351)	(179.932)	---	---	---
Pseudo R^2	0.0145	0.1245	0.0145	0.0137	0.1389	0.0145
Log likelihood	-1245.600	-97.015	-449.752	-1278.134	-100.981	-449.752

Table 4.16: First-step probit estimates for factors affecting types of milk and yogurt consumed - older women, disaggregated groups, CCHS2.2

Variables	skim milk	1% milk	2% milk	whole milk	yogurt
age	-0.007	-0.003	0.005	-0.001	-0.002
	(0.008)	(0.007)	(0.004)	(0.014)	(0.010)
urban dummy	-0.101	-0.140	-0.158**	(dropped)	(dropped)
	(0.165)	(0.159)	(0.080)	---	---
children dummy	(dropped)	(dropped)	0.047	(dropped)	0.606
	---	---	(0.351)	---	(0.495)
education	-0.014	0.022	-0.021	-0.005	0.089***
	(0.027)	(0.026)	(0.013)	(0.049)	(0.032)
income	0.003	0.002	0.002	0.003	0.003
	(0.003)	(0.003)	(0.002)	(0.005)	(0.003)
language dummy	-1.289***	-0.372	-0.229	(dropped)	0.072
	(0.458)	(0.463)	(0.187)	---	(0.697)
provMAR dummy	0.027	0.019	0.549***	0.340	(dropped)
	(0.224)	(0.184)	(0.097)	(0.307)	---
provQC dummy	1.023***	0.098	0.011	(dropped)	-0.051
	(0.362)	(0.476)	(0.224)	---	(0.701)
provON dummy	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)
	---	---	---	---	---
provPRA dummy	0.299*	-0.460*	0.189*	(dropped)	0.065
	(0.176)	(0.250)	(0.101)		(0.213)
provBC dummy	-0.172	-0.012	0.170	0.122	-0.103
	(0.348)	(0.236)	(0.142)	(0.382)	(0.286)
CHC dummy	0.160	-0.032	-0.061	0.068	0.174
	(0.191)	(0.172)	(0.087)	(0.319)	(0.223)
smoking dummy	-0.202	-0.144	0.150	0.493*	-0.108
	(0.226)	(0.217)	(0.094)	(0.282)	(0.287)
SR health status	-0.009	0.012	-0.051	-0.152	0.020
	(0.073)	(0.073)	(0.036)	(0.125)	(0.097)
Physical activity	-0.004	-0.039	-0.117**	-0.075	0.300***
	(0.100)	(0.098)	(0.054)	(0.193)	(0.112)
BMI	0.000	0.000	0.000*	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
constant	-2.236***	-2.657***	-2.612***	-3.777***	-3.047***
	(0.797)	(0.754)	(0.392)	(1.423)	(0.998)
Pseudo R^2	0.0565	0.0325	0.0541	0.0722	0.1314
Log	-149.731	-158.700	-685.855	-44.841	-102.547

likelihood					

Table 4.17: Marginal effects of probit estimates for types of milk and yogurt consumed - older women, disaggregated groups, CCHS2.2

Variables	skim milk	1% milk	2% milk	whole milk	yogurt
age	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
urban dummy	-0.001	-0.002	-0.010**	(dropped)	(dropped)
	(0.002)	(0.002)	(0.006)	---	---
children dummy	(dropped)	(dropped)	0.003	(dropped)	0.011
	---	---	(0.022)	---	(0.017)
education	0.000	0.000	-0.001	0.000	0.001***
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)
income	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
language dummy	-0.006***	-0.003	-0.011	(dropped)	0.001
	(0.001)	(0.003)	(0.008)	---	(0.006)
provMAR dummy	0.000	0.000	0.045***	0.003	(dropped)
	(0.002)	(0.002)	(0.010)	(0.003)	---
provQC dummy	0.033***	0.001	0.001	0.001	0.000
	(0.024)	(0.007)	(0.013)	(0.003)	(0.005)
provON dummy	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)
	---	---	---	---	---
provPRA dummy	0.004*	-0.004*	0.012*	(dropped)	0.001
	(0.003)	(0.002)	(0.007)	---	(0.002)
provBC dummy	-0.001	0.000	0.011	(dropped)	-0.001
	(0.002)	(0.003)	(0.011)	---	(0.002)
CHC dummy	0.001	0.000	-0.004	0.000	0.001
	(0.002)	(0.002)	(0.005)	(0.002)	(0.001)
smoking dummy	-0.002	-0.002	0.010	0.005*	-0.001
	(0.002)	(0.002)	(0.007)	(0.004)	(0.002)
SR health status	-0.000	-0.000	-0.003	-0.001	-0.000
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)
Physical activity	-0.000	-0.000	-0.007**	-0.000	0.002***
	(0.001)	(0.001)	(0.003)	(0.001)	(0.001)
BMI	0.000	0.000	0.000*	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Pseudo R^2	0.0565	0.0325	0.0541	0.0722	0.1314
Log likelihood	-149.731	-158.700	-685.855	-44.841	-102.547

Table 4.18: Second-step SUR estimates for factors affecting quantity of milk, yogurt, and cheese consumed - older women, aggregated group, CCHS2.2

Variables	milk	yogurt	cheese
milk price	0.048	-0.016	0.043
	(0.042)	(0.033)	(0.042)
yogurt price	-0.016	-0.230*	-0.012
	(0.033)	(0.118)	(0.032)
cheese price	0.043	-0.012	0.048
	(0.042)	(0.032)	(0.041)
milk advertising	0.000	-0.000*	0.000
	(0.000)	(0.000)	(0.000)
yogurt advertising	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
cheese advertising	(dropped)	(dropped)	(dropped)
	---	---	---
other dairy dummy	0.004	(dropped)	---
	(0.032)	---	---
age	-0.000**	0.000	0.000
	(0.000)	(0.000)	(0.000)
urban dummy	(dropped)	(dropped)	(dropped)
	---	---	---
children dummy	0.000	-0.005	-0.001
	(0.009)	(0.003)	(0.011)
education	0.000	-0.001***	0.000
	(0.000)	(0.000)	(0.000)
income	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
language dummy	0.000	-0.002	0.003
	(0.006)	(0.002)	(0.007)
food security status	(dropped)	(dropped)	(dropped)
	---	---	---
provMAR dummy	(dropped)	(dropped)	(dropped)
	---	---	---
provQC dummy	(dropped)	(dropped)	(dropped)

	---	---	---
provON dummy	(omitted)	(omitted)	(omitted)
	---	---	---
provPRA dummy	0.075	-0.065	0.076
	(0.074)	(0.074)	(0.073)
provBC dummy	(dropped)	(dropped)	(dropped)
	---	---	---
CHC dummy	0.002	-0.001	-0.007***
	(0.002)	(0.001)	(0.003)
smoking dummy	0.005**	-0.001	-0.002
	(0.002)	(0.001)	(0.003)
SR health status	0.001*	-0.000	0.001
	(0.001)	(0.000)	(0.001)
Physical activity	0.001	-0.001***	0.001
	(0.001)	(0.000)	(0.001)
BMI	0.000*	0.000	0.000
	(0.000)	(0.000)	(0.000)
IMR	0.073***	0.157***	0.143***
	(0.002)	(0.002)	(0.003)
constant	(dropped)	(dropped)	(dropped)
RMSE	0.0441	0.0180	0.0555
Chi^2	1629.82	8997.28	1910.83

Table 4.19: Second-step SUR estimates for factors affecting quantity of milk and yogurt types consumed - older women, disaggregated groups, CCHS2.2

Variables	skim milk	1% milk	2% milk	whole milk	yogurt
age	0.004	0.012	-0.030	0.002	-0.006
	(0.016)	(0.015)	(0.026)	(0.001)	(0.012)
urban dummy	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)
	---	---	---	---	---
children dummy	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)
	---	---	---	---	---
education	0.039	0.026	-0.011	0.011**	-0.143***
	(0.054)	(0.050)	(0.089)	(0.005)	(0.042)
income	0.005	-0.011*	-0.019*	-0.001	-0.009
	(0.007)	(0.006)	(0.011)	(0.001)	(0.005)
language dummy	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)
	---	---	---	---	---

provMAR dummy	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)
	---	---	---	---	---
provQC dummy	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)
	---	---	---	---	---
provON dummy	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)
	---	---	---	---	---
provPRA dummy	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)
	---	---	---	---	---
provBC dummy	-0.156	-0.482	-1.131*	-0.131***	0.106
	(0.385)	(0.358)	(0.634)	(0.034)	(0.297)
CHC dummy	-0.234	-0.293	0.351	-0.051	-0.424
	(0.398)	(0.371)	(0.655)	(0.035)	(0.307)
smoking dummy	(dropped)	(dropped)	(dropped)	(dropped)	(dropped)
	---	---	---	---	---
SR health status	0.245	0.309**	-0.047	0.090***	-0.000
	(0.152)	(0.142)	(0.251)	(0.013)	(0.118)
Physical activity	-0.035	0.125	0.265	0.027	-0.294*
	(0.212)	(0.197)	(0.349)	(0.019)	(0.164)
BMI	0.000	0.000*	-0.001	-0.000**	0.000
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)
IMR	31.415***	30.960***	19.055***	41.565***	48.970***
	(0.923)	(0.691)	(0.743)	(0.118)	(0.568)
constant	(dropped)	(dropped)	3.134	-0.041	(dropped)
	---	---	(2.674)	(0.143)	---
RMSE	6.2332	5.8030	10.2581	0.5484	4.8108
Chi^2	1173.34	2037.44	665.47	124964	7529.9

4.4.5. Comparison Between Groups

Only coefficients that are significant at a level of 10% or lower, for more than one population group, are compared in this section. Although the fact that some factors are significant for one group but not for others could be of interest from a policy perspective, due to the low consumption rates among the at-risk population groups in this data set, the non-significant estimates could in reality be the same as for the other groups but not evident in this analysis. All the significant coefficients had the same sign for the different population groups in the aggregate category analysis for milk, yogurt, and cheese. In the disaggregated

category analysis, some differences were noted between population groups. It appears that among older women, those with a higher BMI were more likely to drink 2% milk while among adolescents those with a lower BMI were more likely to drink 2% milk. In the whole sample, smokers drank more skim milk while among adolescents non-smokers drank more skim milk. Older women with lower self-rated health and adolescents with higher self-rated health drank more 1% milk. In the whole sample, females drank more whole milk but among adolescents males drank more whole milk. Older women with a higher BMI ate more low/non-fat yogurt but adolescents with a lower BMI ate more low/non-fat yogurt. Respondents from the whole sample living in a rural area consumed more whole-fat yogurt but adolescents living in an urban area consumed more whole-fat yogurt.

Table 4.20: Differences in estimation results between population groups

Estimation Step	Product	Variable	Whole Sample	Women >50	Teens
1st	2% milk	BMI	(ns)	(+)	(-)
2nd	Skim milk	Smoking Status	(+)	(ns)	(-)
2nd	1% milk	SR health	(ns)	(-)	(+)
2nd	Whole milk	Gender dummy (female=1)	(+)	(ns)	(-)
2nd	Low/non-fat yogurt	BMI	(+)	(ns)	(-)
2nd	Whole fat yogurt	Urban dummy	(-)	(ns)	(+)

4.4.6. Comparison to other studies

In their study in the US, Robb et al (2007) found that several demographic factors were significant predictors of whether individuals drank low-fat or high-fat milk. Most notably, older individuals and those with higher levels of education and income were more likely to choose low-fat milk. Park et al (2005) found that while smokers were less likely to drink milk, people with higher levels of physical activity drank more milk. Boumtje et al (2005) found that among

American children between the ages of 12 and 18, low-fat milk consumption was negatively associated with being overweight. Deshmukh-Taskar et al (2007) found that dairy product consumption was higher in individuals with more education.

4.5. Summary

In this chapter, the internal factors (demographic and health characteristics) affecting dairy product consumption were analyzed using the CCHS 2.2 data in order to address the objective of determining how demographic and health characteristics play a role in milk and yogurt choices. The estimation results implied that people who are more likely to consume milk (yogurt, cheese) differ in characteristics from those who consume greater quantities of milk (yogurt, cheese). Also important to note is that people who are more likely to consume milk (yogurt/cheese) are not necessarily the same people who consume milk (yogurt/cheese) more frequently. For example, people with children in the home are more likely to consume milk, but consume milk less frequently. In addition, bigger consumers of milk are not necessarily big consumers of yogurt or cheese, and vice versa. Individuals with lower incomes consume milk more frequently while those with higher incomes consume yogurt more frequently.

There are also differences in factors of consumption between the whole sample and the dairy-deficient population groups for the disaggregated categories. This is important to consider when designing policies that affect public health. BMI and self-rated health status appear to have different effects on dairy consumption among the at-risk groups which implies that their perceptions about dairy products (their healthfulness and fat content) likely differ from the rest of the population's and therefore play a role in their decisions with regards to dairy product consumption. As such, educational campaigns could help to breach these gaps in knowledge so that at-risk population groups, as well as the general population, have accurate perceptions of the benefits and drawbacks of dairy product consumption and can make consumption decisions conducive to positive health outcomes.

Chapter 5: National Dairy Survey Consumption Analysis

5.1. Introduction

One of the objectives of this study is to determine how demographic and health characteristics, which were both identified as factors affecting product choices in the conceptual framework, predict milk and yogurt consumption. This chapter attempts to answer this question by discussing the results of the demographic and health characteristic analysis performed on the data collected through the National Dairy Survey (NDS). Unlike the CCHS 2.2, the NDS does not include a 24-hour dietary recall. Instead, respondents are asked how frequently they consume the products in question. This data can be more accurate than a dietary recall because consumption levels are estimated as averages (such as once per week) whereas in a recall a person may have consumed a product which they typically eat only once per week but it would appear in the data as though they consume it every day. The NDS data is analyzed to determine how several variables affect both frequency of milk and yogurt consumption as well as type of milk and yogurt typically consumed.

This section describes the data collected through the NDS, then explains the econometric method and model specification used. Next, the results of the whole sample analysis are discussed, followed by the results of the young adult and women over 50 analyses. As the NDS did not include people under the age of 19, young adults between the ages of 19-24 were used to represent an at-risk group, which is appropriate given that the accumulation of bone density lasts until approximately 23 years of age. A comparison of results between population groups is then done to determine if factors predicting dairy consumption differs between the general population and at-risk groups. Finally, a comparison of results between the NDS and CCHS 2.2 data determines if there are any differences over time.

5.2. Data Setup and Descriptive Statistics

The NDS is an original survey that was administered in Canada in January, 2011. The online survey was conducted by TNS Global and was completed by 1705 Canadians. This survey collected self-reported milk and yogurt intake along with demographic information, health status and behavior, and attitudes and beliefs with regards to food and nutrition. It also elicited types of milk and yogurt products and attributes preferred through choice experiments.

This survey did not include people under the age of 18 or those living in the territories. Subsequently, persons under the age of 25 were under-represented while people aged 45-75 were over-represented. In addition, women and individuals from Ontario were over-represented in this survey while Albertans were under-represented. Please refer to Table 3.13 for more details.

5.2.1. Data Setup

Once obtained, the data was recoded as necessary in SPSS version 17 (such as adjusting provincial codes to regional dummies, gender codes to gender dummies, rescaling income into thousands, etc.) and compiled into one file containing all the demographic and health characteristics (independent variables) necessary for the regression. This recoding is required to run statistical analyses with the collected data as dummy variables must be coded as 0/1 and many of the questions were not framed in a manner which can be used directly for analysis (such as those which state 'check all that apply' the answers to this sort of question are set up as a series of dummy variables and someone could have a one in each cell). In addition, items like height and weight must be consistent, so inches were converted to centimeters and pounds to kilograms. For the dependent variables, the respondents were asked which product they typically purchased (skim milk, 1% milk, 2% milk, or whole milk for milk and fat free, low fat, or whole fat for yogurt) and this was recoded into a dummy variable for each product type (m1dum=1 if respondent typically purchases 1% milk and 0 otherwise). The frequency of home and away from home consumption was combined to generate a total frequency of consumption for both milk and yogurt which was used as the dependent variable in the second step of the

analysis. The analysis to determine the factors affecting milk and yogurt consumption was then performed using STATA version 10.

5.2.2. Descriptive Statistics

The mean age of respondents was 50 years old. Average household income was $63,500 and the mean level of education among respondents was college or technical school. Fifty percent of respondents were male and 26% of respondents had children in the household. Sixty-seven percent of respondents lived in a city, while 18% lived in a town and the remainder lived in a rural setting. Approximately 1% of respondents were pregnant while 2% were currently breastfeeding.

Ninety-five percent of respondents were consumers of both meat and dairy products, while approximately 2% ate meat but not dairy and another 2% ate dairy but not meat. Less than 1% of respondents ate neither meat nor dairy.

On average, respondents rated their health as good to very good. Sixty-one percent of respondents reported making lifestyle changes in the past 12 months in order to improve their overall health. Of those, under 25% had quit smoking, reduced caffeine intake, or eaten less red meat to improve their health. Twenty-five to 50% of respondents claimed to have reduced salt intake, reduced sugar intake, snacked less, reduced calorie intake, taken a vitamin or supplement, introduced a beneficial food to their diet, or eaten more fibre. Over 50% of respondents claimed to have reduced consumption of fat, eaten more fruits and/or vegetables, exercised, eaten less fast food, and consumed more water.

Of the 1705 respondents, 2.4% said they do not eat dairy while 10.5% claimed to never drink milk and 14.7% claimed to never eat yogurt, and 3% are people who do not drink milk or eat yogurt. That worked out to 11.6% people who drink milk but do not eat yogurt and 7.4% people who eat yogurt but do not drink milk.

On average, respondents reported purchasing milk for themselves between ‘occasionally’ and ‘frequently’ and purchasing milk for their households between ‘frequently’ and ‘always’. A two-litre carton of milk is consumed approximately

2-3 times per week on average, and people claimed to consume milk at home between '1 to 5 times per month' and '1 to 5 times per week', while they consumed milk away from home between 'less than one time per month' and '1 to 5 times per month'. About 70% of respondents always purchased the same kind of milk.

The average values for the following behaviours while purchasing milk fall between the 'once in a while' and 'occasionally' measures in the following order of increasing frequency; 'look for a healthy choice symbol', 'read the ingredient list', read the nutrition facts panel to find out the vitamin or mineral content', 'read the nutrition facts panel to find out the calorie content', and 'read the nutrition facts panel to find out the fat content'. The least common behaviour which fell between the 'never' and 'once in a while' measures was 'read the health claims'.

Of the people who did drink milk, approximately 17% of the respondents from our survey claimed to typically purchased skim milk, while 29% purchased 1% milk, 46% purchased 2% milk, and 8% purchased whole milk. About 96% of respondents purchased plain (as opposed to flavoured) milk. Cartons and bags are the most common container types of milk purchased at 40% and 38% respectively followed by jugs at 19%. Approximately 10% of respondents claimed to purchase milk which has been fortified with functional ingredients and about 6% purchased organic milk.

Fat content was ranked as the most important factor in a milk purchasing decision by 34% of respondents while price was ranked most important by 31%. Brand, flavour, and container size were ranked as most important by 13%, 11%, and 11% of respondents respectively.

On average, respondents reported occasionally purchasing yogurt for both themselves and their households. Yogurt was reported as consumed in the household approximately 2-3 times per week. Respondents claimed to consume yogurt at home at least once a week but less than once a month away from home. Less than a quarter of respondents claimed to always purchase the same kind of yogurt.

The average values for the following behaviours while purchasing yogurt fall between the 'once in a while' and 'occasionally' measures in the following order of increasing frequency; 'look for a healthy choice symbol', 'read the health claims', 'read the nutrition facts panel to find out the vitamin or mineral content', 'read the ingredient list', 'read the nutrition facts panel to find out the calorie content', and 'read the nutrition facts panel to find out the fat content'.

Thirty-three percent of respondents reported that they typically purchase pre- or probiotic yogurt, while 44% purchase conventional yogurt and the rest were not sure. Approximately 70% purchase either fat-free or low-fat yogurt, and over 80% purchase flavoured yogurt. Over 30% of people purchase yogurt in tubs while 57% purchase it in single serving containers, and 62% of people purchase yogurt with fruit pieces.

Price was ranked as the most important factor in a yogurt purchasing decision by 36% of respondents, while flavour and fat content were most important to 28% and 12% of people respectively. Less than 10% reported brand, probiotic content, sugar content, or container size to be the most important factor to them.

Respondents claimed to purchase the following products between 'never' and 'once in a while' in the following order of increasing frequency; soy yogurt, lactose free yogurt, almond milk, lactose free milk, organic milk, organic yogurt, and soy milk.

There are a few differences between the average values for the whole sample when compared with the average values for older women or young adults. Not surprisingly, more young adults had children living at home with them (41%) than older women did (8%) (26% of the whole sample had children living at home). Despite the fact that the whole sample was 50% female, 73% of the young adults were female. The young adult group also had an average household income of approximately $63,000 (the same as the whole sample average) whereas the older women group had an average household income of $54,000. Several differences between the groups were noted in health behaviours. Women over 50 were much more likely to try to reduce salt, fat, and caffeine consumption

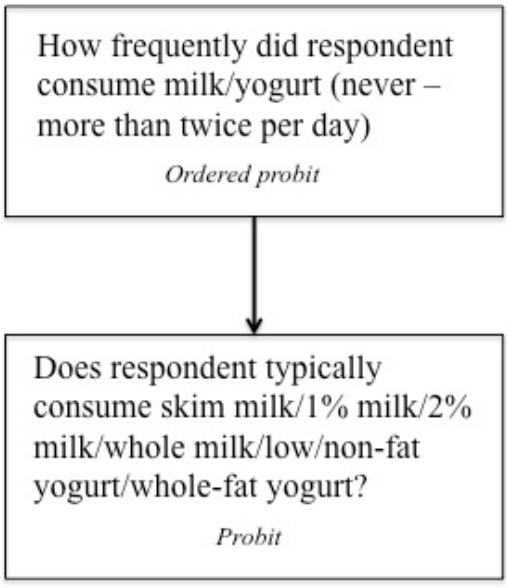
while increasing fruit and vegetable consumption and fibre intake. Women over 50 were also more likely to take vitamins or supplements. Young adults had a lower average BMI than the whole sample and women over 50.

