Comparing Consumer Perceptions of the Health Value of Dairy Milk and Plant-Based Dairy Milk Alternatives

By

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Abstract

The purpose of this study was to compare consumer perceptions regarding the health value of dairy milk and plant-based dairy milk alternatives (PBDMAs). The motivation stemmed from the decline in dairy milk consumption, contrasted with the rising popularity of PBDMAs. Data on consumer perceptions were collected from 1,036 respondents through an online survey. The Wilcoxon signed-rank test was used to test for differences in perception, while binary logistic models identified the factors that influenced consumption decisions. Significant differences in perception were found for 15 of the 16 health claims tested; while respondents tended to have an overall positive perception of dairy milk's health value, there were apparent concerns with its fat content and impact on weight which were not similarly present for PBDMAs. Health perceptions were found to have a significant, positive effect on the decision to consume dairy milk and PBDMAs, thus substantiating the importance of studying consumer perceptions.

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Chapter 1: Introduction

In recent years, there has been a noticeable shift in the Canadian dairy milk market; per capita milk consumption has been decreasing, the beverage market has become saturated as new products are constantly introduced and the way in which consumers make their purchasing decisions is evolving. The issue of declining milk consumption is quite complex and involves many factors such as the rise of veganism, changing demographics, lactose intolerance, health concerns, animal welfare concerns, and changing consumer preferences (Atkins 2015; St. Pierre 2017). One factor that has not yet been explored at great lengths in the literature is the idea that consumers may be switching to plant-based dairy milk alternatives (PBDMAs) due to a perception of increased health benefits. Thus, the purpose of this research was to evaluate and compare consumer perceptions of the health value of dairy milk and PBDMAs to determine if any significant differences in perception existed.

1.1 Background

1.1.1 Dairy Milk Consumption in Canada

In 2006, Statistics Canada published the findings from the first Canadian Community Health Survey which surveyed over 35,000 Canadians, asking them to recall what they had eaten in the past 24 hours (Garriguet 2006). The purpose of the survey was to provide a snapshot into the diet of the average Canadian and determine in what ways their dietary intake was sufficiently adequate or lacking. One important finding from the survey was that most Canadians were not meeting the recommended minimum number of servings of milk products as suggested by the Canada Food Guide. In fact, of the four food groups in the Guide (the others being Vegetables and Fruit; Grain Products; and Meat and Alternatives), the dairy products (Milk and Alternatives) category had the lowest rate of compliance. As seen in Table 1, after the age of

Table 1. Percentage of the population that did not meet recommended minimum number of servings of milk products, by age and sex

Age Group	Male	Female
4 to 9 years	37%	37%
10 to 16 years	61%	83%
17 to 30 years	46%	65%
31 to 50 years	65%	72%
51 to 70 years	74%	80%
71 years or older	79%	84%

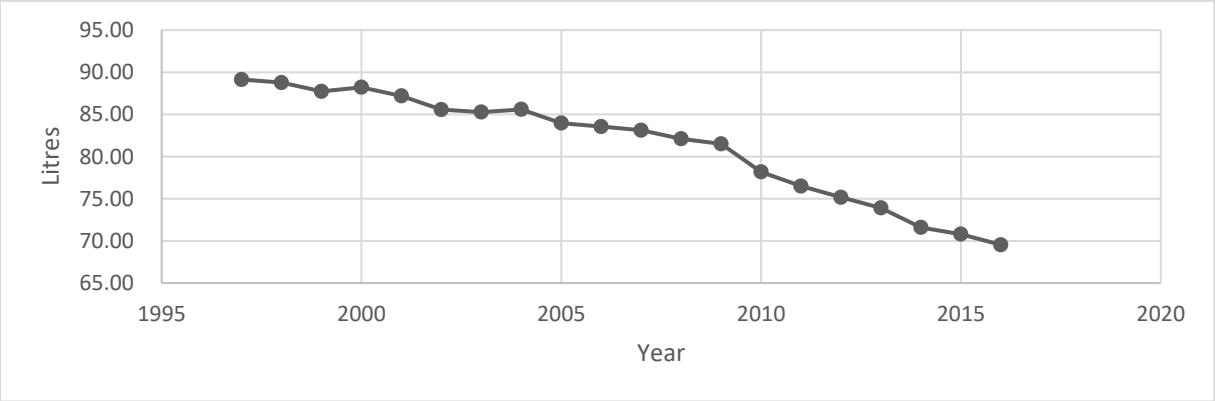
Source: Garriguet (2006)