In terms of dairy consumption behaviours, 5% of young adults do not eat dairy whereas only 2% of older women and the whole sample are non-dairy consumers. Older women purchased yogurt for themselves more frequently than young adults did. Also, while 54% of young adults rank price as the most important factor in purchasing yogurt, only 28% of older women ranked it as most important (36% of the whole sample ranked it most important). Seventeen percent of older women ranked fat content as most important, while only 3% of young adults did (as did 12% of the whole sample). Young adults drink milk away from home more frequently than older women and the whole sample. Young adults also purchase flavoured milk more frequently than older women and the whole sample. Similar trends are noted in factors in purchasing milk as in yogurt; 49% of young adults, compared with 31% of the whole sample and 24% of older women, rank price as the most important factor. 43% of older women, compared with 14% of young adults and 34% of the whole sample rank fat content as the most important factor in purchasing milk.

These differences demonstrate that the at-risk population groups (young adults and women over 50) differ from the whole sample and each other in their purchasing behaviours and decision-making factors when it comes to dairy products. Therefore what may help to increase dairy intake in the general population may not work in these dairy-deficient groups, so the unique considerations made by these two groups should be taken into account when attempting to increase their dairy consumption.

5.3. Model specification

Figure 5.1: Outline of process used for analysis of NDS data



The purpose of this analysis is to determine how the internal factors in question (demographic and health characteristics) impact milk and yogurt choices in accordance with the first objective of this study. As was outlined in Chapter 3, a probit model is used to determine how internal factors affect the type of milk or yogurt product chosen as these are binary dependent variables, while an ordered probit is used to determine how internal factors affect the frequency of milk and yogurt consumption as they are ordinal dependent variables.

In the first step of this analysis, an ordered probit regression was run with the frequency of consumption as the dependent variable and the same demographic and health variables as the explanatory variables. One of the options for frequency of consumption was 'never', so whether or not respondents consume milk or yogurt is captured in this step. In the second step, a probit regression is used to estimate whether individual *i* claims to typically purchase product *d* as a function of demographic and health variables. This step was done with disaggregated milk and yogurt data, where product *d* could be skim milk, 1% milk, 2% milk, whole milk, low/non-fat yogurt, or full-fat yogurt. All of the independent variables that were included in the NDS analysis were also included

in the CCHS 2.2 analysis, although some of the variables from the CCHS 2.2 analysis were not available for inclusion in the NDS analysis.

The independent demographic variables included age (in years), gender (0=male, 1=female), preferred language (0=English, 1=French), education (in years), income (in thousands of dollars), urban (0=does not live in an urban area, 1=lives in an urban area), town (0=does not live in a town, 1=lives in a town), and region (dummy variables for Maritimes, Quebec, Ontario, Prairies, and British Columbia). For the regional dummy variables, Ontario is omitted and used as the base case. Self-rated health status (on a scale from 1 to 5) is included as a health indicator variable. The demographic variables were the same as in the CCHS 2.2 analysis, so the results can be compared in terms of sign but not magnitude because the NDS did not collect information about smoking status, food security status, chronic health conditions, or physical activity level. For means and standard deviations of the explanatory variables, please see Tables 3.5 and 3.6.

In the first step of the analysis, an ordered probit model is used to explain the factors affecting the frequency of milk and yogurt consumption (including whether or not milk and yogurt are consumed). An ordered probit is used in situations where the dependent variable is ordinal rather than binary (Verbeek, 2008 pg.213):

$$y_i = j \text{ if } \gamma_{j-1} < y_i^* \leq \gamma_j$$

We observe individual i's choice y_i if their actual y^*, which is a function of their characteristics and a set of parameters, falls within a designated range, which in this case is a range of consumption frequencies. This model also assumes a standard normal distribution. Individual i's actual y^* is expressed as a function of demographic characteristics:

$$y_i^* = X_i\beta + \varepsilon_i$$

where

$$X_i\beta = \beta_0 + \beta_1 age + \beta_2 sex + \beta_3 lang + \beta_4 ed + \beta_5 inc + \beta_6 child + \beta_7 urban + \beta_8 SRH + \beta_9 provMAR + \beta_{10} provQC + \beta_{11} provON + \beta_{12} provPRA + \beta_{13} provBC$$

The second step of the analysis, the probability that a respondent typically chooses a given product (ie: 1% milk), is modeled as a participation choice problem: the dependent variable y_{id} is a binary choice variable which is equal to 1 if individual i says that they usually consume product d and 0 if individual i says that they do not usually consume product d. (Product d can be skim milk, 1% milk, 2% milk, whole milk, low/non-fat yogurt, or whole-fat yogurt.) Then

$$E(y_{id}) = (1*p_{id}) + (0*(1-p_{id})) = p_{id},$$

which is usually modeled as a function of demographic variables:

$$y_i = X_i\beta + \varepsilon_i \qquad \varepsilon_i \sim N(0,1), \quad d_i = 1(y_i>0).$$

where

$$X_{id}\beta = \beta_0 + \beta_1 age + \beta_2 sex + \beta_3 lang + \beta_4 ed + \beta_5 inc + \beta_6 child + \beta_7 urban + \beta_8 SRH + \beta_9 provMAR + \beta_{10} provQC + \beta_{11} provON + \beta_{12} provPRA + \beta_{13} provBC$$

Table 5.1: Variable abbreviations and descriptions

Variable abbreviation	**Variable description**
age	age (in years)
sex	gender (1=female, 0=male)
lang	preferred language (1=French, 0=English)
ed	education (in years)
inc	income (in thousands)
child	children in the home (1=yes, 0=no)
urban	lives in a city or town (1=yes, 0=no)
SRH	Self-rated health (1=poor, 5=excellent)
provMAR	lives in the Maritimes (1=yes, 0=no)
provQC	lives in Quebec (1=yes, 0=no)
provON	lives in Ontario (1=yes, 0=no)
provPRA	lives in the Prairies (1=yes, 0=no)
provBC	lives in British Columbia (1=yes, 0=no)

5.4. Results

In this section, the results from the estimations are reported. The first step probit coefficients are reported first, followed by the first step marginal effects, then by the second step ordered probit coefficients. These results are reported and discussed first for the whole sample, then for young adults, and finally for older

women. A comparison of results between population groups is then provided, followed by a comparison between the results from the NDS and CCHS2.2.

5.4.1. Estimation Results – Whole Sample

Only results significant at a level of 10% or lower are discussed in this section. For complete numerical results, please see Tables 5.6 to 5.11. Coefficients marked as 'omitted' have not been included in the regression for the purposes of avoiding multicollinearity, as in the case of leaving out one of the region dummy variables instead of including them all, while those marked as 'dropped' have been dropped from the regression by the software due to statistical problems, such as too many zero responses, in calculating the coefficient.

The first stage of the analysis shows that people with children in the house, more education, higher BMIs, higher self-rated health status, and residents of Quebec drink milk more frequently. Women, people with higher levels of education and higher self-rated health eat yogurt more frequently.

The second step results from analysis of the NDS show that people with no children in the home, higher level of education, higher income, whose preferred language is English, who have higher self-rated health, and who live in the Maritimes or BC are more likely to consume skim milk. People with higher income, live in urban areas, who have lower self-rated health, who have higher BMIs, and who live in the Prairies are more likely to consume 1% milk. Older people, people with children in the home, people with lower BMIs, people with lower education and lower income are more likely to consume 2% milk. Residents of the Maritimes, the Prairies, and BC are less likely to consume 2% milk. People who have children in the house, have a lower income, whose preferred language is French, and residents of BC are more likely to consume whole milk. Women are more likely to consume low or non-fat yogurt, while residents of the Prairies and BC are less likely to eat non- or low-fat yogurt. People living in BC are more likely to consume whole fat yogurt.

These results demonstrate that there are variations in which milk or yogurt product consumers choose based on the region they live in, whether or not they

have children in the home, their age, and their level of self-rated health, education, and income. Frequency of consumption varies by the same characteristics. These results support the theory that milk consumers and yogurt consumers are not necessarily the same people, which was suggested by the results of the CCHS 2.2 analysis. Frequency of both milk and yogurt consumption was, however, positively influenced by education and self-rated health status.

The probit and ordered probit models were tested for heteroskedasticity around the age, education, income, and self-rated health variables using the heteroskedasticity test function in Stata. There was some statistical evidence that heteroskedasticity was a problem in a limited number of the probit models. Correcting for it, however, resulted in estimations with very few statistically significant coefficients. As such, the probit models shown were not corrected for heteroskedasticity. In the ordered probit models, there was statistically significant evidence of heteroskedasticity for both milk and yogurt. The ordered probit estimates shown in the following tables have been corrected for heteroskedasticity.

Table 5.2: First step ordered probit estimates for whole sample analysis, NDS.

	Milk		Yogurt	
Variable	Coefficient	Standard Error	Coefficient	Standard Error
	Index function for probability			
age	-0.003	(0.002)	-0.001	(0.002)
gender dummy	-0.091	(0.065)	0.299***	(0.064)
urban dummy	-0.018	(0.086)	0.009	(0.072)
children dummy	0.294***	(0.089)	0.092	(0.063)
education	0.036**	(0.014)	0.032***	(0.010)
income	-0.001	(0.001)	0.001	(0.001)
language dummy	-0.234	(0.210)	0.196	(0.173)
BMI	0.026***	(0.006)	-0.001	(0.004)
provMAR dummy	0.198	(0.152)	0.033	(0.113)
provQC dummy	0.420*	(0.219)	-0.053	(0.169)
provON dummy	omitted	omitted	omitted	omitted
provPRA dummy	0.021	(0.098)	-0.030	(0.081)
provBC dummy	-0.112	(0.094)	-0.004	(0.076)
SR health status	0.143***	(0.037)	0.122***	(0.032)
	Variance function			
age	0.005***	(0.001)	0.004**	(0.002)
education	0.000	(0.009)	-0.018**	(0.009)
income	-0.001*	(0.001)	-0.001**	(0.001)
SR health status	0.012	(0.020)	0.045**	(0.021)
	Threshold parameters for index			
MU(1)	0.519***	(0.091)	0.432***	(0.067)
MU(2)	0.960***	(0.160)	0.954***	(0.139)

MU(3)	1.906***	(0.305)	2.124***	(0.307)
MU(4)	3.340***	(0.526)	3.317***	(0.480)
N	1705		1705	
Log likelihood	-2761.682		-2581.444	
Chi^2	51.123		114.542	

Table 5.3: Marginal effects for whole sample ordered probit – total milk consumption

Variable	total milk=1	total milk=2	total milk=3	total milk=4	total milk=5	total milk=6
age	0.000	0.000	0.000	0.000	-0.001	0.000
gender dummy	0.013	0.007	0.005	0.002	-0.017	-0.011
urban dummy	0.003	0.001	0.001	0.000	-0.003	-0.002
children dummy	-0.042	-0.023	-0.017	-0.008	0.056	0.035
education	-0.005	-0.003	-0.002	-0.001	0.007	0.004
income	0.000	0.000	0.000	0.000	0.000	0.000
language dummy	0.034	0.018	0.014	0.006	-0.044	-0.028
BMI	-0.004	-0.002	-0.002	-0.001	0.005	0.003
provMAR dummy	-0.029	-0.016	-0.012	-0.005	0.038	0.024
provQC dummy	-0.060	-0.033	-0.025	-0.011	0.080	0.050
provPRA dummy	-0.003	-0.002	-0.001	-0.001	0.004	0.003
provBC dummy	0.016	0.009	0.007	0.003	-0.021	-0.013
SR health status	-0.021	-0.011	-0.008	-0.004	0.027	0.017
var - age	-0.001	0.000	0.000	0.001	0.000	-0.001
var - education	-0.021	-0.001	0.006	0.025	0.010	-0.019
var - income	-0.004	0.000	0.001	0.005	0.002	-0.004
var - SR health status	0.067	0.003	-0.018	-0.081	-0.032	0.061

Table 5.4: Marginal effects for whole sample ordered probit – total yogurt consumption

Variable	total yogurt= 1	total yogurt= 2	total yogurt= 3	total yogurt= 4	total yogurt= 5	total yogurt= 6
age	0.000	0.000	0.000	0.000	0.000	0.000
gender dummy	-0.066	-0.031	-0.023	0.049	0.060	0.010
urban dummy	-0.002	-0.001	-0.001	0.001	0.002	0.000
children dummy	-0.020	-0.009	-0.007	0.015	0.019	0.003

education	-0.007	-0.003	-0.002	0.005	0.006	0.001
income	0.000	0.000	0.000	0.000	0.000	0.000
language dummy	-0.043	-0.020	-0.015	0.032	0.039	0.006
BMI	0.000	0.000	0.000	0.000	0.000	0.000
provMAR dummy	-0.007	-0.003	-0.002	0.005	0.007	0.001
provQC dummy	0.012	0.005	0.004	-0.009	-0.011	-0.002
provPRA dummy	0.007	0.003	0.002	-0.005	-0.006	-0.001
provBC dummy	0.001	0.000	0.000	-0.001	-0.001	0.000
SR health status	-0.027	-0.013	-0.009	0.020	0.025	0.004
var - age	0.000	0.000	0.000	0.000	0.000	0.000
var - education	0.072	-0.008	-0.048	-0.088	0.051	0.022
var - income	0.002	0.000	-0.001	-0.003	0.002	0.001
var - SR health status	0.022	-0.003	-0.015	-0.027	0.016	0.007

Table 5.5: Second step probit estimates for whole sample analysis, NDS.

Variable	skim milk	1% milk	2% milk	whole milk	yogurt <2%	yogurt >2%
constant	-1.946***	-1.103***	0.947***	-1.632***	-0.413	-1.072**
	(0.388)	(0.338)	(0.322)	(0.461)	(0.351)	(0.430)
age	-0.004	0.001	0.005**	-0.003	0.002	-0.005
	(0.003)	(0.003)	(0.002)	(0.004)	(0.003)	(0.003)
gender dummy	0.070	0.060	-0.035	-0.092	0.136*	-0.001
	(0.078)	(0.068)	(0.065)	(0.095)	(0.070)	(0.089)
urban dummy	0.095	0.161*	-0.125	-0.181	0.007	-0.090
	(0.110)	(0.095)	(0.089)	(0.124)	(0.097)	(0.118)
children dummy	-0.322***	-0.038	0.209***	0.189*	-0.095	0.136
	(0.097)	(0.082)	(0.078)	(0.114)	(0.085)	(0.100)
education	0.044***	0.008	-0.037***	0.003	-0.024	0.010
	(0.017)	(0.015)	(0.014)	(0.021)	(0.015)	(0.019)
income	0.002**	0.002**	-0.002**	-0.003**	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
languge dummy	-0.508**	-0.039	0.047	0.520*	-0.056	-0.342
	(0.239)	(0.213)	(0.191)	(0.279)	(0.203)	(0.277)
BMI	0.002	0.012**	-0.017***	0.009	0.003	-0.004
	(0.006)	(0.005)	(0.005)	(0.007)	(0.005)	(0.007)
provMAR dummy	0.558***	-0.166	-0.405***	0.312	-0.076	-0.281

	(0.148)	(0.149)	(0.142)	(0.196)	(0.149)	(0.216)
provQC dummy	0.042	-0.292	0.250	-0.060	-0.021	0.020
	(0.234)	(0.213)	(0.191)	(0.285)	(0.203)	(0.273)
provON dummy	omitted	omitted	omitted	omitted	omitted	omitted
	---	---	---	---	---	---
provPRA dummy	-0.087	0.192**	-0.175*	0.165	-0.400***	0.145
	(0.115)	(0.096)	(0.094)	(0.147)	(0.108)	(0.120)
provBC dummy	0.214**	-0.014	-0.377***	0.573***	-0.187*	0.220*
	(0.107)	(0.099)	(0.097)	(0.130)	(0.104)	(0.119)
SR health status	0.093**	-0.066*	-0.021	0.038	-0.022	0.008
	(0.045)	(0.038)	(0.036)	(0.053)	(0.040)	(0.049)
never dummy	-0.266**	-0.115	-0.103	0.055	-0.636***	-0.274**
	(0.133)	(0.110)	(0.102)	(0.146)	(0.113)	(0.137)
N	1705	1705	1705	1705	1705	1705
Pseudo R^2	0.056	0.024	0.040	0.043	0.031	0.032
Log likelihood	-714.195	-995.281	-1127.046	-456.423	-928.755	-545.972

Table 5.6: Second step marginal effects for whole sample analysis, NDS.

Variablels	skim milk	1% milk	2% milk	whole milk	yogurt <2%	yogurt >2%
constant	-0.451***	-0.371***	0.375***	-0.224***	-0.129	-0.181**
	(0.089)	(0.113)	(0.127)	(0.063)	(0.109)	(0.073)
age	-0.001	0.000	0.002**	0.000	0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
gender dummy	0.016	0.020	-0.014	-0.013	0.042*	0.000
	(0.018)	(0.023)	(0.026)	(0.013)	(0.022)	(0.015)
urban dummy	0.021	0.052*	-0.050	-0.027	0.002	-0.016
	(0.024)	(0.030)	(0.035)	(0.020)	(0.030)	(0.022)
children dummy	-0.069***	-0.013	0.083***	0.028	-0.029	0.024
	(0.019)	(0.027)	(0.031)	(0.018)	(0.026)	(0.018)
education	0.010***	0.003	-0.015***	0.000	-0.008	0.002
	(0.004)	(0.005)	(0.006)	(0.003)	(0.005)	(0.003)
income	0.000**	0.001**	-0.001**	-0.000**	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
languge dummy	-0.100**	-0.013	0.019	0.089	-0.017	-0.051
	(0.040)	(0.071)	(0.076)	(0.057)	(0.062)	(0.036)
BMI	0.001	0.004**	-0.007***	0.001	0.001	-0.001

	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)	(0.001)
provMAR dummy	0.161***	-0.053	-0.153***	0.052	-0.023	-0.040
	(0.050)	(0.046)	(0.050)	(0.039)	(0.044)	(0.026)
provQC dummy	0.010	-0.093	0.099	-0.008	-0.006	0.003
	(0.056)	(0.064)	(0.076)	(0.037)	(0.063)	(0.047)
provON dummy	omitted	omitted	omitted	omitted	omitted	omitted
	---	---	---	---	---	---
provPRA dummy	-0.020	0.067*	-0.069*	0.025	-0.112***	0.026
	(0.025)	(0.034)	(0.036)	(0.024)	(0.026)	(0.023)
provBC dummy	0.054*	-0.005	-0.144***	0.105***	-0.055*	0.041*
	(0.029)	(0.033)	(0.035)	(0.029)	(0.029)	(0.024)
SR health status	0.021**	-0.022*	-0.008	0.005	-0.007	0.001
	(0.010)	(0.013)	(0.014)	(0.007)	(0.012)	(0.008)
never dummy	-0.055**	-0.038	-0.040	0.008	-0.165***	-0.041**
	(0.024)	(0.035)	(0.040)	(0.021)	(0.023)	(0.018)

Table 5.7: Second step elasticities for whole sample analysis, NDS.

Variablels	skim milk	1% milk	2% milk	whole milk	yogurt <2%	yogurt >2%
age	-0.310	0.063	0.229	-0.280	0.117	-0.481
gender dummy	0.054	0.036	-0.015	-0.087	0.087	-0.001
urban dummy	0.122	0.159	-0.094	-0.322	0.008	-0.141
children dummy	-0.123	-0.012	0.049	0.102	-0.032	0.067
education	0.988	0.130	-0.469	0.091	-0.446	0.250
income	0.211	0.180	-0.119	-0.332	0.120	0.137
languge dummy	-0.143	-0.010	0.009	0.261	-0.015	-0.113
BMI	0.107	0.412	-0.424	0.459	0.126	-0.175
provMAR dummy	0.063	-0.011	-0.020	0.042	-0.006	-0.025
provQC dummy	0.015	-0.074	0.049	-0.024	-0.006	0.008
provPRA dummy	-0.019	0.035	-0.022	0.049	-0.067	0.040
provBC dummy	0.051	-0.002	-0.046	0.207	-0.033	0.062
SR health status	0.485	-0.265	-0.062	0.242	-0.096	0.047
never dummy	-0.039	-0.014	-0.009	0.011	-0.100	-0.063

5.4.2. Estimation Results – Young Adults

Due to the small number (59) of respondents aged 24 years or younger, several variables could not be used in the regressions and the whole milk regression could not be performed (only 3.4% of young adults typically consumed whole milk). In addition, the provincial dummy variables were not included in the young adult regressions. Only results significant at a level of 10% or lower are discussed below. For more detailed numerical information, please see tables 5.12 to 5.17.

Young adults with children in the home and higher incomes drink more milk. Young adult females, those who live in urban areas, and those whose preferred language is French eat more yogurt.

Young adults without children in the home and women are more likely to drink skim milk. Young adults who live in an urban area, have children living in the home, and who prefer English are more likely to drink 1% milk. Young adult males and those with lower incomes are more likely to drink 2% milk. Young adults with children in the home and those with higher levels of education are more likely to eat low or non-fat yogurt.

The probit and ordered probit models were tested for heteroskedasticity around the age, education, income, and self-rated health variables. There was no statistical evidence that heteroskedasticity was a problem in any of the probit models. In the ordered probit models, there was evidence of heteroskedasticity around education and income for milk and education for yogurt. Given that correcting the models for heteroskedasticity resulted in none of the estimated coefficients being statistically signficant, and the fact that there was evidence of only limited heteroskedasticity, the models were not corrected for it.

Table 5.8: First step ordered probit estimates for young adult analysis, NDS.

	Milk		Yogurt	
Variable	Coefficient	Standard Error	Coefficient	Standard Error
	Index function for probability			
gender dummy	0.497	0.343	0.591*	0.346

urban dummy	-0.026	0.427	0.738*	0.432
children dummy	0.584*	0.302	0.273	0.299
education	0.070	0.055	-0.057	0.057
income	0.006*	0.004	0.004	0.004
language dummy	0.363	0.350	0.679*	0.354
BMI	-0.012	0.020	-0.017	0.020
SR health status	-0.108	0.164	0.234	0.167
	Threshold parameters for index			
MU(1)	0.160	0.103	0.489***	0.143
MU(2)	0.561***	0.149	1.386***	0.171
MU(3)	1.671***	0.175	2.643***	0.242
MU(4)	2.723***	0.233	3.702***	0.485
N	59		59	
Log likelihood	-87.283		-83.443	
Chi^2	6.972		13.772	

Table 5.9: Marginal effects for young adult ordered probit – total milk consumption

Variable	total milk=1	total milk=2	total milk=3	total milk=4	total milk=5	total milk=6
gender dummy	-0.095	-0.019	-0.045	-0.018	0.113	0.065
urban dummy	0.004	0.001	0.003	0.002	-0.006	-0.004
children dummy	-0.090	-0.020	-0.054	-0.056	0.125	0.096
education	-0.012	-0.003	-0.007	-0.006	0.016	0.011
income	-0.001	0.000	-0.001	-0.001	0.002	0.001
language dummy	-0.052	-0.013	-0.034	-0.041	0.077	0.063
BMI	0.002	0.001	0.001	0.001	-0.003	-0.002
SR health status	0.018	0.004	0.010	0.009	-0.024	-0.016

Table 5.10: Marginal effects for young adult ordered probit – total yogurt consumption

Variable	total yogurt= 1	total yogurt= 2	total yogurt= 3	total yogurt= 4	total yogurt= 5	total yogurt= 6
gender dummy	-0.133	-0.064	-0.025	0.152	0.062	0.008
urban dummy	-0.189	-0.072	-0.001	0.190	0.064	0.008
children dummy	-0.051	-0.031	-0.025	0.067	0.035	0.005
education	0.011	0.007	0.005	-0.014	-0.007	-0.001
income	-0.001	-0.001	0.000	0.001	0.001	0.000

language dummy	-0.104	-0.075	-0.087	0.140	0.106	0.021
BMI	0.003	0.002	0.001	-0.004	-0.002	0.000
SR health status	-0.045	-0.027	-0.020	0.059	0.029	0.004

Table 5.11: Second step probit estimates for young adult analysis, NDS.

Variablels	skim milk	1% milk	2% milk	yogurt <2%	yogurt >2%
constant	-3.928	0.655	1.707	-11.077	-2.536
	(2.581)	(2.070)	(1.937)	(293390)	(2.318)
gender dummy	1.159*	-0.264	-0.794*	0.125	-0.096
	(0.697)	(0.534)	(0.478)	(0.653)	(0.576)
urban dummy	-0.138	1.191*	-0.563	7.461	-0.630
	(0.719)	(0.717)	(0.562)	(293390)	(0.667)
children dummy	-1.077**	0.738*	-0.137	0.839*	-0.721
	(0.533)	(0.423)	(0.374)	(0.451)	(0.586)
education	-0.010	-0.035	0.056	0.203*	0.128
	(0.126)	(0.109)	(0.094)	(0.121)	(0.127)
income	0.005	0.007	-0.013**	-0.006	0.004
	(0.006)	(0.006)	(0.005)	(0.007)	(0.006)
languge dummy	-0.144	-1.578**	0.434	0.224	0.169
	(0.683)	(0.790)	(0.488)	(0.645)	(0.630)
BMI	0.052	-0.032	-0.035	-0.019	0.020
	(0.047)	(0.038)	(0.038)	(0.051)	(0.041)
SR health status	0.322	-0.400	0.044	0.178	-0.088
	(0.297)	(0.247)	(0.208)	(0.274)	(0.276)
never dummy	-7.066	0.004	-0.059	-7.378	-0.319
	(217687)	(0.712)	(0.606)	(296274)	(0.743)
N	59	59	59	59	59
Pseudo R^2	0.204	0.203	0.141	0.268	0.110
Log likelihood	-21.378	-28.233	-35.060	-24.470	-20.830

Table 5.12: Second step marginal effects for young adult analysis, NDS.

Variablels	skim milk	1% milk	2% milk	yogurt <2%	yogurt >2%
constant	-0.947	0.147	0.436**	-0.995	-0.795*
	(852.64)	(0.310)	(0.171)	(808.86)	(0.406)
gender dummy	0.065	-0.083	-0.306*	0.002	-0.018
	(2678.46)	(0.174)	(0.171)	(245.01)	(0.111)
urban dummy	-0.012	0.242***	-0.219	0.058	-0.149

	(462.20)	(0.090)	(0.208)	(4685.76)	(0.189)
children dummy	-0.080	0.231*	-0.054	0.017	-0.122
	(3059.73)	(0.132)	(0.148)	(2264.09)	(0.088)
education	-0.001	-0.011	0.022	0.003	0.023
	(31.40)	(0.033)	(0.037)	(424.11)	(0.023)
income	0.000	0.002	-0.005**	0.000	0.001
	(17.10)	(0.002)	(0.002)	(11.83)	(0.001)
languge dummy	-0.011	-0.321***	0.172	0.004	0.033
	(433.58)	(0.091)	(0.189)	(538.06)	(0.128)
BMI	0.004	-0.010	-0.014	0.000	0.004
	(164.46)	(0.011)	(0.015)	(38.98)	(0.007)
SR health status	0.026	-0.121*	0.018	0.003	-0.016
	(1018.59)	(0.072)	(0.083)	(371.45)	(0.050)
never dummy	-0.141**	0.001	-0.024	-0.057	-0.050
	(0.06)	(0.216)	(0.240)	(4558.01)	(0.099)

Table 5.13: Second step elasticities for young adults analysis, NDS.

Variablels	skim milk	1% milk	2% milk	yogurt <2%	yogurt >2%
gender dummy	1.308	-0.265	-0.471	0.245	-0.125
urban dummy	-0.285	0.916	-0.400	10.219	-1.225
children dummy	-0.896	0.413	-0.047	1.393	-0.472
education	-0.295	-0.626	0.640	7.980	3.003
income	0.747	0.614	-0.674	-1.033	0.470
languge dummy	-0.065	-0.310	0.080	0.169	0.069
BMI	2.774	-1.040	-0.716	-1.316	0.861
SR health status	2.466	-1.851	0.129	1.800	-0.531
never dummy	-0.394	0.000	-0.005	-1.567	-0.065

5.4.3. Estimation Results – Older Women

Only results significant at a level of 10% or lower are discussed below. For more detailed numerical information, please see tables 5.18 to 5.23.

Older women who have higher BMIs and higher self-rated health status drink milk more frequently. Older women without children living in the home and who have higher self-rated health eat yogurt more frequently.

Older women without children in the home, whose preferred language is English, and who reside in the Maritimes or BC are more likely to drink skim milk. Older women who have children living in the home and whose preferred language is French are more likely to drink 2% milk while older women who live in the Maritimes and BC are less likely to drink 2% milk. Older women who are older, with lower incomes, and who live in the Maritimes or BC are more likely to drink whole milk. Older women who are residents of the Prairies are less likely to eat low or non-fat yogurt. Older women who live in the Prairies are more likely to eat whole-fat yogurt.

The probit and ordered probit models were tested for heteroskedasticity around the age, education, income, and self-rated health variables. Most models did not show statistical evidence of heteroskedasticity, with the exceptions the probit models for skim milk with age, 2% milk with education, and whole fat yogurt with income and self-rated health. Given that correcting the models for heteroskedasticity resulted in fewer significant estimations, and the fact that there was evidence of only limited heteroskedasticity, the models were not corrected for it.

Table 5.14: First step ordered probit estimates for older women analysis, NDS

	Milk		Yogurt	
Variable	Coefficient	Standard Error	Coefficient	Standard Error
	Index function for probability			
age	-0.005	0.006	0.005	0.006
urban dummy	0.103	0.144	0.043	0.144
children dummy	0.131	0.192	-0.409**	0.193
education	0.010	0.023	0.035	0.023
incoe	0.000	0.002	0.002	0.002
language dummy	-0.219	0.338	0.498	0.341
BMI	0.018**	0.007	-0.006	0.007
provMAR dummy	0.372	0.226	0.281	0.229
provQC dummy	0.548	0.339	-0.445	0.341
provPRA dummy	-0.052	0.153	0.087	0.152
provBC dummy	0.172	0.160	0.226	0.159
SR health status	0.137**	0.058	0.137**	0.058
	Threshold parameters for index			

MU(1)	0.417***	0.049	0.456***	0.052
MU(2)	0.788***	0.054	0.982***	0.057
MU(3)	1.407***	0.062	2.054***	0.073
MU(4)	2.755***	0.108	3.494***	0.165
N	415		415	
Log likelihood	-676.863		-643.997	
Chi^2	13.797		24.086	

Table 5.15: Marginal effects for older women ordered probit – total milk consumption

Variable	total milk=1	total milk=2	total milk=3	total milk=4	total milk=5	total milk=6
age	0.001	0.000	0.000	0.000	-0.001	0.000
urban dummy	-0.024	-0.010	-0.006	0.002	0.029	0.009
children dummy	-0.028	-0.013	-0.009	-0.001	0.037	0.014
education	-0.002	-0.001	-0.001	0.000	0.003	0.001
incoe	0.000	0.000	0.000	0.000	0.000	0.000
language dummy	0.053	0.021	0.012	-0.005	-0.062	-0.019
BMI	-0.004	-0.002	-0.001	0.000	0.005	0.002
provMAR dummy	-0.071	-0.037	-0.027	-0.011	0.099	0.046
provQC dummy	-0.107	-0.053	-0.039	-0.013	0.145	0.067
provPRA dummy	0.012	0.005	0.003	-0.001	-0.015	-0.005
provBC dummy	-0.037	-0.017	-0.011	-0.001	0.048	0.018
SR health status	-0.031	-0.013	-0.008	0.001	0.039	0.013

Table 5.16: Marginal effects for older women ordered probit – total yogurt consumption

Variable	total yogurt=1	total yogurt=2	total yogurt=3	total yogurt=4	total yogurt=5	total yogurt=6
age	-0.001	-0.001	0.000	0.001	0.001	0.000
urban dummy	-0.008	-0.005	-0.004	0.005	0.011	0.001
children dummy	0.093	0.042	0.026	-0.062	-0.091	-0.009
education	-0.007	-0.004	-0.003	0.004	0.009	0.001
incoe	0.000	0.000	0.000	0.000	0.001	0.000
language dummy	-0.079	-0.052	-0.052	0.028	0.134	0.021
BMI	0.001	0.001	0.001	-0.001	-0.002	0.000
provMAR dummy	-0.045	-0.030	-0.029	0.017	0.076	0.011
provQC dummy	0.096	0.047	0.032	-0.061	-0.103	-0.011
provPRA	-0.016	-0.009	-0.008	0.008	0.023	0.003

dummy						
provBC dummy	-0.038	-0.024	-0.023	0.017	0.060	0.008
SR health status	-0.026	-0.015	-0.013	0.014	0.035	0.004

Table 5.17: Second step probit estimates for older women analysis, NDS.

Variablels	skim milk	1% milk	2% milk	whole milk	yogurt <2%	yogurt >2%
constant	-1.854*	-1.573*	0.026	4.324**	0.401	0.336
	(1.032)	(0.889)	(0.847)	(1.723)	(0.870)	(1.250)
age	0.000	0.005	0.012	-0.067***	0.006	-0.025
	(0.012)	(0.010)	(0.010)	(0.021)	(0.010)	(0.016)
urban dummy	0.062	0.118	-0.152	0.036	-0.074	-0.077
	(0.221)	(0.194)	(0.183)	(0.321)	(0.187)	(0.260)
children dummy	-0.625*	-0.091	0.701***	-7.456	-0.071	0.203
	(0.347)	(0.253)	(0.245)	(224761)	(0.258)	(0.332)
education	0.020	0.028	-0.031	-0.101	-0.051	0.067
	(0.038)	(0.033)	(0.031)	(0.069)	(0.033)	(0.045)
income	0.002	0.003	-0.002	-0.015***	0.002	-0.003
	(0.002)	(0.002)	(0.002)	(0.005)	(0.002)	(0.003)
languge dummy	-1.462***	-0.296	0.746*	0.980	-0.539	-0.146
	(0.556)	(0.437)	(0.429)	(0.653)	(0.416)	(0.735)
BMI	0.008	0.008	-0.007	-0.007	-0.005	-0.017
	(0.013)	(0.011)	(0.010)	(0.018)	(0.011)	(0.015)
provMAR dummy	0.719**	-0.347	-0.531*	1.115**	-0.115	-0.293
	(0.298)	(0.313)	(0.294)	(0.533)	(0.289)	(0.500)
provQC dummy	0.838	-0.092	-0.424	0.092	0.300	-0.054
	(0.533)	(0.435)	(0.431)	(0.638)	(0.414)	(0.735)
provON dummy	omitted	omitted	omitted	omitted	omitted	omitted
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provPRA dummy	-0.245	0.296	-0.094	0.218	-0.601***	0.530**
	(0.240)	(0.190)	(0.189)	(0.419)	(0.212)	(0.248)
provBC dummy	0.408*	-0.147	-0.424**	1.024***	-0.199	0.339
	(0.216)	(0.205)	(0.198)	(0.362)	(0.203)	(0.269)
SR health status	0.106	-0.033	0.000	-0.138	-0.078	-0.153
	(0.091)	(0.076)	(0.074)	(0.136)	(0.076)	(0.107)
never dummy	-0.511**	0.104	-0.284	0.814***	-0.657***	-0.738*
	(0.257)	(0.188)	(0.187)	(0.287)	(0.243)	(0.445)

N	415	415	415	415	415	415
Pseudo R^2	0.103	0.037	0.055	0.254	0.041	0.101
Log likelihood	-171.689	-241.211	-269.976	-78.478	-241.987	-110.071

Table 5.18: Second step marginal effects for older women analysis, NDS.

Variablels	skim milk	1% milk	2% milk	whole milk	yogurt <2%	yogurt >2%
constant	-0.643**	-0.558***	0.010	0.006	0.119	0.033
	(0.297)	(0.216)	(0.334)	(304.901)	(0.218)	(0.092)
age	0.000	0.002	0.005	-0.001	0.002	-0.003
	(0.003)	(0.004)	(0.004)	(51.196)	(0.003)	(0.002)
urban dummy	0.014	0.039	-0.061	0.001	-0.026	-0.010
	(0.049)	(0.062)	(0.073)	(27.293)	(0.065)	(0.036)
children dummy	-0.107***	-0.030	0.271***	-0.028**	-0.024	0.030
	(0.041)	(0.082)	(0.086)	(0.011)	(0.085)	(0.055)
education	0.005	0.009	-0.012	-0.002	-0.017	0.009
	(0.009)	(0.011)	(0.012)	(77.496)	(0.011)	(0.006)
income	0.000	0.001	-0.001	0.000	0.001	0.000
	(0.001)	(0.001)	(0.001)	(11.488)	(0.001)	(0.000)
languge dummy	-0.224***	-0.095	0.290*	0.035	-0.166	-0.018
	(0.057)	(0.133)	(0.157)	(1367.150)	(0.114)	(0.084)
BMI	0.002	0.003	-0.003	0.000	-0.002	-0.002
	(0.003)	(0.004)	(0.004)	(5.768)	(0.004)	(0.002)
provMAR dummy	0.217**	-0.106	-0.196**	0.065	-0.038	-0.031
	(0.108)	(0.085)	(0.097)	(2211.507)	(0.093)	(0.042)
provQC dummy	0.235	-0.031	-0.163	0.002	0.106	-0.007
	(0.172)	(0.143)	(0.159)	(74.401)	(0.151)	(0.091)
provON dummy	omitted	omitted	omitted	omitted	omitted	omitted
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provPRA dummy	-0.052	0.105	-0.037	0.004	-0.178***	0.089*
	(0.046)	(0.070)	(0.074)	(196.750)	(0.052)	(0.051)
provBC dummy	0.108*	-0.048	-0.162**	0.046	-0.065	0.052
	(0.064)	(0.065)	(0.071)	(1680.130)	(0.063)	(0.048)
SR health status	0.024	-0.011	0.000	-0.002	-0.026	-0.020
	(0.021)	(0.026)	(0.029)	(106.394)	(0.026)	(0.014)
never dummy	-0.096**	0.036	-0.110	0.030	-0.187***	-0.062***
	(0.038)	(0.066)	(0.070)	(1157.356)	(0.054)	(0.022)

Table 5.19: Second step elasticities for older women analysis, NDS.

Variablels	skim milk	1% milk	2% milk	whole milk	yogurt <2%	yogurt >2%
age	0.040	0.383	0.636	-11.489	0.403	-2.948
urban dummy	0.079	0.115	-0.113	0.084	-0.075	-0.130
children dummy	-0.060	-0.009	0.049	-0.393	-0.007	0.037
education	0.433	0.457	-0.377	-3.914	-0.827	1.778
income	0.133	0.196	-0.092	-2.280	0.141	-0.361
languge dummy	-0.352	-0.078	0.150	1.407	-0.134	-0.062
BMI	0.339	0.263	-0.171	-0.605	-0.162	-0.936
provMAR dummy	0.092	-0.023	-0.027	0.700	-0.008	-0.029
provQC dummy	0.377	-0.026	-0.086	0.066	0.088	-0.024
provPRA dummy	-0.057	0.060	-0.013	0.121	-0.100	0.216
provBC dummy	0.108	-0.025	-0.053	1.157	-0.033	0.115
SR health status	0.550	-0.129	-0.001	-1.304	-0.306	-0.984
never dummy	-0.096	0.019	-0.036	0.748	-0.075	-0.109

5.4.4. Comparison between groups

There were no significant coefficients or marginal effects which had different signs (positive/ negative) between the different population groups in the NDS analysis. There were however, differences in the magnitude of the marginal effects between groups. (Only marginal effects significant at a level of 10% or lower for two or more groups are compared.) Young adults living in urban areas are more likely to purchase 1% milk than others living in urban areas. Older women with children in the home are less likely to purchase skim milk and more likely to purchase 2% milk than others with children in the home. Young adults with lower income are more likely to purchase 2% milk than other lower income individuals. English speaking older women are more likely to purchase skim milk than other English speakers. Older women living in the Maritimes are more likely to purchase skim milk and less likely to purchase 2% milk than other Maritime residents. Older women living in the Prairies are less likely to purchase non- or

low-fat yogurt than other Prairie residents. Older women living in BC are more likely to purchase skim milk than other BC residents. Older women with children in the home drink milk more frequently than others with children in the home.

5.4.5. Comparison between NDS and CCHS 2.2

The CCHS 2.2 analysis highlighted the factors involved in whether or not individuals purchased a given product and how much of a given product they consumed. The analysis from the NDS considered which product an individual claimed to purchase most of the time and the frequency with which they claimed to consume it. Therefore the resulting estimates are not directly comparable in terms of magnitude, but the marginal effects might be expected to have the same signs (positive or negative). It is also important to note that the CCHS 2.2 was conducted in 2004 whereas the NDS was conducted in 2011, so the seven-year gap and subsequent changes in consumption patterns could account for some of the differences between the two. Only effects which are significant at a level of 10% or lower for both data sets are compared. Results from the first step of the analysis of the whole sample are discussed first.

5.4.5.1. Whole Sample

For skim milk, the marginal effect of the language dummy variable is negative in both cases, indicating that individuals whose first language is English are more likely to choose skim milk. The marginal effects of the Maritime regional dummy variable are positive in both cases, meaning that individuals living in the Maritimes are more likely to consume skim milk.

In the case of 1% milk, the marginal effect of income is positive for both the CCHS 2.2 and the NDS, meaning that people with higher incomes are more likely to choose 1% milk.

For 2% milk, the marginal effect of education is negative in both cases, indicating that people with lower levels of education are more likely to consume 2% milk. The Maritime regional dummy marginal effect is positive in the CCHS 2.2 analysis and negative in the NDS analysis.

In both analyses, having children in the household had a positive marginal effect on whole milk consumption, while income had a negative marginal effect. This means that people with kids in the house or those with lower incomes are more likely to consume whole milk. There were discrepancies in the marginal effects of the urban dummy variable and the BC regional variable between the two data sources for whole milk. The CCHS 2.2 had a positive marginal effect for the urban variable whereas the NDS had a negative one, and the CCHS 2.2 had a negative marginal effect for the BC variable whereas the NDS had a positive one.

There were no significant similarities or differences between the marginal effects calculated for the CCHS 2.2 and the NDS for either disaggregated yogurt category.

Next, signs of significant coefficients are compared for the second stage of the analyses. Age had a negative effect on the frequency of milk consumption in both surveys, indicating that younger people drink more milk. The NDS showed a positive relationship between milk consumption and having children in the home whereas the CCHS 2.2 showed a negative relationship.