nine, the percentage of the population that did not meet the daily recommended minimum number of servings of milk products was over 50% for every group, except men aged 17 to 30 years. These results were concerning since dairy products are the main dietary source of both calcium and vitamin D, and reducing dairy intake could thus lead to an insufficient intake of valuable nutrients and an increase in the risk of developing nutrition-related diseases such as osteoporosis (Garriguet 2011). Canada's Food Guide has since been updated with increases to the minimum number of servings for certain demographic groups; accordingly, had the data been evaluated with these updated recommendations, it is quite likely that the compliance rate would be even lower.

This trend does not appear to be improving as per capita milk consumption has continued to trend steadily downwards since the results of the survey were released. Figure 1 shows the decline in per capita milk consumption dating back to 1997. This data includes consumption of 3%, 2%, 1%, skim, flavoured milk and buttermilk. In 1997, per capita consumption of all milk products was 89.14 litres. By 2016, this number had decreased by more than 20% to 69.53 litres.

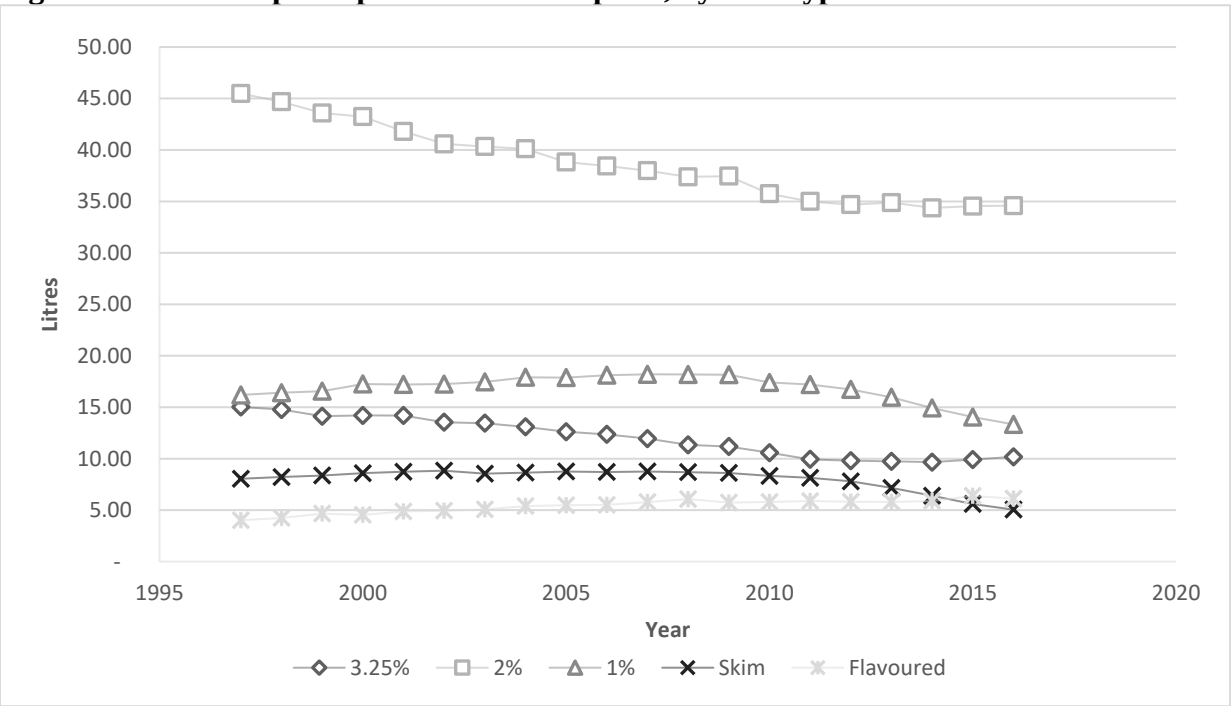
To provide a more detailed description of milk consumption patterns of Canadians, Figure 2 depicts per capita milk consumption by type of milk (excluding buttermilk as total consumption was minimal compared to the other types, averaging 0.39 litres per year). Figure 2