As for yogurt consumption, the NDS found a positive relationship between education and frequency of yogurt consumption whereas the data from the CCHS 2.2 exhibited a negative one. In both cases a positive relationship was shown between self-rated health status and yogurt consumption. The CCHS 2.2 showed that men eat more yogurt, while the NDS showed that women eat more yogurt.

In general, these similarities and differences possibly indicate that some factors affecting consumption have remained relatively constant over the last seven years, while others have changed. The idea that younger people drink more milk and people who consider themselves healthier eat more yogurt is supported by both data sources. Some other factors about which milk products people choose have also remained the same. What has changed are mainly the factors involved in how much yogurt people eat; in the CCHS 2.2 data men and people with less education were consuming more and in the NDS data women and people with higher education were consuming more. There were also a couple of

changes in who chooses to drink whole milk. Again, it should be noted that these differences could be due to the time between the collection of the two data sources or to differences in sampling.

5.4.5.2. Young Adults / Adolescents

Similar results were found for the disaggregated data estimations for the young adults/adolescents. Both the NDS and CCHS 2.2 found that young adults/adolescents who lived in a home with children were less likely to drink skim milk. Both surveys found that young adults/adolescents in higher income households were more likely to drink 1% milk and the younger individuals within these groups were more likely to drink 2% milk. There were, however, a couple differences between the results for the aggregated data. The NDS found that young adults living in a home with children drank more milk whereas the CCHS 2.2 found that adolescents living in a home with children drank less milk. As well, the NDS found that young adults living in urban areas ate more yogurt whereas the CCHS 2.2 found that adolescents living in rural areas ate more yogurt.

5.4.5.3. Women over 50

Both data sets found that older women who prefer English were more likely to drink skim milk. The NDS found that older women living in the Prairies were more likely to drink 1% milk and that older women living in the Maritimes were more likely to drink 2% milk while the CCHS 2.2 found the opposite effects. Both data sets found that the younger individuals within the older women group drank more milk. The NDS found that older women with higher levels of education ate more yogurt while the CCHS 2.2 found that older women with lower levels of education ate more yogurt.

5.5. Summary

The purpose of this chapter was to address the objective of determining how demographic and health status characteristics predict milk and yogurt consumption. Demographic characteristics were identified in the conceptual framework as one of the major aspects of static internal factors affecting food product choices. This chapter assessed how these characteristics affect milk and

yogurt consumption, both in terms of frequency of consumption as well as in type of product typically consumed. On its own, the NDS data shows that the characteristics of people who purchase different types of the same product (ie: skim milk vs. 2% milk) differ widely, and that the characteristics of milk consumers and yogurt consumers are also different. There was little evidence, however, that there were different determinants of milk and yogurt consumption for the dairy deficient populations than for the general population. As such, in order to improve public health through increasing dairy consumption and subsequent micronutrient intake, a broad general public educational campaign explaining the benefits of dairy consumption could be used in addition to strategies targeting specific demographic groups, depending on available resources and budget constraints. There were some differences between the results from the NDS and the CCHS 2.2 data which could be evidence of changing consumption patterns between 2004 and 2011, or they could be due to something else entirely. In the next chapter, the results from the choice experiment conducted as part of the NDS are discussed.

Chapter 6: Product Attributes in Milk and Yogurt

6.1. Introduction

This chapter discusses the analysis of the choice experiments conducted as part of the National Dairy Survey (NDS) which explored respondents' choices for various types of product factors, namely price, product attributes, and information on packaging. The objectives of this research are both to determine how demographic and health characteristics predict milk and yogurt consumption as well as to determine how various product attributes in milk and yogurt impact intended consumption. This chapter addresses mainly the second objective by analyzing consumer choices for products with different attributes in milk and yogurt, but also considers the first objective in that it examines how demographic and health characteristics affect preferences for these attributes.

The choice experiments were analyzed first by running multinomial logit models to determine the relationships between demographic characteristics and the various product attributes (fat content, probiotic, vitamin-enhanced, voluntary nutrition panel, and the Health Check^{TM} symbol). In order to do this, the attributes were interacted with age, gender, preferred language, children in the home, education, income, area, health change status, marital status, role in the household, and probiotic use. (Model specification tests were used to determine which variables should be included, details are given in Table 6.1.) Using these estimations, willingness to pay (WTP) for the attributes in milk and yogurt is calculated.

This analysis is then repeated for women over 50, young adults, and people with high Health Belief Model (HBM) scores to examine any differences between the general population, the at-risk groups, and those who feel that they are more at risk to develop osteoporosis and are more willing to take action to prevent it.

This chapter begins by describing the experimental design and model specification. Next, an overview of the sample used for the HBM analysis is given. Following this, the interactions between the attributes and demographic characteristics are described and the calculated WTPs are discussed for the whole

sample, then for young adults and women over 50, and finally for the high HBM score sample. This chapter then concludes with a discussion and summary.

6.2. Experimental Design

In order to measure consumers' willingness to pay (WTP) for various attributes in milk and yogurt, choice experiments were included in the NDS. The survey was conducted online throughout Canada, and each respondent was presented with 8 visual scenarios; 4 for milks and 4 for yogurts. The choice sets included 2 product options and a 'neither' option, and were based on a 2-litre carton for milk or an 8x100g package for yogurt. Examples of the choice sets are shown in Figures 3 and 4. Experimental design was based on a fractional factorial design for the attributes and levels provided in Table 3.1 for each milk and yogurt.

To explore whether the same attributes would be desirable for milk and yogurt, the same attributes were included for both products in the choice experiments. The attributes in question were either informational or functional characteristics, as well as price and fat content. The informational attributes were a nutrition panel with additional voluntary information on nutrients not currently mandated and a Health Check^{TM} symbol. The functional product attributes used in this experiment are vitamin-enhancement and probiotic.

For further detail about the experimental design of the choice experiment, please see chapter 3.

6.3. Model Specification

The analysis is conducted using a multinomial logit model where utility from the n^{th} individual facing a choice among j alternatives can be represented as (Verbeek, 2008 pg.221):

$$U_{nj} = \beta'_n V_{nj} + \varepsilon_{nj}$$

where β_n is a vector of parameters and V_{nj} is the systematic portion of the individual's utility function. ε_{nj} is the error term.

The systematic portion of the individual's utility function can be written as:

$V_{nj} = b_0(P_j) + b_1(\text{fat content}_j) + b_2(\text{nutrition label}_j) + b_3(\text{HealthCheck}^{TM}{}_j) + b_4(\text{probiotic}_j) + b_5(\text{vitamin-enhanced}_j)$

where P_j is the price of alternative *j* and fat content is the % of milk fat in alternative *j*. Nutrition label is a dummy variable equal to one if alternative *j* has the voluntary nutrition label and zero if it has the mandatory nutrition label. HealthCheck™ is a dummy variable equal to one if alternative *j* has the Health Check™ symbol, zero if not. Probiotic and vitamin-enhanced are also dummy variables equal to one if alternative *j* contains probiotics or additional vitamins and zero otherwise.

To decide which demographics to include in the interaction variables, model specification tests based on likelihood ratio tests (LRT) were applied. If including a particular demographic improved either the milk or yogurt model significantly, it was included in both final models, if not, it was dropped from the analysis. For LRT values please see table 6.1. It should be noted that this procedure is not path independent and that different results could be generated by adding the variables in a different order. The attributes included in the final models were age (in years), gender (0=male, 1=female), preferred language (0=English, 1=French), children in the home (0=no, 1=yes), education (in years), income (in thousands), area dummies (city/town/rural, with rural omitted), health changes (0=has not made changes to improve health in the past 12 months, 1=has made changes to improve health in the past 12 months), previous probiotic purchaser (PPP) (0=does not typically purchase probiotic yogurt, 1=does typically purchase probiotic yogurt), never (0=consumes milk/yogurt, 1=never consumes milk/yogurt), breastfeeding (0=not currently breastfeeding, 1=currently breastfeeding), marital status dummies (married/single/divorced/widowed, with married omitted), and role in the household dummies (main income earner, partner of main income earner, dual income earner, child of main income earner, family member of main income earner, or other with main omitted). It should be noted that by interacting the individual specific characteristics with all of the attributes, the variables could become collinear rather than orthogonal, affecting the model's explanatory power or significance.

The model could be estimated once for the whole sample, then have WTP values calculated separately for each group in question, but this would assume that the estimated coefficients are the same for everyone. For example, the coefficient estimated for age interacted with probiotics would remain the same in all the calculations while age would vary, implying that the effect of age on preferences for probiotics is constant across the population. Therefore, separate models are estimated for each group in question, allowing the effects of the characteristics on preferences for the attributes to vary between groups, which will be evident in the estimated coefficients. WTP values for the young adult and women over 50 groups will be calculated using coefficients from both of the estimated models to determine whether they do in fact capture different effects.

In the young adult, women over 50, and HBM score analyses, marital status and household role dummies were not included as they resulted in too many parameters for the number of observations. In addition, gender and breastfeeding were not included in the women over 50 analysis as they were obviously all women and none were currently breastfeeding. Of the 1705 respondents, 59 were included in the young adult category and 416 were in the women over 50 group. The HBM scores differed slightly between milk and yogurt as different questions were used for the two products to assess some constructs such as perceived pleasantness (discussed in futher detail in section 6.4), which resulted in sample sizes of 89 and 75 respectively.

Table 6.1: Log likelihood ratio test results to determine significance of explanatory variables for inclusion in multinomial logit model.

	Milk		Yogurt	
Model	Log-likelihood	LR test statistics	Log-likelihood	LR test statistics
Base	-6819.4		-6897.8	
Restricting				
Age	-6788.4	62.02***	-6866.5	62.67***
Gender	-6775.6	25.62***	-6860	13.05**
Language	-6763.9	23.78***	-6855.3	9.27*
Kid	-6762.2	3.38	-6851.2	17.50***
Education	-6755.6	16.52***	-6849.3	21.32***
Income	-6750.9	9.47*	-6846.6	5.34

Area	-6734.7	41.78***	-6831.8	35.0***
PPP	-6705.2	58.92***	-6742.7	178.27***
SR Health	-6702.8	4.87	-6740.2	5.04
Health changes	-6692.1	26.20***	-6735.5	14.34**
Health improvement	-6688.8	6.75	-6731	8.96
Pregnant	-6689.3	5.62	-6732.7	5.74
Breastfeeding	-6691.7	0.82	-6730.7	9.70*
BMI	-6691	2.2	-6726.4	8.47
Employed	-6690.9	2.54	-6728.7	3.89
Marital Status	-6679.5	25.4***	-6718.7	23.90***
Role in household	-6662.1	34.7***	-6703.4	30.6***
Eating behaviour	errors		errors	

Note: ***,**, and * indicate statistical significance at 1%, 5%, and 10% respectively.
Chi-square(5) critical values are 15.09(1%), 11.07(5%), and 9.24(10%)

The estimated coefficients are then used to calculate WTP for the various attributes. According to Alpizar *et al.* (2001), assuming a linear utility function, the marginal rate of substitution between two different attributes is the ratio of the coefficients of the two attributes, so marginal WTP is calculated as follows:

$$MWTP_x = -\beta_x / \beta_p$$

where β_x is the estimated coefficient for attribute x and β_p is the estimated price coefficient.

To incorporate the interacted variables in calculating mean WTPs for any group of respondents, the coefficients for the interactions are multiplied by the means of the characteristic for that group (for all characteristics which are continuous variables) and then summed with the coefficient for the attribute in question, giving an overall coefficient for that attribute (as is done to calculate Hanemann's (1989) grand constant). The dummy variables should be held constant for the group in calculating mean WTP, so that the whole group falls into one category, such as men living in cities with children in the home. The negative of the overall attribute coefficient is then divided by the price coefficient to get the mean WTP.

$$\text{Mean } WTP_x = -[\beta_x + \Sigma\ \beta_{xi}(i)] / \beta_p$$

where β_{xi} is the estimated coefficient for the interaction between attribute *x* and characteristic *i*, β_x is the estimated coefficient for attribute *x*, β_p is the estimated price coefficient, *x* is the attribute, and *i* is the sample mean of the characteristic.

In addition, individual WTP is calculated for each respondent and attribute. To calculate the individual level WTP, *i* becomes each individual's value for characteristic *i* instead of the sample mean. These values are used in two ways. The individual WTPs are averaged to determine the mean WTP of the whole sample, as well as graphed in order to examine the distributions of WTP for the different attributes. A narrow distribution would indicate that most respondents are WTP a similar value for the attribute in question, while a wide distribution would indicate heterogeneous preferences among the respondents for that attribute.

6.4. High HBM score group

In order to identify a group of respondents whose HBM scores set them apart from the general population, individuals who chose either 'agree' or 'strongly agree' to all of the statements assessing perceived benefits, perceived barriers, perceived susceptibility, perceived severity, self-efficacy, willingness to use, and perceived pleasantness were put in the high HBM score group. This means that people in this group perceive both the benefits of and barriers to dairy consumption as high, perceive their susceptibility to and severity of osteoporosis as high, are willing to use milk/yogurt with extra calcium as a way of increasing the calcium content of their diet, have high belief that they are capable of consuming the recommended amount of dairy products, and perceive milk/yogurt as pleasant. This group is identified separately for milk and yogurt as the willingness to use and perceived pleasantness measures use different questions for milk and yogurt. The same multinomial logit model is run using this sample and WTP is calculated to identify if this group has different valuations for the attributes than the general population. Table 6.3 describes the demographic characteristics of the high HBM score groups. Relative to the whole sample, the high HBM score group has more females, is slightly younger, has children in the

home more frequently, has lower education and income, and live more in towns and rural areas.

Table 6.2: Demographic characteristics of high HBM score group

	Milk (n=89)		Yogurt (n=75)	
	mean	SD	mean	SD
Female (d)	0.71		0.72	
French (d)	0.25		0.23	
Age	48.85	13.64	48.45	13.57
Children (d)	0.36		0.41	
Education	13.57	2.27	14.00	2.38
Income	57.03	34.86	61.29	36.04
City dummy (d)	0.56		0.56	
Town dummy (d)	0.26		0.25	

(d) = dummy variable

6.5. Results

In this section, attribute coefficients, interaction coefficients, and WTP's are discussed. Interaction coefficients are only discussed if they are statistically significant at a level of 10% or lower. Estimated numerical values are given at the end of each subsection. For calculations involving the whole sample, distributions of WTP for each product are graphed. The whole sample results are presented first, followed by the young adult results, the women over 50 results, and finally the HBM results.

6.5.1. Interactions – Whole Sample

6.5.1.1. Estimated Coefficients - Milk

The price coefficient was negative and significant at a level of 1%, indicating that people prefer cheaper milk. The voluntary nutrition panel and vitamin-enhancement were positive and significant at levels of 1% and 5% respectively, meaning that in general, people are interested in milk with a more comprehensive nutrition panel and vitamin-enhanced milk. The coefficients for fat content and the Health Check^{TM} symbol were all positive but not significant, while the coefficient for probiotic was negative but not significant.

For the variables interacting the attributes with demographic characteristics, 26 of the 95 coefficients were significant at a 10% level or lower.

The voluntary nutrition panel interacted with age and education had negative coefficients, meaning that younger people and those with less education are more interested in milk with additional nutritional information. The voluntary nutrition panel/health change interaction was positive, indicating that people who have made changes to improve their health are interested in a longer nutrition panel on their milk. The voluntary nutrition panel/dual interaction was positive, indicating that dual income earners are more likely to purchase milk with a longer nutrition panel. The voluntary nutrition panel/never interaction was negative, indicating that people who never drink milk are less interested in milk with additional nutritional information. Probiotic also had a negative coefficient when interacted with age, meaning younger people are more likely to purchase milk with probiotics. The probiotic/town interaction was positive, indicating that people living in towns are more likely to purchase probiotic milk. The probiotic/PPP was positive, meaning that previous probiotic purchasers were more interested in probiotic milk. The probiotic/dual interaction was positive, meaning that dual income earners are more interested in probiotic milk. The vitamin-enhanced attribute had negative coefficients when interacted with language and children in the home variables, meaning that individuals whose preferred language is English and those without children in the home are more willing to purchase vitamin-enhanced milk. The vitamin-enhanced/town and city variables both had positive coefficients indicating that people living in either a town or city would be more likely to purchase vitamin-enhanced milk. The vitamin-enhanced/health change interaction was positive, meaning that people who have made changes to improve their health are more likely to purchase vitamin-enhanced milk. The vitamin-enhanced/single interaction was negative, indicating that single people are less likely to purchase vitamin-enhanced milk. The vitamin-enhanced/partner and child interactions were both negative, meaning that partners and children of the main household income earner are less interested in vitamin-enhanced milk. The vitamin-enhanced/never coefficient was negative, meaning that people who never drink milk are less interested in vitamin-enhanced milk. The Health Check^{TM} income and PPP interactions were both positive, indicating that people with

higher incomes and those who have previously purchased probiotics are more likely to purchase milk with a Health Check™ symbol. The Health Check™/never coefficient was also negative, indicating that people who never drink milk are less interested in milk with a Health Check™ symbol. The fat content/gender and age interactions were negative indicating that women and younger people are more likely to avoid fat in their milk. The fat content attribute had a positive coefficient when interacted with the language variable, showing that people whose preferred language is French prefer milk with more fat. The fat content/widow and divorced interactions both had positive coefficients, meaning that people who are widowed or divorced prefer milk with more fat in it.

6.5.1.2. Estimated Coefficients - Yogurt

The price coefficient for yogurt was negative and significant at a level of 1%, indicating that people prefer cheaper yogurt. The fat content coefficient was also negative and significant at a level of 5%, meaning that in general people want yogurt with less fat in it. The nutrition panel coefficient was both positive and significant at a level of 10%, meaning that in general, people are interested in purchasing yogurt with a more comprehensive nutrition panel. The vitamin-enhanced and probiotic coefficients were both positive but not significant while the Health Check™ coefficient was negative but not significant.

For yogurt, 28 out of the 95 interactions resulted in coefficients significant at a level of 10% or lower. The voluntary nutrition panel interacted with age, gender, and education resulted in negative coefficients, meaning that younger people, males, and people with less education are more interested in additional nutrition information on yogurt packaging. The voluntary nutrition panel/never interaction had a negative coefficient, indicating that people who never eat yogurt are less interested in a longer nutrition panel. The voluntary nutrition panel/partner, family, and other interactions were all positive, indicating that partners and family members of the main income earner and others are more likely to purchase yogurt with a longer nutrition panel.

The probiotic/town and city interactions were positive, meaning that people living in a town or city are more likely to purchase probiotic yogurt. The probiotic/PPP interaction was positive, meaning that people who have previously purchased probiotics are more likely to purchase probiotic yogurt. The probiotic/never coefficient was negative, indicating that people who never eat yogurt are less interested in probiotic yogurt. The vitamin-enhanced/language, children in the home, and income coefficients were negative, meaning that people whose preferred language is English, those without children in the home, and people with lower incomes are more likely to try vitamin-enhanced yogurt. The vitamin-enhanced/town and city coefficients were again positive signifying that people living in a town or city are more likely to purchase vitamin-enhanced yogurt. The vitamin-enhanced/PPP interaction was positive, meaning that people who previously purchased probiotics are more likely to purchase vitamin-enhanced yogurt. The vitamin-enhanced/never coefficient was negative, implying that people who never eat yogurt are less likely to purchase vitamin-enhanced yogurt. The vitamin-enhanced/breastfeeding interaction was positive, meaning that women currently breastfeeding are more interested in vitamin-enhanced milk. The vitamin-enhanced/single and other interactions were negative, meaning that people who are single or are other members of the household are less interested in vitamin-enhanced yogurt.

The Health Check™ logo had positive coefficients when interacted with language, income, and widowed, meaning that people whose preferred language is French, who have higher incomes, and who are widowed are more likely to purchase yogurt with a Health Check™ logo on the package. The Health Check™/never coefficient was negative, indicating that people who never eat yogurt are less likely to purchase yogurt with a Health Check™ symbol. The fat content/children interaction had a positive coefficient, indicating that people with children prefer yogurts with more fat in them. The fat content/breastfeeding interaction was negative, meaning that women who are breastfeeding prefer yogurts with less fat. The fat content/never interaction was negative, meaning that people who never eat yogurt prefer the idea of yogurt with less fat in it.

6.5.2. Willingness to Pay – Whole Sample

The estimated coefficients were then used to calculate willingness to pay (WTP) for both milk and yogurt, first for an arbitrarily chosen respondent (an English speaking, 40 year old man who lives in a city with children in the home and average education and income), then for all respondents. The mean WTP for the whole sample is then calculated by averaging the individual WTPs for each attribute. The amount people are willing to pay extra is to obtain the attribute in question in either a 2-litre carton of milk or an 8x100g package of yogurt. Actual calculated values on average across the population are provided in Table 6.4.

Table 6.3: Willingness to pay (in $) for attributes in milk (for a 2L carton) and yogurt (for an 8x100g package) – English speaking 40 year old man living in a city with children in the home with average education and income.

	milk	yogurt
Nutrition panel	0.22	0.44
Fat content	-0.13	-0.34
Vitamin-enhanced	0.37	0.52
Probiotic	-0.08	-0.30
Health Check^{TM}	0.42	0.26

For milk, this respondent (an English speaking, 40 year old man who lives in a city with children in the home and average education and income) has a WTP of $0.22 for a voluntary nutrition panel and $0.42 for a Health Check^{TM} symbol. He has a WTP of $-0.13 for fat content and $-0.08 for probiotics in milk, indicating that he wishes to avoid both fat and probiotics in milk. He has a WTP of $0.37 for vitamin-enhanced milk.

For yogurt, this respondent's WTP for the information attributes is approximately the opposite of his WTP for them in milk; he is WTP $0.44 for a voluntary nutrition panel and $0.26 for a Health Check^{TM} symbol. He is still avoiding fat and probiotics in yogurt with WTPs of $-0.34 and $-0.30 respectively. He is WTP $0.52 for vitamin-enhanced yogurt.

The individual WTP values for each attribute are now calculated for both milk and yogurt. The means of these WTPs are discussed first, followed by a discussion of the distributions.

Table 6.4: Mean willingness to pay (in $) for attributes in milk (for a 2L carton) and yogurt (for an 8x100g package) – whole sample (average retail prices: $3.50 and $5.50 for milk and yogurt respectively)

	milk	yogurt
Nutrition panel	0.23	0.20
Fat content	-0.22	-0.59
Vitamin-enhanced	0.15	0.62
Probiotic	-0.06	-0.15
Health Check™	0.32	0.25

In the case of milk, consumers on average have a WTP of $-0.22 for fat content, signifying that they will pay to have less fat in their milk. On average respondents were most willing to pay extra for a Health Check™ logo ($0.32) or a more comprehensive nutrition facts panel ($0.23), followed by vitamin-enhanced milk ($0.15). People on average were WTP $-0.06 for milk containing probiotics, meaning that respondents wanted to avoid probiotics in their milk.

The mean WTP for fat content in yogurt is also negative ($-0.59), meaning that people will pay to have a lower fat content in their yogurt. On average, individuals were most willing to pay extra for a vitamin-enhanced yogurt ($0.62), followed by a Health Check™ logo ($0.25) and a voluntary nutrition panel ($0.20). Respondents on average were WTP -$0.15 for yogurt containing probiotics, signifying that they wanted to avoid probiotic yogurt. This is unexpected given the recent success of probiotic yogurts in the marketplace (Granato *et al.*, 2010).

While these mean WTP measures are important, it is also important to note the distribution of the individual WTPs. Figures 6.1 and 6.2 demonstrate the distributions of WTP for the various attributes in milk and yogurt, across the choices made by respondents to the survey (calculated for each choice). Figure 6.1 shows that only about 5% of the choices suggest a willingness to pay some positive amount to have more fat in their milk, while the majority of choices

suggest that respondents are willing to pay somewhere between $0.10 and $0.40 to avoid fat in their milk. Despite the fact that the average WTP for probiotics in milk was negative, about 40% of the choices made by respondents suggest a positive WTP for probiotics in milk. Conversely, the vitamin-enhanced attribute had a positive average WTP but almost 30% of the choices made by respondents suggest a negative WTP for vitamin-enhanced milk. There were just over 10% of choices made by respondents with a negative WTP for both the voluntary nutrition panel and the Health Check™ logo, but most choices suggested that respondents were WTP some positive amount for these attributes, with the nutrition panel having a wider distribution.

Figure 6.2 shows that most of the choices made by respondents suggest a WTP between $0.30 and $0.80 to have less fat in their yogurt; none of the choices suggest a WTP to have more fat in their yogurt. Again the average WTP for probiotics in yogurt was negative, but 44% of the choices made had a positive WTP. Only 5% of the choices made by respondents had a negative WTP for vitamin-enhanced yogurt, but the distribution of WTP was very wide. Eighty-nine and 80% of choices made by respondents had a positive WTP for the Health Check™ and voluntary nutrition panel attributes respectively.

Figure 6.1: Distribution of WTP for attributes in milk – whole sample

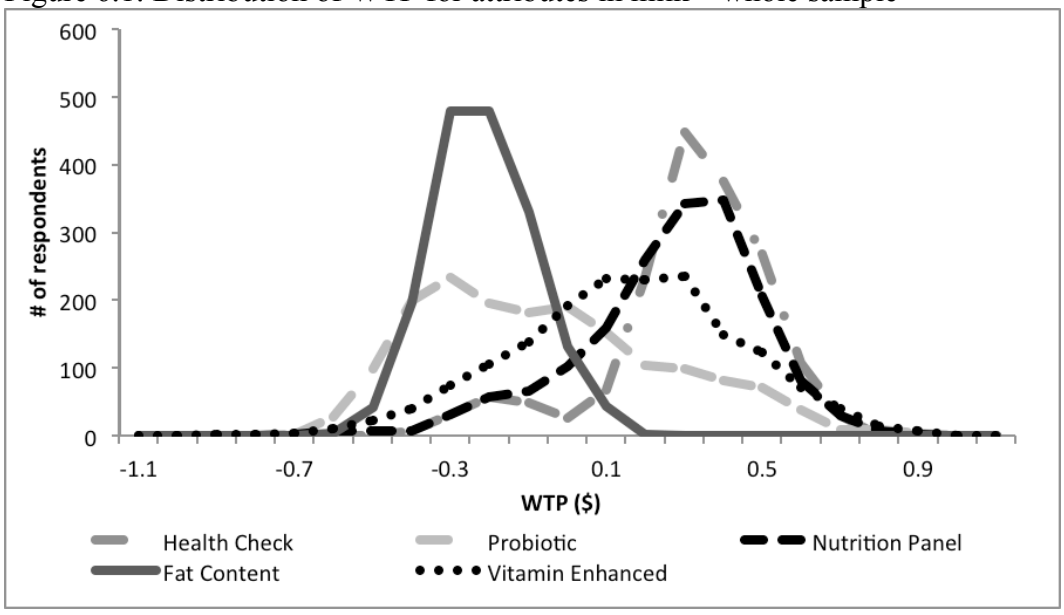
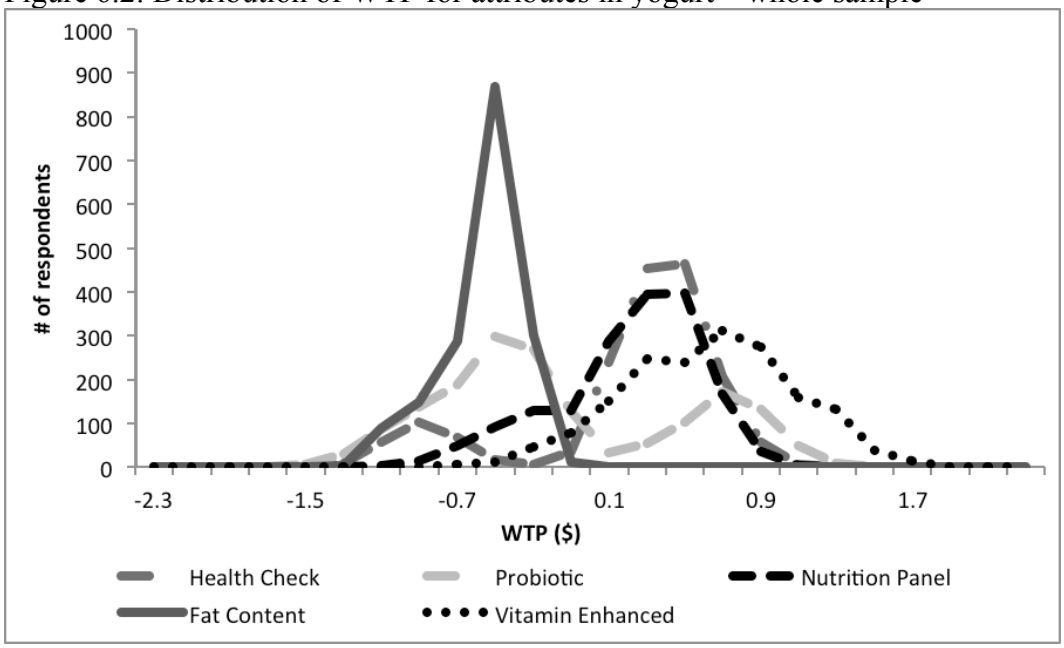


Figure 6.2: Distribution of WTP for attributes in yogurt – whole sample



What should be noted about these results is that consumers are not necessarily WTP the same amount for the same attributes in different dairy products. It is also important to note that there are different segments of consumers, some of which are WTP to have certain attributes in their food and some of which who want to avoid these same attributes. Consumers are WTP to avoid fat in their food, but are WTP more to avoid fat in yogurt than in milk. Given that yogurt is typically consumed in a smaller portion size than milk, a 1% decrease in fat content would actually have a larger effect in a portion milk than in yogurt. Despite the fact that there is a segment of the population who will pay to have probiotics in their yogurt and milk, more than half of respondents don't see probiotics as a positive attribute. People are WTP around the same amount to have a more informative nutrition panel or a Health Check™ logo on their milk and yogurt package, but they are WTP much more to have vitamin-enhanced yogurt than they are to have vitamin-enhanced milk.

6.5.3. Interactions – Young Adults

6.5.3.1. Estimated Coefficients – Milk

In the young adult milk analysis, the price coefficient was negative and significant at a level of 1%, meaning that young adults prefer cheaper milk. The vitamin-enhanced and Health Check™ coefficients were positive and significant at 10% and 5% respectively, indicating that young adults like the idea of vitamin-enhanced milk and milk with a Health Check™ logo. Fat content and the voluntary nutrition panel both had positive but statistically insignificant coefficients while probiotics had a negative but insignificant coefficient.

Of the 60 interactions, 10 were significant at a level of 10% or lower. The nutrition panel/income interaction had a positive coefficient, indicating that young adults with higher incomes are more interested in milk with a more comprehensive nutrition panel. The probiotic/education interaction had a negative coefficient, meaning that young adults with lower levels of education are more interested in probiotic milk. The vitamin-enhanced/gender and age interactions were negative, indicating that young adult males and the younger individuals within that group are more interested in vitamin-enhanced milk. The vitamin-enhanced/education and health change interactions were positive, meaning that young adults with higher levels of education and those who made changes to improve their health are more interested in vitamin-enhanced milk. The vitamin-enhanced/income interaction was negative, indicating that young adults with lower incomes are more interested in vitamin-enhanced milk. The vitamin-enhanced/never interaction was negative, indicating that people who never consume milk are less interested in vitamin-enhanced milk. The Health Check™/gender interaction was negative, meaning that young adult males are more interested in having a Health Check™ symbol on their milk. The fat content/PPP interaction was negative, indicating that previous probiotic purchasers want less fat in their milk.

6.5.3.2. Estimated Coefficients - Yogurt

In the young adult yogurt analysis, the price coefficient was negative and significant at a level of 1%, meaning that young adults prefer cheaper yogurt. The Health Check™ coefficient was positive and significant at 5%, meaning that young adults like the idea of having a Health Check™ logo on their yogurt. The fat content, vitamin-enhanced, and probiotic coefficients were all positive but not significant while the voluntary nutrition panel coefficient was negative but not significant.

Of the 60 interactions in the young adult yogurt analysis, 8 were significant at a level of 10% or lower. The voluntary nutrition panel/education coefficient was positive, indicating that young adults with more education are more interested in a longer nutrition panel. The probiotic/PPP interaction was positive, indicating that young adults who have previously purchased probiotics are more interested in probiotic yogurt. The vitamin-enhanced/breastfeeding interaction was positive, indicating that young adults who are currently breastfeeding are more interested in vitamin-enhanced yogurt. The Health Check™/gender interaction was negative, meaning that young adult males are more likely to purchase yogurt with a Health Check™ symbol. The Health Check™/children interaction was positive, meaning that young adults with children in the home are more interested in yogurt with a Health Check™ symbol. The fat content/education interaction was negative, meaning that young adults with more education want less fat in their yogurt. The fat content/income and health change interactions were positive, meaning that young adults with higher incomes and those who have made changes to improve their health prefer higher fat yogurts.

6.5.4. Willingness to Pay – Young Adults

The estimated coefficients for young adults were then used to calculate WTP for both milk and yogurt. In addition, the estimated coefficients from the whole sample model are also used to calculate young adults' WTP for the attributes to see if the different models capture different effects. The amount

young adults are willing to pay extra is to obtain the attribute in question in either a 2-litre carton of milk or an 8x100g package of yogurt. Actual calculated values on average across the young adult group are provided in Table 6.5.

Table 6.5: Willingness to Pay (in $) for attributes in milk (for a 2L carton) and yogurt (for an 8x100g package) – young adults (average retail prices: $3.50 and $5.50 for milk and yogurt respectively)

	Young adult model		Whole sample model	
	milk	yogurt	milk	yogurt
Nutrition panel	0.06	0.34	0.39	0.35
Fat content	-0.26	-0.63	-0.28	-0.60
Vitamin-enhanced	-0.07	-0.1	0.67	0.87
Probiotic	0.00	0.18	0.00	-0.28
Health Check™	0.33	0.95	0.52	0.62

In the case of milk, young adult consumers on average had a WTP of $-0.26 for fat content, signifying that they will pay to have less fat in their milk. On average young adults were willing to pay the most for a Health Check™ logo ($0.33), and were willing to pay $0.06 for a more comprehensive nutrition facts panel and $0.00 for probiotics. On average, young adults had a WTP of $-0.07 for vitamin-enhanced milk, meaning that they wanted to avoid having additional vitamins added to their milk.

The mean WTP for fat content in yogurt is also negative ($-0.63), meaning that young adults will pay to have a lower fat content in their yogurt. On average, young adults were most willing to pay extra for a Health Check™ logo ($0.95), followed by a voluntary nutrition panel ($0.34), then by probiotic yogurt ($0.18). Respondents on average were WTP -$0.10 for vitamin-enhanced yogurt, signifying that they wanted to avoid yogurt with vitamins added to it.

The discrepancies between the WTPs for the probiotic and vitamin-enhanced attributes demonstrate that there are different effects between the estimations for the two groups. These results also show that young adults differ from the general population in several ways. Where the whole population had a negative average WTP for probiotics in both milk and yogurt, the young adult

group had a positive average WTP for both products. In addition, the whole population had a positive average WTP for vitamin-enhanced milk and yogurt whereas the young adult group had a negative average WTP for both products. The young adult group was willing to pay less than the whole sample for an extended nutrition panel on their milk but more than the whole sample for the extended nutrition panel on their yogurt. The young adult group was also willing to pay a lot more than the rest of the sample to have a Health Check™ symbol on their yogurt. What is consistent between the whole sample and the young adult group is that in both cases they are willing to pay approximately twice as much to avoid fat in their yogurt than they are in milk.

6.5.5. Interactions – Women Over 50

6.5.5.1. Estimated Coefficients – Milk

In the women over 50 milk analysis, the price coefficient was negative and significant at a level of 1%, indicating that women over 50 prefer cheaper milk. The Health Check™ coefficient was negative and significant at a level of 10%, meaning that women over 50 are not interested in milk with a Health Check™ logo. The voluntary nutrition panel, vitamin-enhanced, and probiotic coefficients were positive but not significant while the fat content coefficient was negative but not significant.

Of the 50 interaction variables in the women over 50 milk analysis, 9 were statistically significant at a level of 10% or lower. The nutrition panel/language interaction was negative, indicating that older women whose preferred language is English are more interested in having a more comprehensive nutrition panel on their milk. The nutrition panel/education interaction was also negative, meaning that older women with less education are more interested in the longer nutrition panel on their milk. The nutrition panel/town interaction was positive, indicating that older women living in towns are more interested in the longer nutrition panel on their milk. The nutrition panel/never interaction was negative, meaning that people who never buy milk are less interested in milk with a longer nutrition panel. The probiotic/age interaction was negative, meaning that the younger

individuals in the women over 50 group are more interested in probiotic milk. The probiotic/children interaction was also negative, meaning that older women without children in the home are more interested in probiotic milk. The Health Check™/education interaction was positive, indicating that older women with more education are more interested in milk with a Health Check™ symbol. The Health Check™/never interaction was negative, meaning that women over 50 who never purchase milk are less interested in milk with a Health Check™ logo.

6.5.5.2. Estimated Coefficients - Yogurt

In the women over 50 yogurt analysis, the price coefficient was negative and significant at a level of 1%, indicating that women over 50 prefer cheaper yogurt. The voluntary nutrition coefficient was positive and significant at a level of 1%, meaning that women over 50 are interested in yogurt with a more comprehensive nutrition panel. The vitamin-enhanced and probiotic coefficients were positive but not significant, while the fat content and Health Check™ coefficients were negative but not significant.

Of the 50 interaction variables, 9 were statistically significant at a level of 10% or lower. The nutrition panel/education interaction was negative, meaning that older women with less education are more interested in the longer nutrition panel on their yogurt. The nutrition panel/health change interaction was positive, indicating that women over 50 who have made changes to improve their health are more likely to purchase yogurt with a longer nutrition panel. The nutrition panel/never interaction was negative, meaning that women over 50 who never purchase yogurt are less interested in yogurt with a longer nutrition panel. The probiotic/town and PPP interactions were positive, indicating that women over 50 who live in towns and those who've previously purchased probiotics are more likely to purchase probiotic yogurts. The probiotic/never interaction was negative, indicating that older women who never purchase yogurt are less interested in probiotic yogurt. The fat content/income interaction was negative, indicating that older women with higher income are more interested in yogurt with less fat. The fat content/never interaction was also negative, indicating that women over 50 who never purchase yogurt prefer lower fat yogurts. The Health Check™/never

interaction was negative, meaning that women over 50 who never purchase yogurt are less interested in yogurt with a Health Check™ symbol.

6.5.6. Willingness to Pay – Women Over 50

The estimated coefficients were then used to calculate WTP for both milk and yogurt. In addition, the estimated coefficients from the whole sample model are also used to calculate women over 50's WTP for the attributes to see if the different models capture different effects. The amount women over 50 are willing to pay extra is to obtain the attribute in question in either a 2-litre carton of milk or an 8x100g package of yogurt. Actual calculated values on average across the women over 50 group are provided in Table 6.6.

Table 6.6: Willingness to Pay (in $) for attributes in milk (for a 2L carton) and yogurt (for an 8x100g package) – women over 50 (average retail prices: $3.50 and $5.50 for milk and yogurt respectively)

	Women over 50 model		Whole sample model	
	milk	yogurt	milk	yogurt
Nutrition panel	0.35	0.20	0.37	0.34
Fat content	-0.37	-0.77	-0.44	-0.88
Vitamin enhanced	0.36	0.76	0.36	1.01
Probiotic	0.00	-0.30	-0.40	-0.42
Health Check™	0.44	0.47	0.34	0.25

In the case of milk, women over 50 on average have a WTP of $-0.37 for fat content, signifying that they will pay to have less fat in their milk. On average the women over 50 are most willing to pay extra for a Health Check™ logo ($0.44), vitamin-enhanced milk ($0.36), or a more comprehensive nutrition facts panel ($0.35). Women over 50 on average are WTP $0.00 for milk containing probiotics.

The mean WTP for fat content in yogurt is also negative ($-0.77), meaning that women over 50 will pay to have a lower fat content in their yogurt. On average, women over 50 are most willing to pay extra for a vitamin-enhanced yogurt ($0.76), followed by a Health Check™ logo ($0.47), then a voluntary

nutrition panel ($0.20). Respondents on average are WTP -$0.30 for yogurt containing probiotics, signifying that they want to avoid probiotic yogurt.

The discrepancies between the WTP for values for probiotics in milk and vitamin enhancement for yogurt demonstrate that there are different effects in the women over 50 and whole sample models. These results also show that older women make similar choices to those of the general population. In general, they are WTP more for the attributes they deem positive (vitamin-enhanced, lower fat and with a Health Check™ symbol) than the rest of the population is, despite having a lower mean income than the whole sample.

6.5.7. Interactions - Health Belief Model

6.5.7.1. Estimated coefficients - milk

In the milk analysis for individuals with high HBM scores, the price coefficient was negative and significant at a level of 1%, indicating that people with high HBM scores prefer cheaper milk. The voluntary nutrition panel, Health Check™, fat content, and probiotic coefficients were positive but not significant, while the vitamin-enhanced coefficient was negative but not significant.

Of the 51 interaction variables in the milk analysis, 9 were statistically significant. The nutrition panel/language interaction was negative, indicating that people whose preferred language is English with high HBM scores are more interested in a longer nutrition panel. Fat content interacted with gender and education was negative, meaning that women and people with more education with high HBM scores prefer milk with less fat. The fat content/city interaction was positive, indicating that people living in cities with high HBM scores prefer milk with more fat. Vitamin-enhanced interacted with both language and children was negative, indicating that people whose preferred language is English and those without children in the home with high HBM scores are more interested in vitamin-enhanced milk. The vitamin-enhanced/education coefficient was positive, indicating that people with more education and high HBM scores are more interested in vitamin-enhanced milk. Health Chcck™ interacted with both age and children was negative, indicating that younger people and those without

children in the home with high HBM scores are more interested in milk with a Health Check™ symbol.

6.5.7.2. Estimated coefficients - yogurt

In the yogurt analysis for individuals with high HBM scores, the price coefficient was negative and significant at a level of 1%, indicating that people with high HBM scores prefer cheaper yogurt. The nutrition panel and fat content coefficients were both positive and significant at a level of 10%, indicating that people with high HBM scores are interested in having a more comprehensive nutrition panel and more fat in their yogurt. The vitamin-enhanced and probiotic coefficients were negative but not significant while the Health Check™ coefficient was positive but not significant.

Of the 51 interaction variables in the yogurt analysis, 9 were statistically significant. Fat content interacted with age, gender, and income was negative, indicating that older people, women, and people with higher income with high HBM scores prefer yogurt with less fat. The vitamin-enhanced/gender and town interactions were positive, meaning that women and people living in towns with high HBM scores are more interested in vitamin-enhanced yogurt. The vitamin-enhanced/language coefficient was negative, indicating that people whose preferred language is English with high HBM scores are more interested in vitamin-enhanced yogurt. Probiotics interacted with children, city, and previous probiotic purchaser were all positive, meaning that people with children in the home, people living in cities, and people who have previously purchased probiotics with high HBM scores are more interested in probiotic yogurt.

6.5.8. Willingness to Pay – Respondents with high Heath Belief Model scores

The estimated coefficients from the HBM analysis were then used to calculate willingness to pay (WTP) for both milk and yogurt. The amount people are willing to pay extra is to obtain the attribute in question in either a 2-litre carton of milk or an 8x100g package of yogurt. Actual calculated values on average across the population are provided in Table 16.

Table 6.7: Willingness to pay (in $) for attributes in milk (for a 2L carton) and yogurt (for an 8x100g package) – high HBM score group (average retail prices: $3.50 and $5.50 for milk and yogurt respectively)

	Milk	Yogurt
Nutrition panel	0.40	-0.09
Probiotics	0.36	1.12
Vitamin enhanced	0.56	0.59
Health Check^{TM}	0.74	0.25
Fat content	-0.11	-0.63

In the case of milk, consumers with high HBM scores have an average WTP of $0.40 for a longer nutrition panel, which is higher than the $0.23 the general population was WTP on average. Consumers with high HBM scores have an average WTP of $0.36 for milk with probiotics, which is higher than the $-0.06 the general population was WTP on average. Consumers with high HBM scores have an average WTP of $0.56 for vitamin-enhanced milk, which is higher than the $0.15 the general population was WTP on average. Consumers with high HBM scores have an average WTP of $0.74 for milk with a Health CheckTM symbol, which is higher than the $0.32 the general population was WTP on average. Consumers with high HBM scores have an average WTP of $-0.11 for fat content, which means that they prefer milk with less fat but are not as adverse to fat as is the general population whose average WTP was $-0.22.

In the case of yogurt, consumers with high HBM scores have an average WTP of $-0.09 for a longer nutrition panel, indicating that they do not particularly want a longer nutrition panel, whereas the general population had a WTP of $0.20. Consumers with high HBM scores are WTP $1.12 for probiotic yogurt whereas the general population is WTP $-0.15. Consumers with high HBM scores are WTP $0.59 for vitamin-enhanced yogurt which is quite similar to the $0.62 the general population is WTP. Consumers with high HBM scores are WTP the same as the general population ($0.25) for yogurt with a Health Check^{TM} symbol. Both the consumers with high HBM scores and the general population are WTP to avoid fat in their yogurt at $-0.63 and $-0.59 respectively.

6.6. Summary

WTP appears to vary by product, attribute, and consumer segment. Most people are willing to pay similar amounts to have a Health Check™ symbol or additional nutritional information on the packaging of milk and yogurt, and in general, women over 50 seem to be WTP more for these informational attributes than the rest of the population. The exception is that young adults are WTP less than the rest for a voluntary nutrition panel on milk but more to have one on yogurt and are WTP more than the rest for a Health Check™ logo on yogurt. Many individuals appear to be willing to pay extra to have vitamin-enhanced yogurt, while some will pay to have vitamin-enhanced milk and some want to avoid it. Specifically, women over 50 will pay more than the general population for vitamin-enhanced milk and yogurt, while young adults appear not to want vitamins added to either their milk or their yogurt. Some people do not want probiotics added to their milk or yogurt, but some will pay extra to have them. Young adults seem more likely to pay extra for probiotic dairy products. Consumers are willing to pay more to avoid fat in their yogurt than in their milk, and women over 50 are willing to pay more to avoid fat in milk than the rest of the population is.

In general, it appears that individuals who perceive the benefits of and barriers to dairy consumption as greater as well as perceive their susceptibility to and the severity of osteoporosis as higher are WTP more than the general population for milk with additional health and information attributes, but this trend is not as evident for yogurt. Overall, there does seem to be a link between respondents' health beliefs and their interest in dairy products with additional attributes.

This chapter has explored how product attributes in milk and yogurt, which were identified as product factors affecting choices in the conceptual framework, play a role in consumer choices for milk and yogurt products, which is the second objective of this research. It has also examined the relationships between various attributes and how demographic and health characteristics (internal factors) affect valuation of these attributes, addressing the first objective of this research.

The analysis discussed in this chapter was done using a multinomial logit model which was sufficient for the purpose of this study. Going forward, however, using a mixed logit or latent class model could provide more richness in the analysis, helping to identify various groups within the sample, and will be the focus of future research.

Chapter 7: Summary of Research

7.1. Summary and conclusions

Fluid milk consumption in Canada has been decreasing while yogurt consumption has been increasing. Declining dairy product consumption overall could be having a negative impact on public health in Canada as dairy products are a primary source of calcium and vitamins B_2, B_{12}, and D in the diet. There is evidence that some of the population groups most susceptible to negative health outcomes as a result of low calcium and vitamin D intake (women over 50 and adolescents) are in fact not consuming adequate levels of several micronutrients which could be a result of lower than recommended dairy consumption. In this study, the factors that play a role in milk and yogurt consumption as outlined by the conceptual framework described in chapter 2 are examined. The conceptual framework was used to organize and categorize the various factors affecting individual choices of milk and yogurt products. It was a useful tool in identifying the internal factors and product factors that affect both consumption and hypothetical choices as the evidence showed that not only did demographic characteristics and product attributes have significant explanatory power in many of the analyses, but that they also interacted with each other, as shown by the differences in choices made by different demographic groups.

The specific objectives of this study, given the factors discussed in the conceptual framework, were to determine:

1) How do demographic and health status characteristics affect milk and yogurt consumption?
2) How do various combinations of product attributes in milk and yogurt impact preferences?

In order to address these objectives, two data sets were used. The first was the CCHS 2.2 which was collected by Statistics Canada in 2004. The second was the NDS which was conducted by the authors in 2011. Utilizing these data sets, the following analyses were conducted:

1) A two-stage Heien and Wessells procedure (probit and SUR) was used on the CCHS 2.2 data to determine demographic and health factors involved

in a) whether or not an individual consumes a given product and b) how much of a given product an individual consumes. (The details of this analysis are discussed in Chapter 4.)

2) Probit and ordered probit models were used on the NDS data to determine demographic and health factors involved in a) the frequency with which an individual consumes milk or yogurt, where 'never' is an option, and b) which type of product the individual typically consumes. (The details of this analysis are discussed in Chapter 5.)
3) A multinomial logit model was used to analyze the choice experiment data collected as part of the NDS to determine a) the interactions between demographic characteristics with various attributes in milk and yogurt and b) how much respondents would be willing to pay for various attributes in milk and yogurt. (The details of this analysis are discussed in Chapter 6.)

The findings of each analysis are now summarized.

7.1.1. CCHS 2.2 Consumption Analysis

The purpose of the CCHS 2.2 analysis was to determine how demographic and health characteristics, identified as internal factors affecting product choice in the conceptual framework, played a role in the consumption of milk and yogurt. This analysis indicated that several factors, including age, gender, region, income, preferred language, whether or not there are children in the home, self-rated health, and level of physical activity played a role in determining both what types of milk and yogurt products were preferred as well as how much of them were consumed. Some differences were noted between the whole sample and the sub-populations in question. Among older women, those with a higher BMI were more likely to drink 2% milk while among adolescents those with a lower BMI were more likely to drink 2% milk. In the whole sample, smokers drank more skim milk while among adolescents non-smokers drank more skim milk. Older women with lower self-rated health and adolescents with higher self-rated health drank more 1% milk. In the whole sample females drank more whole milk but among adolescents

males drank more whole milk. Older women with a higher BMI ate more low/non-fat yogurt but adolescents with a lower BMI ate more low/non-fat yogurt. Respondents from the whole sample living in a rural area consumed more whole-fat yogurt but adolescents living in an urban area consumed more whole-fat yogurt. Overall the results from this analysis indicated the following:

1) Milk and yogurt consumers are not the same people.
2) Consumers of individual dairy products (such as 1% milk vs. whole milk) fall into different demographic categories.
3) Individuals who are more likely to consume milk (yogurt) do not have the same characteristics as the people who consume milk (yogurt) more frequently or in larger quantities.
4) There are differences in how factors affect milk and yogurt consumption between the whole sample and the dairy deficient populations, especially the health characteristics BMI, self-rated health status, and smoking status.

7.1.2. NDS Consumption Analysis

The purpose of the NDS consumption analysis was to determine how demographic and health characteristics, identified as internal factors affecting product choice in the conceptual framework, played a role in the consumption of milk and yogurt. The NDS analysis results indicated that there are variations in which milk or yogurt product consumers choose based on the region they live in, whether or not they have children in the home, their age, and their level of self-rated health, education, and income. Frequency of consumption varies by the same characteristics. The results from this chapter corroborate findings 1, 2, and 3 from the CCHS 2.2 analysis, but no differences between the whole sample and the dairy deficient populations were found in this analysis. Differences between the signs of marginal effects in the NDS and CCHS 2.2 analyses are shown in Table 7.1. These differences could demonstrate how milk and yogurt consumption patterns have changed between 2004 and 2011, possibly highlighting trends that should be considered in future research, such as the role of education in product choices or how dairy consumption differs by region.

Table 7.1 Differences in signs of marginal effects in CCHS 2.2 and NDS

Product	Variable	ME in CCHS 2.2 (2004)	ME in NDS (2011)
2% milk	Maritimes	(+)	(-)
Whole milk	Urban	(+)	(-)
Whole milk	British Columbia	(-)	(+)
Yogurt	Education	(-)	(+)
Yogurt	Gender	(-)	(+)
Milk	Children in home	(-)	(+)

7.1.3. Choice Experiment Analysis

The purpose of the choice experiment analysis was to determine how product attributes and label information, identified in the conceptual framework as product factors affecting product choice, affect consumer preferences for milk and yogurt products. Respondents' choices for products with different attributes vary by product, attribute, and consumer segment. Most people are willing to pay similar amounts (slightly more for milk) to have a Health Check^{TM} symbol or additional nutritional information on the packaging of both milk and yogurt. Many individuals appear to be willing to pay extra to have vitamin-enhanced yogurt, while some will pay to have vitamin-enhanced milk and some want to avoid it. Some people do not want probiotics added to their milk or yogurt, but some will pay extra to have them. Overall, consumers are willing to pay more to avoid fat in their yogurt than in their milk. Given the findings of the consumption analyses indicating that frequent milk consumers are not the same people as frequent yogurt consumers, it makes sense that the different groups of consumers would have different preferences for attributes in milk and yogurt.

Women over 50 appear to be WTP more for the informational attributes than the general population. Women over 50 will also pay more than the general population for vitamin-enhanced milk and yogurt and to avoid fat in their milk and yogurt. Young adults are WTP more than the general population for the informational attributes in yogurt but not in milk. Young adults appear not to want vitamins added to either their milk or yogurt, but are WTP more than the general population to have probiotics added to both their milk and yogurt.

In general, it appears that individuals who perceive the benefits of and barriers to dairy consumption as greater as well as perceive their susceptibility to and the severity of osteoporosis as higher are WTP more than the general population for milk with additional health and information attributes, but this trend is not as evident for yogurt.

Table 7.2: WTP (in $) for attributes in milk and yogurt for all groups

	Whole Sample		Women Over 50		Young Adults		High HBM score	
	Milk	Yogurt	Milk	Yogurt	Milk	Yogurt	Milk	Yogurt
Nutrition panel	0.23	0.20	0.35	0.20	0.06	0.34	0.40	-0.09
Fat content	-0.22	-0.59	-0.37	-0.77	-0.26	-0.63	-0.11	-0.63
Vitamin-enhanced	0.15	0.62	0.36	0.76	-0.07	-0.10	0.56	0.59
Probiotic	-0.06	-0.15	0.00	-0.30	0.00	0.18	0.36	1.12
Health Check™	0.32	0.25	0.44	0.47	0.33	0.95	0.74	0.25

7.1.4. Summary of Results

The consumption analysis revealed several trends regarding the characteristics of milk and yogurt consumers, addressing the first objective of this study. The stated preference analysis revealed additional findings pertaining to consumer preferences for various attributes in milk and yogurt, addressing the second objective of this study. What was not anticipated in the design of this study and therefore not explicitly discussed in the objectives was the strong interaction between the two types of factors (internal and product factors) as outlined by the conceptual framework. The individual specific characteristics had significant interactions with the product attributes in question, demonstrating that the different factors not only play a role in product choice, but also affect how other types of factors influence the consumer's decision.

7.2. Implications

The results of this research have several implications for public health in Canada. The evidence shows that there are differences in predictors of milk and yogurt consumption for the dairy deficient population sub-groups as compared to the general population. Therefore to increase the overall dairy consumption (and

subsequent micronutrient intake) in young adults/adolescents and women over 50, different considerations need to be made than for the general population. Health characteristics such as BMI and self-rated health status appear to affect milk and yogurt consumption differently among these groups than others. These groups also value attributes in milk and yogurt differently than the rest of the population. It appears that women over 50 are more likely to try low-fat dairy products that have been enhanced with additional vitamins while young adults appear to be more likely to try dairy products with probiotics.

There is also evidence there are differences between groups of frequent dairy consumers. One noted trend is that people with children in the home consume milk more frequently but are WTP less for vitamin-enhanced milk and yogurt. Also, people who rated their health status as higher consume milk and yogurt more frequently while those who made health changes are WTP more for several attributes in both milk and yogurt. These results demonstrate that while not all groups who consume dairy products frequently value additional attributes, people who take an interest in maintaining their health are the likely consumers of functional milks or yogurts.

These results demonstrate that providing more health information on the packaging (in the form of a more comprehensive nutrition panel or a Health Check^{TM} logo), or producing milk and yogurt with probiotics or additional vitamins may increase some consumer's interest in some dairy products. However, due to the fact that it is a smaller segment of the population that is WTP for functional milk products than for functional yogurt products (based on Figures 6.1 and 6.2), functional milk would likely not experience the same retail success that functional yogurts have. Adding more health information to the packaging, however, could increase sales (or sale price) with only small changes to packaging layout without alienating consumers by adding ingredients to the actual food product. The first products to add more health information would likely be have a competitive advantage over other similar products until competitors also put the same level of information on their packaging. This could be the first step in

increasing overall consumption of dairy products, potentially improving the nutritional status of the Canadian population.

The findings of this study could be of use not only to agencies promoting public health in Canada, but also to medical practitioners who make recommendations to patients (who are also consumers) on ways to improve their health and to the dairy industry who needs to allocate its research budget to developing products which have the most potential to be successful in the market place.

7.3. Limitations and future research

There are several limitations of this study. The first is in utilizing the CCHS 2.2 as a data source. Twenty-four hour dietary recalls can be biased in terms of respondents over-reporting intake of healthy foods and under-reporting intake of unhealthy foods in addition to the possibility of forgetting to report some items. In addition, 24-hour dietary recalls are a better indicator of overall diet quality than of intake of specific foods. The zero consumption rates for both milk and yogurt were very high in the CCHS 2.2 data, potentially distorting the estimations. The CCHS 2.2 is also not as representative as desired and is dated (2004), but as it is the only national level dietary data available, it was used regardless. The NDS also may suffer from under- or over-reporting the frequency of milk or yogurt consumption, but this is unavoidable in surveys. When comparing the results between the CCHS 2.2 and NDS demographic analysis, it needs to be noted that these are not exactly the same kinds of analysis, so the resulting estimates are not directly comparable in terms of magnitude. There are also likely differences due to the 7-year gap between the collections of the two data sets.

There are also several limitations of the stated preference analysis. By nature, stated preference analysis suffers from several kinds of bias: response bias (respondents are only those with Internet access, self-select to complete the survey, and may have chosen to participate in the survey due to an interest in dairy products), social desirability bias (choose what they think is the 'correct' choice), and hypothetical bias (their choices are not consequential and thus may

not accurately reflect true valuations of attributes). Using a multinomial logit model with interaction variables for the stated preference analysis is also limiting as it may have problems with collinearity and endogeneity and only captures the observed heterogeneity in the sample rather than the unobserved heterogeneity. It also assumes that all variables are orthogonal which may not truly be the case.

Possible extensions of this research include examining the relationships between WTP for various attributes in dairy products and other internal factors identified in the conceptual framework such as attitudes towards food technology, nutrition knowledge levels, attitudes towards food and health, label use, and attitudes towards organic foods. Combining multiple statements from the Health Belief Model into individual factors for use in regressions (with validity of factors tested using the Cronbach's alpha measure) could also generate some interesting analysis. Research examining how the external factors outlined in the conceptual framework, such as context and environment, affect dairy product consumption could also help to understand how consumers make milk and yogurt consumption decisions. Given that the results indicate differences between population groups, further surveys could be done targeting specific demographic groups as the sample sizes of some groups in this study were relatively small. In addition, analysis could also be done for various population sub-groups to determine differences in WTP. Another area for future research would be analyzing the choice experiment data using a mixed logit or latent class model, which could provide more information about the preferences of various groups within the sample population by revealing some of the data's unobserved heterogeneity.

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Appendix A: Tables of Estimations on Choice Experiment Data

Table A.1: Multinomial logit model estimates from choice experiment for various attributes and interacted variables – whole sample

Variable	milk Co	milk SE	yog Co	yog SE
price	-0.781***	(0.031)	-0.502***	(0.018)
nutrition panel	0.754***	(0.263)	1.067***	(0.277)
nut-panel*age	-0.005*	(0.003)	-0.008***	(0.003)
nut-panel*gender	0.018	(0.066)	-0.135**	(0.069)
nut-panel*language	-0.085	(0.071)	0.079	(0.075)
nut-panel*children	-0.056	(0.078)	-0.065	(0.081)
nut-panel*education	-0.026**	(0.013)	-0.033**	(0.014)
nut-panel*income	-0.001	(0.001)	-0.001	(0.001)
nut-panel*city	-0.001	(0.085)	-0.030	(0.090)
nut-panel*town	0.116	(0.101)	-0.004	(0.106)
nut-panel*PPP	0.043	(0.063)	0.013	(0.067)
nut-panel*health change	0.110*	(0.060)	0.103	(0.063)
nut-panel*breastfeeding	0.056	(0.235)	-0.285	(0.250)
nut-panel*single	-0.054	(0.087)	-0.142	(0.091)
nut-panel*widow	-0.072	(0.199)	0.260	(0.212)
nut-panel*divorced	0.089	(0.101)	0.079	(0.106)
nut-panel*partner	0.123	(0.091)	0.160*	(0.095)
nut-panel*dual	0.149*	(0.076)	0.111	(0.080)
nut-panel*child	0.159	(0.214)	0.155	(0.223)
nut-panel*family	0.281	(0.180)	0.592***	(0.187)
nut-panel*other	1.411	(0.887)	1.405*	(0.844)
nut-panel*never	-0.364***	(0.101)	-0.393***	(0.102)
fat content	0.117	(0.137)	-0.280**	(0.140)
fat content*age	-0.004***	(0.001)	-0.002	(0.001)
fat content*gender	-0.161***	(0.034)	-0.036	(0.035)
fat content*language	0.134***	(0.037)	0.046	(0.038)
fat content*children	0.038	(0.041)	0.132***	(0.041)
fat content*education	-0.002	(0.007)	0.004	(0.007)
fat content*income	-0.000	(0.000)	0.000	(0.000)
fat content*city	-0.026	(0.044)	0.002	(0.045)
fat content*town	-0.016	(0.053)	0.023	(0.054)
fat content*PPP	-0.003	(0.034)	0.009	(0.035)
fat content*health change	-0.044	(0.032)	0.000	(0.032)
fat content*breastfeeding	-0.069	(0.138)	-0.301**	(0.144)
fat content*single	0.011	(0.046)	0.002	(0.047)

fat content*widow	0.400***	(0.107)	0.119	(0.113)
fat content*divorced	0.122**	(0.053)	0.047	(0.055)
fat content*partner	0.042	(0.048)	-0.058	(0.049)
fat content*dual	-0.001	(0.040)	-0.032	(0.041)
fat content*child	0.163	(0.125)	0.074	(0.121)
fat content*family	0.016	(0.094)	0.020	(0.096)
fat content*other	-0.297	(0.468)	0.164	(0.418)
fat content*never	-0.070	(0.050)	-0.256***	(0.049)
vitamin enhanced	0.711**	(0.327)	0.533	(0.339)
vit-enhance*age	-0.006	(0.003)	-0.005	(0.003)
vit-enhance*gender	0.123	(0.082)	0.071	(0.085)
vit-enhance*language	-0.237***	(0.089)	-0.232**	(0.092)
vit-enhance*children	-0.195**	(0.097)	-0.199**	(0.099)
vit-enhance*education	-0.026	(0.017)	-0.004	(0.017)
vit-enhance*income	-0.001	(0.001)	-0.002*	(0.001)
vit-enhance*city	0.190*	(0.105)	0.284***	(0.108)
vit-enhance*town	0.385***	(0.127)	0.423***	(0.130)
vit-enhance*PPP	0.104	(0.080)	0.173**	(0.083)
vit-enhance*health change	0.255***	(0.075)	0.028	(0.077)
vit-enhance*breastfeeding	0.231	(0.298)	0.864***	(0.327)
vit-enhance*single	-0.206*	(0.110)	-0.187*	(0.113)
vit-enhance*widow	-0.085	(0.252)	-0.368	(0.268)
vit-enhance*divorced	-0.183	(0.125)	-0.125	(0.130)
vit-enhance*partner	-0.223**	(0.113)	0.057	(0.116)
vit-enhance*dual	-0.128	(0.095)	0.049	(0.097)
vit-enhance*child	-0.723***	(0.280)	-0.416	(0.285)
vit-enhance*family	-0.083	(0.224)	-0.210	(0.232)
vit-enhance*other	-1.999	(1.264)	-1.890*	(1.141)
vit-enhance*never	-0.266**	(0.120)	-0.222*	(0.118)
probiotics	-0.220	(0.328)	0.196	(0.340)
probiotic*age	-0.008**	(0.003)	-0.004	(0.003)
probiotic*gender	0.070	(0.081)	-0.020	(0.084)
probiotic*language	-0.124	(0.088)	-0.028	(0.092)
probiotic*children	0.061	(0.096)	-0.019	(0.099)
probiotic*education	0.020	(0.017)	-0.026	(0.017)
probiotic*income	0.000	(0.001)	-0.001	(0.001)
probiotic*city	0.032	(0.104)	0.187*	(0.108)
probiotic*town	0.228*	(0.126)	0.289**	(0.130)
probiotic*PPP	0.341***	(0.079)	0.555***	(0.083)
probiotic*health change	0.099	(0.074)	0.082	(0.077)
probiotic*breastfeeding	0.059	(0.290)	0.015	(0.302)

probiotic*single	-0.080	(0.109)	-0.083	(0.112)
probiotic*widow	-0.172	(0.247)	-0.348	(0.265)
probiotic*divorced	-0.027	(0.124)	-0.209	(0.129)
probiotic*partner	-0.077	(0.113)	-0.002	(0.116)
probiotic*dual	0.177*	(0.094)	0.076	(0.097)
probiotic*child	0.391	(0.275)	0.239	(0.287)
probiotic*family	-0.069	(0.234)	0.388	(0.245)
probiotic*other	1.125	(1.001)	0.746	(0.908)
probiotic*never	-0.036	(0.117)	-0.262**	(0.117)
health check	0.122	(0.321)	-0.039	(0.343)
health-chk*age	0.001	(0.003)	-0.003	(0.003)
health-chk*gender	0.092	(0.080)	0.122	(0.085)
health-chk*language	-0.083	(0.088)	0.165*	(0.094)
health-chk*children	0.006	(0.096)	-0.054	(0.101)
health-chk*education	0.001	(0.016)	0.002	(0.017)
health-chk*income	0.002*	(0.001)	0.002*	(0.001)
health-chk*city	-0.017	(0.103)	0.097	(0.110)
health-chk*town	-0.078	(0.124)	0.106	(0.132)
health-chk*PPP	0.131*	(0.079)	0.094	(0.084)
health-chk*health change	0.038	(0.073)	0.091	(0.078)
health-chk*breastfeeding	-0.105	(0.297)	0.076	(0.313)
health-chk*single	0.012	(0.107)	-0.045	(0.113)
health-chk*widow	-0.179	(0.243)	0.591**	(0.259)
health-chk*divorced	-0.142	(0.126)	0.040	(0.134)
health-chk*partner	-0.155	(0.112)	-0.095	(0.118)
health-chk*dual	-0.093	(0.094)	0.021	(0.099)
health-chk*child	-0.262	(0.281)	0.215	(0.305)
health-chk*family	-0.045	(0.227)	0.235	(0.243)
health-chk*other	0.374	(0.841)	0.172	(0.793)
health-chk*never	-0.395***	(0.118)	-0.576***	(0.122)
neither	-3.806***	(0.140)	-3.393***	(0.119)
Log likelihood	-6626.079		-6590.917	
AIC	1.975		1.964	
BIC	2.082		2.071	

Table A.2: Multinomial logit model estimates from choice experiment for various attributes and interacted variables – young adults

Variable	milk Co	milk SE	yog Co	yog SE
price	-0.876***	(0.210)	-0.673***	(0.125)
nutrition panel	1.691	(2.598)	-3.279	(2.669)
nut-panel*age	-0.036	(0.126)	0.021	(0.123)

nut-panel*gender	0.390	(0.491)	-0.133	(0.502)
nut-panel*language	-0.081	(0.560)	-0.030	(0.610)
nut-panel*children	-0.185	(0.404)	0.176	(0.420)
nut-panel*education	-0.139	(0.112)	0.201*	(0.110)
nut-panel*income	0.010*	(0.005)	0.006	(0.005)
nut-panel*city	0.152	(0.550)	0.564	(0.560)
nut-panel*town	-0.853	(0.758)	0.451	(0.761)
nut-panel*PPP	-0.085	(0.469)	-0.311	(0.516)
nut-panel*health change	0.156	(0.535)	-0.392	(0.529)
nut-panel*breastfeeding	0.574	(1.049)	-1.057	(1.008)
nut-panel*never	0.927	(0.862)	-0.190	(0.649)
fat content	0.986	(1.421)	0.722	(1.431)
fat content*age	0.316	(0.252)	0.256	(0.283)
fat content*gender	-0.080	(0.070)	-0.041	(0.068)
fat content*language	0.167	(0.290)	0.471	(0.347)
fat content*children	0.219	(0.224)	0.190	(0.232)
fat content*education	0.020	(0.062)	-0.110*	(0.059)
fat content*income	0.003	(0.003)	0.007**	(0.003)
fat content*city	-0.205	(0.334)	0.072	(0.318)
fat content*town	0.008	(0.432)	-0.268	(0.403)
fat content*PPP	-0.5889**	(0.256)	-0.427	(0.269)
fat content*health change	0.186	(0.256)	0.724**	(0.283)
fat content*breastfeeding	-1.245	(0.861)	0.501	(0.573)
fat content*never	-0.326	(0.420)	0.088	(0.377)
vitamin enhanced	6.820*	(3.734)	0.750	(3.773)
vit-enhance*age	-1.383**	(0.679)	-0.815	(0.674)
vit-enhance*gender	-0.474***	(0.182)	-0.092	(0.166)
vit-enhance*language	0.079	(0.775)	0.373	(0.782)
vit-enhance*children	-0.151	(0.581)	-0.853	(0.578)
vit-enhance*education	0.353**	(0.158)	0.147	(0.146)
vit-enhance*income	-0.014*	(0.008)	-0.007	(0.008)
vit-enhance*city	-0.462	(0.775)	0.167	(0.767)
vit-enhance*town	0.228	(1.072)	0.993	(1.007)
vit-enhance*PPP	0.261	(0.644)	0.709	(0.691)
vit-enhance*health change	1.405**	(0.704)	-0.298	(0.667)
vit-enhance*breastfeeding	2.169	(1.700)	2.491**	(1.189)
vit-enhance*never	-3.152***	(1.049)	0.360	(0.944)
probiotics	-0.596	(3.561)	3.162	(3.604)
probiotic*age	-0.036	(0.633)	-0.334	(0.632)
probiotic*gender	0.233	(0.180)	-0.061	(0.171)
probiotic*language	-0.144	(0.684)	-0.207	(0.742)

probiotic*children	-0.660	(0.548)	-0.115	(0.562)
probiotic*education	-0.311**	(0.154)	-0.126	(0.149)
probiotic*income	-0.004	(0.007)	0.004	(0.007)
probiotic*city	0.321	(0.815)	0.530	(0.803)
probiotic*town	0.034	(1.111)	-0.055	(1.086)
probiotic*PPP	0.214	(0.617)	1.328*	(0.680)
probiotic*health change	0.226	(0.652)	-1.094	(0.672)
probiotic*breastfeeding	-0.099	(1.375)	-0.009	(1.045)
probiotic*never	-1.443	(0.941)	0.215	(0.907)
health check	8.661**	(3.673)	10.012**	(3.958)
health-chk*age	-0.282	(0.628)	0.164	(0.672)
health-chk*gender	-0.289*	(0.168)	-0.452**	(0.185)
health-chk*language	0.076	(0.679)	-0.035	(0.800)
health-chk*children	0.519	(0.524)	1.237**	(0.579)
health-chk*education	-0.221	(0.140)	-0.071	(0.149)
health-chk*income	0.008	(0.007)	0.006	(0.007)
health-chk*city	0.201	(0.738)	0.544	(0.785)
health-chk*town	0.146	(1.001)	0.174	(1.051)
health-chk*PPP	0.196	(0.616)	-0.043	(0.716)
health-chk*health change	0.127	(0.622)	0.038	(0.681)
health-chk*breastfeeding	1.260	(1.731)	0.543	(1.409)
health-chk*never	0.223	(1.005)	0.043	(0.916)
neither	-4.907***	(0.938)	-5.031***	(0.795)
Log likelihood	-182.267		-181.761	
AIC	2.112		2.108	
BIC	3.096		3.092	

Table A.3: Multinomial logit model estimates from choice experiment for various attributes and interacted variables – women over 50

Variable	milk Co	milk SE	yog Co	yog SE
price	-0.741***	(0.065)	-0.488***	(0.037)
nutrition panel	0.663	(0.695)	2.155***	(0.722)
nut-panel*age	0.008	(0.009)	-0.007	(0.009)
nut-panel*language	-0.431***	(0.148)	-0.161	(0.153)
nut-panel*children	-0.108	(0.232)	-0.259	(0.245)
nut-panel*education	-0.074**	(0.031)	-0.124***	(0.032)
nut-panel*income	0.000	(0.002)	0.003	(0.002)
nut-panel*city	0.234	(0.175)	-0.151	(0.183)
nut-panel*town	0.392*	(0.203)	-0.237	(0.209)
nut-panel*PPP	-0.112	(0.128)	-0.055	(0.133)
nut-panel*health change	0.137	(0.128)	0.286**	(0.132)

nut-panel*never	-0.363*	(0.187)	-0.614**	(0.240)
fat content	-0.267	(0.364)	-0.280	(0.367)
fat content*age	0.002	(0.005)	-0.002	(0.005)
fat content*language	0.052	(0.076)	-0.084	(0.078)
fat content*children	0.187	(0.122)	-0.035	(0.127)
fat content*education	-0.008	(0.016)	0.011	(0.015)
fat content*income	-0.001	(0.001)	-0.002*	(0.001)
fat content*city	0.052	(0.091)	0.054	(0.093)
fat content*town	-0.007	(0.108)	0.108	(0.106)
fat content*PPP	0.100	(0.068)	0.034	(0.069)
fat content*health change	-0.033	(0.067)	-0.049	(0.067)
fat content*never	-0.121	(0.093)	-0.210*	(0.115)
vitamin enhanced	1.007	(0.865)	0.558	(0.881)
vit-enhance*age	-0.003	(0.011)	0.000	(0.011)
vit-enhance*language	-0.190	(0.181)	-0.238	(0.185)
vit-enhance*children	-0.133	(0.286)	-0.003	(0.298)
vit-enhance*education	-0.056	(0.038)	-0.036	(0.039)
vit-enhance*income	-0.002	(0.002)	0.000	(0.002)
vit-enhance*city	0.080	(0.216)	0.248	(0.221)
vit-enhance*town	0.221	(0.255)	0.295	(0.257)
vit-enhance*PPP	0.149	(0.160)	0.132	(0.166)
vit-enhance*health change	0.298*	(0.158)	0.174	(0.161)
vit-enhance*never	0.009	(0.220)	-0.295	(0.266)
probiotics	1.019	(0.845)	0.118	(0.872)
probiotic*age	-0.022**	(0.011)	-0.003	(0.011)
probiotic*language	-0.184	(0.177)	-0.060	(0.183)
probiotic*children	-0.615**	(0.282)	0.315	(0.297)
probiotic*education	0.027	(0.037)	-0.039	(0.038)
probiotic*income	0.001	(0.002)	-0.001	(0.002)
probiotic*city	-0.318	(0.213)	0.310	(0.221)
probiotic*town	-0.065	(0.252)	0.466*	(0.257)
probiotic*PPP	0.251	(0.158)	0.582***	(0.165)
probiotic*health change	0.221	(0.155)	0.066	(0.159)
probiotic*never	-0.211	(0.214)	-0.454*	(0.271)
health check	-1.630*	(0.832)	-0.753	(0.872)
health-chk*age	0.014	(0.011)	0.012	(0.012)
health-chk*language	-0.099	(0.177)	0.131	(0.186)
health-chk*children	-0.254	(0.280)	0.143	(0.300)
health-chk*education	0.086**	(0.035)	-0.008	(0.037)
health-chk*income	0.002	(0.002)	0.002	(0.002)
health-chk*city	-0.220	(0.205)	0.096	(0.218)

health-chk*town	-0.001	(0.239)	0.152	(0.251)
health-chk*PPP	0.052	(0.154)	0.177	(0.165)
health-chk*health change	0.077	(0.152)	0.230	(0.160)
health-chk*never	-0.540**	(0.215)	-0.530*	(0.275)
neither	-3.431***	(0.291)	-3.306***	(0.245)
Log likelihood	-1600.621		-1582.572	
AIC	1.997		1.975	
BIC	2.183		2.161	

Table A.4: Multinomial logit model estimates from choice experiment for various attributes and interacted variables – high HBM score

Variable	Milk Co	Milk SE	Yogurt Co	Yogurt SE
price	-0.486***	(0.134)	-0.597***	(0.101)
nutrition panel	0.118	(1.266)	2.617*	(1.559)
nut-panel*age	0.005	(0.012)	-0.007	(0.015)
nut-panel*gender	0.196	(0.293)	0.004	(0.369)
nut-panel*language	-0.589*	(0.344)	-0.334	(0.424)
nut-panel*children	0.476	(0.322)	-0.277	(0.400)
nut-panel*education	0.016	(0.065)	-0.062	(0.073)
nut-panel*income	-0.004	(0.005)	-0.007	(0.005)
nut-panel*city	-0.053	(0.363)	0.219	(0.432)
nut-panel*town	0.304	(0.418)	0.164	(0.509)
nut-panel*health change	-0.086	(0.149)	-0.247	(0.186)
nut-panel*PPP	-0.070	(0.276)	-0.253	(0.333)
fat content	1.072	(0.743)	1.543*	(0.934)
fat content*age	-0.005	(0.007)	-0.036***	(0.009)
fat content*gender	-0.755***	(0.180)	-0.819***	(0.236)
fat content*language	0.198	(0.192)	0.251	(0.256)
fat content*children	0.051	(0.179)	-0.343	(0.238)
fat content*education	-0.064*	(0.038)	0.022	(0.042)
fat content*income	0.000	(0.002)	-0.005*	(0.003)
fat content*city	0.365*	(0.216)	0.165	(0.263)
fat content*town	0.090	(0.247)	-0.009	(0.310)
fat content*health change	0.057	(0.085)	0.087	(0.107)
fat content*PPP	0.043	(0.155)	0.215	(0.197)
vitamin enhanced	-1.684	(1.640)	-2.170	(2.166)
vit-enhance*age	0.017	(0.016)	0.013	(0.021)
vit-enhance*gender	0.169	(0.396)	0.936*	(0.533)
vit-enhance*language	-1.319***	(0.440)	-1.575***	(0.581)

vit-enhance*children	-0.692*	(0.408)	-0.835	(0.532)
vit-enhance*education	0.150*	(0.085)	0.140	(0.102)
vit-enhance*income	-0.007	(0.006)	-0.009	(0.007)
vit-enhance*city	-0.696	(0.495)	0.188	(0.573)
vit-enhance*town	-0.297	(0.570)	1.199*	(0.686)
vit-enhance*PPP	0.405	(0.358)	-0.481	(0.446)
vit-enhance*health change	0.084	(0.188)	0.113	(0.231)
probiotics	0.432	(1.659)	-1.459	(2.156)
probiotic*age	-0.014	(0.017)	0.028	(0.022)
probiotic*gender	0.236	(0.407)	0.057	(0.563)
probiotic*language	-0.495	(0.425)	0.216	(0.576)
probiotic*children	-0.232	(0.451)	1.132*	(0.656)
probiotic*education	0.084	(0.094)	-0.053	(0.103)
probiotic*income	0.001	(0.005)	0.001	(0.007)
probiotic*city	0.031	(0.454)	1.180**	(0.556)
probiotic*town	0.204	(0.528)	0.974	(0.656)
probiotic*PPP	0.254	(0.367)	1.033**	(0.451)
probiotic*health change	-0.262	(0.209)	-0.174	(0.267)
health check	1.152	(1.743)	2.187	(2.294)
health-chk*age	-0.031*	(0.017)	-0.018	(0.022)
health-chk*gender	-0.015	(0.418)	-0.757	(0.571)
health-chk*language	-0.162	(0.462)	0.422	(0.611)
health-chk*children	-0.771*	(0.458)	-0.573	(0.585)
health-chk*education	0.046	(0.086)	0.045	(0.100)
health-chk*income	0.005	(0.006)	0.002	(0.007)
health-chk*city	-0.232	(0.495)	-0.194	(0.591)
health-chk*town	-0.329	(0.562)	-1.085	(0.749)
health-chk*PPP	-0.201	(0.368)	-0.117	(0.475)
health-chk*health change	0.136	(0.213)	-0.217	(0.280)
neither	-2.999***	(0.616)	-5.463***	(0.708)
Log likelihood	-305.143		-211.912	
AIC	2.035		1.793	
BIC	2.655		2.496	

Appendix B: The National Dairy Survey

Survey instrument –Milk and Yogurt

Section I:

1. In which of the following age groups do you fall?

1. ❒ 18-20
2. ❒ 21-24
2. ❒ 25-34
3. ❒ 35-44
4. ❒ 45-54
5. ❒ 55-64
6. ❒ 65-75
7. ❒ 75 +

2. Please indicate your gender.

1. ❒ Male
2. ❒ Female

3. How many people live in your household?

1. ❒ 1
2. ❒ 2
3. ❒ 3
4. ❒ 4+

4. How many children younger than 18 live in your house?

1. ❒ No home living children under 18 years
2. ❒ 1
3. ❒ 2
4. ❒ 3
5. ❒ 4
6. ❒ More than 4

5. What is your position in the household? **ONLY ONE ANSWER POSSIBLE**

1. ❒ Main income earner
2. ❒ Partner of main income earner

3. ❒ One of two income earners
4. ❒ Child
5. ❒ Other family member
Other person (not family)

6. What is your marital status? **ONLY ONE ANSWER POSSIBLE**

1. ❒ Married/Living together/Common Law
2. ❒ Single
3. ❒ Divorced/Separated
4. ❒ Widowed

7. What is the highest level of education you've achieved? **ONLY ONE ANSWER POSSIBLE**

1. ❒ Elementary school
2. ❒ Secondary (high) school
3. ❒ Technical/ business school/Community college
4. ❒ University/ bachelor's degree
5. ❒ Post graduate studies (Masters or PhD)

8. Which of the following best describes your employment status? **ONLY ONE ANSWER POSSIBLE**

1. ❒ Employed full-time or self-employed
2. ❒ Employed part-time
3. ❒ Homemaker
4. ❒ Student and full-time employed
5. ❒ Student and part-time employed
6. ❒ Student only
7. ❒ Retired
8. ❒ Unemployed
9. ❒ Other

9. What is the approximate range of your total household income? **ONLY ONE ANSWER POSSIBLE**

1. ❒ $ 14,999 or under
2. ❒ Between $ 15,000 and $ 29,999
3. ❒ Between $ 30,000 and $ 39,999
4. ❒ Between $40,000 and $ 49,999
5. ❒ Between $ 50,000 and $ 59,999
6. ❒ Between $ 60,000 and $ 79,999

7. ❒ Between $ 80,000 and $ 99,999
8. ❒ Between $ 100,000 and $ 119,999
9. ❒ $ 120,000 or more

10. Which region do you live in? **ONLY ONE ANSWER POSSIBLE**

1. ❒ Maritimes
2. ❒ Quebec
3. ❒ Ontario
4. ❒ Manitoba
5. ❒ Saskatchewan
6. ❒ Alberta
7. ❒ British Columbia
8. ❒ Northern Canada (Yukon, Northwest Territories, or Nunavut)

11. Do you live in a city, in a town or in the countryside? **ONLY ONE ANSWER POSSIBLE**

1. ❒ In a city (>100.000 inhabitants)
2. ❒ In a town (> 10.000 inhabitants)
3. ❒ In the countryside/rural district

13. Which of the following best describes your food preferences?

1 ❒ I eat meat and dairy products.
2 ❒ I eat dairy products but don't eat meat.
3 ❒ I eat meat but I don't eat dairy products.
4 ❒ I don't eat either meat or dairy products.

14. What is your height?

_____ feet and inches ❒ or centimetres ❒.

15. What is your weight?

_____ pounds ❒ or kilograms ❒

16. In general would you say that your health is ….

1. ❒ Excellent
2. ❒ Very Good
3. ❒ Good
4. ❒ Fair
5. ❒ Poor

17. Over the past year, would you say you have made changes in your lifestyle to improve or maintain your health?

1. ❒ Yes
2. ❒ No

[PROGRAMMING: SKIP IF "NO" IN Q17.]

18. If yes, please indicate any changes that you have made. (check all that apply)

1. ❒ Reducing salt intake
2. ❒ Trying to consume less fat
3. ❒ Eating more fruit and/or vegetables
4. ❒ Eating less red meat
5. ❒ Reduce sugar intake
6. ❒ Less snacking
7. ❒ Reduce calorie intake/eating less
8. ❒ Reducing caffeine intake
9. ❒ Taking vitamins and supplements
10. ❒ Introducing foods to your diet that may provide health benefits
11. ❒ Exercising
12. ❒ Quit smoking
13. ❒ Reducing alcohol intake
14. ❒ Eat less fast food
15. ❒ Eat more foods containing fibre
16. ❒ Eat more foods containing calcium
17. ❒ Drinking more water

19. Compared to one year ago how would you say your health is now? Would you say that it is

1. ❒ much better now than 1 year ago
2. ❒ somewhat better now than 1 year ago
3. ❒ about the same
4. ❒ somewhat worse now than 1 year ago
5. ❒ much worse now than 1 year ago

20. Are you currently pregnant?

1. ❒ Yes
2. ❒ No

21. Are you currently breastfeeding?

1. ❒ Yes
2. ❒ No

Section II:

22. How often are you involved in the daily grocery shopping for your household?

never	once in a while	occasionally	frequently	always
1	2	3	4	5
❒	❒	❒	❒	❒

(alternate order for respondents so some see questions 23 – 29 are first for some and questions 30-37 are first for some)

23. Do you ever buy yogurt?

never	once in a while	occasionally	frequently	always
1	2	3	4	5
❒	❒	❒	❒	❒

24. How often is yogurt consumed in your home?

never	1-2 times per week	3-4 times per week	5-7 times per week	more than 7 times per week
1	2	3	4	5
❒	❒	❒	❒	❒

25. How often do you eat yogurt at home?

never	Less than one time per month	1-5 times per month	1-5 times per week	1-2 times per day	More than 2 times per day
1	**2**	**3**	**4**	**5**	6
❒	❒	❒	❒	❒	❒

26. How often do you eat yogurt away from home? (For example, in a restaurant, cafeteria, or as a snack.)

never	Less than one time per month	1-5 times per month	1-5 times per week	1-2 times per day	More than 2 times per day
1	**2**	**3**	**4**	**5**	6
❒	❒	❒	❒	❒	❒

27. Do you always purchase the same kind of yogurt?

1. ❒ Yes
2. ❒ No

28. Please rank the following factors in order of importance to you in making a choice of yogurt. Please rank from 1 to 7, with 1 being most important, and 7 being least important.	
price	
flavour	
fat content	
brand	
probiotic content	
sugar content	
container size	

29. When purchasing yogurt, how often do you do the following?					
	Never	**Once in a while**	**Occasionally**	**Frequently**	**Always**
	1	**2**	**3**	**4**	**5**
Read the ingredient list.	☐	☐	☐	☐	☐
Read the nutrition	☐	☐	☐	☐	☐

facts panel to find out the calorie content.					
Read the nutrition facts panel to find out the fat content.	☐	☐	☐	☐	☐
Read the nutrition facts panel to find out the vitamin or mineral content.	☐	☐	☐	☐	☐
Look for a healthy choice symbol (such as the Heart and Stroke logo).	☐	☐	☐	☐	☐
Read the health claims.	☐	☐	☐	☐	☐

30. Is the yogurt you typically purchase:

a)

1. ❒ Pre or probiotic
2. ❒ Conventional (not pre or probiotic)
3. ❒ Not sure

b)

1. ❒ Fat free
2. ❒ Low fat (0.5 – 3%),
3. ❒ Full fat (greater than 3%)
4. ❒ Not sure

c)

1. ❒ Plain
2. ❒ Flavoured
3. ❒ Not sure

d)

1. ❒ In single serving containers as a package of 12
2. ❒ In singe serving containers as a package of 8
2. ❒ In tubs (650-750mL)
3. ❒ Not sure

e)

1. ❒ With fruit pieces
2. ❒ Without fruit pieces
3. ❒ Not sure

f) Sweetened with:

1. ❒ Sugar
2. ❒ Juice
3. ❒ Aspartame
4. ❒ Sucralose (Splenda)
5. ❒ Unsweetened
6. ❒ Not sure

g) Fortified with any functional ingredients (such as omega 3 or CLA fatty acids)

1. ❒ Yes
2. ❒ No
3. ❒ Not sure

h) Organic

1. ❒ Yes
2. ❒ No
3. ❒ Not sure

31. Do you ever buy milk?

never	once in a while	occasionally	frequently	always
1	**2**	**3**	**4**	**5**
❒	❒	❒	❒	❒

32. How often is milk consumed in your home?

never	1-2 times per week	3-4 times per week	5-7 times per week	more than 7 times per week
1	**2**	**3**	**4**	**5**
❒	❒	❒	❒	❒

33. How often do you drink milk at home?

never	Less than one time per month	1-5 times per month	1-5 times per week	1-2 times per day	More than 2 times per day
1	2	3	4	5	6
❒	❒	❒	❒	❒	❒

34. How often do you drink milk away from home? (For example, in restaurants, cafeterias, or as a snack.)

never	Less than one time per month	1-5 times per month	1-5 times per week	1-2 times per day	More than 2 times per day
1	2	3	4	5	6
❒	❒	❒	❒	❒	❒

35. Do you always purchase the same kind of milk?

1. ❒ Yes
2. ❒ No

36. Please rank the following factors in order of importance to you in making a choice of yogurt. Please rank from 1 to 5, with 1 being most important, and 5 being least important.	
price	
flavour	
fat content	
brand	
container size	

37. When purchasing milk, how often do you do the following?					
	Never	**Once in a while**	**Occasionally**	**Frequently**	**Always**
	1	**2**	**3**	**4**	**5**
Read the ingredient	☐	☐	☐	☐	☐

list.					
Read the nutrition facts panel to find out the calorie content.	☐	☐	☐	☐	☐
Read the nutrition facts panel to find out the fat content.	☐	☐	☐	☐	☐
Read the nutrition facts panel to find out the vitamin or mineral content.	☐	☐	☐	☐	☐
Look for a healthy choice symbol (such as the Heart and Stroke logo).	☐	☐	☐	☐	☐
Read the health claims.					

38. Is the milk you typically purchase:

a)

1. ❒ Skim
2. ❒ 1%
3. ❒ 2%
4. ❒ Whole
5. ❒ Not sure

b)

1. ❒ Plain
2. ❒ Flavoured
3. ❒ Not sure

c) Sold in:

1. ❒ Cartons
2. ❒ Jugs
3. ❒ Bottles
4. ❒ Bags
5. ❒ Not sure

d) Fortified with any functional ingredients (such as omega 3 or CLA fatty acids)

1. ❒ Yes
2. ❒ No
3. ❒ Not sure

e) Organic

1. ❒ Yes
2. ❒ No
3. ❒ Not sure

39. Do you ever purchase the following products?					
	Never	**Once in a while**	**Occasionally**	**Frequently**	**Always**
	1	**2**	**3**	**4**	**5**
Lactose free milk	☐	☐	☐	☐	☐
Lactose free yogurt	☐	☐	☐	☐	☐
Soy milk	☐	☐	☐	☐	☐
Soy yogurt	☐	☐	☐	☐	☐
Almond milk	☐	☐	☐	☐	☐
Organic milk	☐	☐	☐	☐	☐
Organic yogurt	☐	☐	☐	☐	☐

40. Besides taste, how often do you choose foods or beverages for the following reasons?					
	never	**rarely**	**sometimes**	**usually**	**always**
	1	**2**	**3**	**4**	**5**
Because they contain desirable nutritional qualities (such as fibre, antioxidants, essential fatty acids)	❒	❒	❒	❒	❒
To enhance general wellbeing	❒	❒	❒	❒	❒

Because they contribute to weight control	❒	❒	❒	❒	❒
To enhance resistance to illness	❒	❒	❒	❒	❒
To improve athletic performance	❒	❒	❒	❒	❒
To improve mental performance	❒	❒	❒	❒	❒
For specific medical purposes or health concerns (such as high blood pressure, diabetes, cardiovascular disease)	❒	❒	❒	❒	❒
Because they are fortified with extra vitamins or minerals	❒	❒	❒	❒	❒

41. When you look at the label on a food product, which of the following do you look for? (Please select all that apply.)

1. ❒ Nutrition facts table
2. ❒ Ingredient list
3. ❒ Health claims
4. ❒ A healthy choice symbol or logo
5. ❒ Best before date
6. ❒ Total size of the product (in grams or milliliters)
7. ❒ None of these

42. When you look for information on a food package, how often do you use the information provided in the following ways?					
	never	**rarely**	**sometimes**	**usually**	**always**
	1	**2**	**3**	**4**	**5**
To compare different types of foods with each other. (Eg: to compare granola bars and cookies.)	❒	❒	❒	❒	❒

To compare similar types of foods with each other. (Eg: to compare two different brands of crackers.)	❒	❒	❒	❒	❒
To figure out how much of a product you or your family should eat	❒	❒	❒	❒	❒
To get an idea of the calorie content of a food	❒	❒	❒	❒	❒
To see whether the food contains a specific ingredient	❒	❒	❒	❒	❒
To see how much of a nutrient is in a product, such as the amount of fat, carbohydrate, vitamins, or minerals	❒	❒	❒	❒	❒
To see whether the food is organic	❒	❒	❒	❒	❒
To see if the product contains functional ingredients (such as probiotics or omega-3's)	❒	❒	❒	❒	❒
To find out how the food was produced or what technologies were used in the production	❒	❒	❒	❒	❒

Section III:

[INSTRUCTIONS: RANDOMIZE ORDER OF NUTRIENTS]

43. Please rank the following nutrient information (provided on food product labels) in order of importance to you in making a choice of yogurt. Please rank from 1 to 14, with 1 being the most important, and 14 being the least important.	
Calories	
Total Fat	
Saturated Fat	
Transfat	

Cholesterol	
Sodium	
Carbohydrate	
Fibre	
Sugar	
Protein	
Vitamin A	
Vitamin C	
Calcium	
Iron	

[INSTRUCTIONS: RANDOMIZE ORDER OF NUTRIENTS]

44. Please rank the following nutrient information (provided on food product labels) in order of importance to you in making a choice of milk. Please rank from 1 to 14, with 1 being the most important, and 14 being the least important.	
Calories	
Total Fat	
Saturated Fat	
Transfat	
Cholesterol	
Sodium	
Carbohydrate	
Fibre	
Sugar	
Protein	
Vitamin A	
Vitamin C	

Calcium	
Iron	

45. In communicating to consumers that a specific product contains a food component with additional nutritional or health benefits, would you say it is more important:
(a) That the food label tell consumers that the product contains the component e.g. an excellent source of calcium
OR
(b) That the packaging state that the product offers a specific health benefit e.g. may reduce the risk of osteoporosis.

Product contains the component.	Product offers a specific health benefit.	Both.	Don't know.
1	**2**	**3**	**4**
❒	❒	❒	❒

[INSTRUCTIONS: RANDOMIZE ORDER OF NUTRIENTS]
(randomize order of questions across respondents)

46. Calcium, which is found naturally in dairy products, is proven to have health benefits. Assuming you wanted to get calcium into your diet, how likely are you to consider consuming the following forms of calcium?

	Very unlikely	**Unlikely**	**Neither likely nor unlikely**	**Likely**	**Very likely**
	1	**2**	**3**	**4**	**5**
In a pill or capsule	☐	☐	☐	☐	☐
Soluble powder or fizzy tablet	☐	☐	☐	☐	☐
Milk in the diet	☐	☐	☐	☐	☐
Fortified foods or beverages	☐	☐	☐	☐	☐
Injection	☐	☐	☐	☐	☐
Yogurt in the diet	☐	☐	☐	☐	☐
Other dairy products such as cheese					

47. Some new sources of calcium may be available in the future. How likely would you be to use each of the following, assuming the taste, texture, and color of the items would not be changed by adding calcium. Again, let's assume you want to get calcium into your diet.

	Very unlikely	**Unlikely**	**Neither likely nor unlikely**	**Likely**	**Very likely**
	1	**2**	**3**	**4**	**5**
Beverages (such as orange juice) with added calcium.	☐	☐	☐	☐	☐
Salad dressings or other condiments with added calcium.	☐	☐	☐	☐	☐
Milk with extra calcium.	☐	☐	☐	☐	☐
Cereals or bread with added calcium.	☐	☐	☐	☐	☐
Sports bars with added calcium.	☐	☐	☐	☐	☐
Snacks such as chips or crackers with added calcium.	☐	☐	☐	☐	☐
Dessert snacks such as pudding, candy or cookies with added calcium.	☐	☐	☐	☐	☐
Yogurt or cheese with extra calcium.	☐	☐	☐	☐	☐

48. To what extent do you think the following factors play a role in maintaining overall health?

	no role	a limited role	a moderate role	a great role	don't know
	1	**2**	**3**	**4**	**5**
Food and nutrition	❒	❒	❒	❒	❒
Exercise	❒	❒	❒	❒	❒
Family health history	❒	❒	❒	❒	❒

Work or stress level	❒	❒	❒	❒	❒

49. Would you agree or disagree that the following are benefits from consuming dairy products?					
	Strongly Disagree	**Disagree**	**Neither agree or disagree**	**Agree**	**Strongly Agree**
	1	**2**	**3**	**4**	**5**
Higher likelihood of consuming an adequate amount of minerals, including calcium.	☐	☐	☐	☐	☐
Higher likelihood of consuming an adequate amount of B vitamins.	☐	☐	☐	☐	☐
Higher likelihood of consuming an adequate amount of vitamin D.	☐	☐	☐	☐	☐
I will have improved bone health and be less likely to get osteoporosis.	☐	☐	☐	☐	☐
My body will burn more fat.	☐	☐	☐	☐	☐
My digestive system will contain more 'good bacteria'.	☐	☐	☐	☐	☐
My diet will contain more 'good fats'.	☐	☐	☐	☐	☐

50. Would you agree or disagree that the following are barriers to consuming dairy products?					
	Strongly Disagree	**Disagree**	**Neither agree or disagree**	**Agree**	**Strongly Agree**
	1	**2**	**3**	**4**	**5**
Expense	☐	☐	☐	☐	☐
Availability	☐	☐	☐	☐	☐
Short shelf life	☐	☐	☐	☐	☐

Personal preference	☐	☐	☐	☐	☐
Fat content	☐	☐	☐	☐	☐
Concern about hormone or antibiotic residues	☐	☐	☐	☐	☐
Too many choices make decisions difficult	☐	☐	☐	☐	☐

51. Do you agree or disagree with the following statements?					
	Strongly Disagree	**Disagree**	**Neither agree or disagree**	**Agree**	**Strongly Agree**
	1	**2**	**3**	**4**	**5**
I would be more likely to get osteoporosis if I did not eat enough dairy products.	☐	☐	☐	☐	☐
I would be worried if I developed osteoporosis.	☐	☐	☐	☐	☐
I would be concerned if I had a B-vitamin deficiency.	☐	☐	☐	☐	☐
I would be worried if I had a D-vitamindeficiency.	☐	☐	☐	☐	☐
I believe that I am at risk to develop osteoporosis.	☐	☐	☐	☐	☐
Osteoporosis is a health concern for Canadians.	☐	☐	☐	☐	☐
Not consuming enough dairy products may be harmful to my health.	☐	☐	☐	☐	☐
I believe that I am at risk to develop a vitamin deficiency.	☐	☐	☐	☐	☐
I am confident that I could eat the recommended amount of dairy products every day. (Canada's Food Guide	☐	☐	☐	☐	☐

recommends 2 to 4 servings daily depending on age and gender.)					

52. Do you agree or disagree with the following statements?					
	Strongly Disagree	**Disagree**	**Neither agree or disagree**	**Agree**	**Strongly Agree**
	1	**2**	**3**	**4**	**5**
Some foods contain active components that reduce risk of diseases and improve long term health.	☐	☐	☐	☐	☐
Some foods contain active components that help with current health, such as improving digestion.	☐	☐	☐	☐	☐
Foods cannot be used to reduce the use of medications or other medical treatments.	☐	☐	☐	☐	☐
Foods enriched with active components that reduce risk of diseases and improve long term health are just as effective as pills and supplements containing the same compound.	☐	☐	☐	☐	☐
It is not important to eat foods that are fortified or enriched with added vitamins or minerals.	☐	☐	☐	☐	☐
It is not important to take vitamin and/or nutritional supplements daily.	☐	☐	☐	☐	☐

[INSTRUCTIONS: RANDOMIZE]

53. Do you agree or disagree with the following statements?							
	Strongly Disagree	**Disagree**	**Somewhat Disagree**	**Neither agree or disagree**	**Somewhat Agree**	**Agree**	**Strongly Agree**
	1	**2**	**3**	**4**	**5**	**6**	**7**
New food technologies are something I am uncertain about.	☐	☐	☐	☐	☐	☐	☐
New foods are not healthier than traditional foods.	☐	☐	☐	☐	☐	☐	☐
The benefits of new food technologies are often grossly overstated.	☐	☐	☐	☐	☐	☐	☐
There are plenty of tasty foods around so we don't need to use new food technologies to produce more.	☐	☐	☐	☐	☐	☐	☐
New food technologies decrease the natural quality of food.	☐	☐	☐	☐	☐	☐	☐
New food technologies are unlikely to have long term negative health effects.	☐	☐	☐	☐	☐	☐	☐
New food technologies give people more control over their food choices.	☐	☐	☐	☐	☐	☐	☐
New products produced using new food technologies can help people have a balanced diet.	☐	☐	☐	☐	☐	☐	☐
New food technologies may have long term	☐	☐	☐	☐	☐	☐	☐

negative environmental effects.							
It can be risky to switch to new food technologies too quickly.	☐	☐	☐	☐	☐	☐	☐
Society should not depend heavily on technologies to solve its food problems.	☐	☐	☐	☐	☐	☐	☐
There is no sense trying out high-tech food products because the ones I eat are already good enough.	☐	☐	☐	☐	☐	☐	☐
The media usually provides a balanced and unbiased view of new food technologies.	☐	☐	☐	☐	☐	☐	☐
Eating organic food is better for my health.	☐	☐	☐	☐	☐	☐	☐
Organic food is better for the environment.	☐	☐	☐	☐	☐	☐	☐

Section IV:

54. People can get information about food and nutrition from a number of different sources. From which of the following sources have you gotten information on food and nutrition in the past year? (Check all that apply.)

1. ❒ A family physician or other health professional
2. ❒ A dietician
3. ❒ Magazines, newspapers, and books
4. ❒ Government materials
5. ❒ Food company materials or advertisements
6. ❒ Radio/TV programs
7. ❒ Food product labels

8. ❒ Friends/Relatives/Colleagues
9. ❒ Fitness/Weight loss programs
10. ❒ Health association materials (Cancer/Heart/Diabetic Association)
11. ❒ The internet

55. Based on what you know about nutrition please tell us whether you agree or disagree with the following statements.					
	Strongly Disagree	**Disagree**	**Neither agree or disagree**	**Agree**	**Strongly Agree**
	1	**2**	**3**	**4**	**5**
Fibre is important in your diet since it can prevent constipation, reduce risk of digestive disorders, lower blood cholesterol levels and control blood sugar levels	☐	☐	☐	☐	☐
The fibre content of my diet is appropriate for my health	☐	☐	☐	☐	☐
Probiotics can improve the function of the digestive system by promoting regularity, treating diarrhea, or fighting ulcerative colitis (Depends on the strain of probiotic)	☐	☐	☐	☐	☐

The probiotic content of my diet is appropriate for my health	☐	☐	☐	☐	☐
Vitamin A is not important in the functioning of the immune system	☐	☐	☐	☐	☐
The Vitamin A content of my diet is appropriate for my health	☐	☐	☐	☐	☐
Vitamin C is important in the diet in the formation of red blood cells, the formation of antibodies and a healthy circulatory system	☐	☐	☐	☐	☐
The Vitamin C content of my diet is appropriate for my health.	☐	☐	☐	☐	☐
Vitamin B_2 (Riboflavin) is unimportant in energy metabolism.	☐	☐	☐	☐	☐
The Vitamin B_2 content of my diet is appropriate for my health.	☐	☐	☐	☐	☐
Vitamin B_{12} is important for the proper functioning of	☐	☐	☐	☐	☐

the brain and nervous system.					
The Vitamin B_{12} content of my diet is appropriate for my health.	☐	☐	☐	☐	☐
Vitamin D is not important for bone health.	☐	☐	☐	☐	☐
The Vitamin D content of my diet is appropriate for my health.	☐	☐	☐	☐	☐
Calcium is important for bone health and performs many other critical functions in the body.	☐	☐	☐	☐	☐
The Calcium content of my diet is appropriate for my health.	☐	☐	☐	☐	☐

[INSTRUCTIONS: RANDOMIZE]

56. Based on what you know about nutrition and dairy products, please tell us whether you agree or disagree with the following statements.					
	Strongly Disagree	**Disagree**	**Neither agree or disagree**	**Agree**	**Strongly Agree**
	1	**2**	**3**	**4**	**5**
Milk contains more vitamin B_2 per serving than yogurt	☐	☐	☐	☐	☐
Yogurt contains more vitamin B_{12} per serving than milk	☐	☐	☐	☐	☐
Milk contains more vitamin D per	☐	☐	☐	☐	☐

serving than yogurt					
Yogurt contains more calcium per serving than milk	☐	☐	☐	☐	☐
Milk is more expensive per serving than yogurt	☐	☐	☐	☐	☐
Yogurt contains more lactose per serving than milk	☐	☐	☐	☐	☐
Milk is healthier than yogurt	☐	☐	☐	☐	☐
All milk sold in Canada is fortified with vitamin D	☐	☐	☐	☐	☐
All yogurt sold in Canada is fortified with vitamin D	☐	☐	☐	☐	☐
Yogurt contains more probiotics (good bacteria) than milk	☐	☐	☐	☐	☐
Milk contains more fat per serving than yogurt	☐	☐	☐	☐	☐
Yogurt is better for you than milk	☐	☐	☐	☐	☐
Milk is a better source of protein than yogurt	☐	☐	☐	☐	☐
Yogurt contains more lactic acid per serving than milk	☐	☐	☐	☐	☐

57. Based on what you know about nutrition, dairy products, and dietary fats, please tell us whether you agree or disagree with the following statements.					
	Strongly	**Disagree**	**Neither**	**Agree**	**Strongly**

	Disagree		agree or disagree		Agree
	1	2	3	4	5
Dairy products contain high amounts of saturated fat	☐	☐	☐	☐	☐
Dairy products contain low amounts of cholesterol	☐	☐	☐	☐	☐
Dairy products are a good source of conjugated linoleic acids (CLA) which are fats thought to have health benefits	☐	☐	☐	☐	☐
Milk contains more saturated fat per serving than yogurt	☐	☐	☐	☐	☐
Yogurt contains more cholesterol per serving than milk	☐	☐	☐	☐	☐
Yogurt is a better source of CLA than milk	☐	☐	☐	☐	☐

For examples of milk and yogurt choice sets, please see Figures 3.5 and 3.6.