Figure 1. Canadian per capita milk consumption, total



Source: Canadian Dairy Information Centre (2017)

Figure 2. Canadian per capita milk consumption, by milk type



Source: Canadian Dairy Information Centre (2017)

illustrates that while 2% milk has seen the largest decline in per capita consumption, from 45.48 litres in 1997 to 34.58 litres in 2016, it remains the most popular milk choice among Canadian consumers. Another point of interest is that flavoured milk is the only category of milk that has seen a constant increase in per capita consumption, from 4.02 litres in 1997 to 6.11 litres in 2016. Per capita consumption of both 1% and skim milk increased somewhat consistently until about

2007, reaching 18.20 litres and 8.76 litres respectively, then began to fall so that in 2016 consumption was at 13.33 litres and 50.05 litres respectively.

Many reasons have been cited as an explanation for the decline in consumption; these include changing demographics, lactose intolerance, milk protein allergies, veganism, animal welfare concerns, as well as changing consumer preferences (Atkins 2015; St. Pierre 2017). Statistics Canada does not collect data on diet type statistics such as the number of vegans or those who are lactose intolerant, making it difficult to evaluate the relative impact of these factors on the decline in dairy milk consumption. Searching for answers, Dairy Farmers of Canada commissioned a survey to provide some insight into the reasons for the decline (Duckworth 2014). Their results indicated that 10% of those who did not drink dairy milk were vegan and an additional 8% did not support the dairy industry due to animal welfare concerns (Duckworth 2014). Lactose intolerance and cow's milk allergies were also cited as reasons for abandoning milk consumption. Two demographic groups that had almost completely given up milk were middle-aged empty nesters and families with children under the age of 12. The latter group accounted for roughly one-quarter of the decline (Duckworth 2014). Another study of 2,251 Canadians found that 16% of respondents were self-reported lactose intolerant (Barr 2013). While lactose intolerant individuals can still consume limited amounts of dairy without noticing any symptoms, the research showed that those individuals tend to avoid dairy products altogether. Soller et al (2010) attempted to estimate the prevalence of milk allergies in the Canadian population and found that 2.09% of respondents self-reported an allergy to milk. While milk allergies are not very common, in such instances milk products must be completely eliminated from the diet. Based on this information, it would seem that a push away from dairy due to veganism, milk allergies, lactose intolerance and concerns for animal welfare alone cannot

fully explain the decline in milk consumption. As further evidence, per capita consumption of other milk products such as yogurt and cream have been on the rise since 2005, which would not be the case if consumers were abandoning dairy products altogether (Canadian Dairy Information Centre 2017). Thus, it is reasonable to assume that changes in consumer perception and preferences account for a portion of the decline. While dairy milk consumption is declining, the popularity of PBDMAs appears to be on the rise and could be posing a threat to the dairy milk industry.

1.1.2 Plant-Based Dairy Milk Alternatives

Plant-based dairy milk alternatives are, as the name suggests, beverages sourced from plant products that act as a substitute for dairy milk as a beverage or as an additive in food preparation for people who don't drink dairy milk either out of preference or necessity. There are a variety of PBDMAs available on the market including soy, almond, cashew, hemp, coconut, rice, and one of the newest releases in this category, pea milk. While the popularity of PBDMAs has seen a dramatic increase in recent years, these products have been consumed for centuries. In fact, the earliest known documentation of a non-dairy milk in the literature is a mention of almond milk in the 1226 book *Kitab al-tabik*, or *A Baghdad Cookery Book* (Shurtleff and Aoyagi 2013).

There are many reasons that consumers would either need or choose to consume PBDMAs instead of dairy milk. As discussed previously, people who are lactose-intolerant or allergic to cow's milk protein need to limit or eliminate dairy consumption and therefore would be more likely to consume PBDMAs. According to Mintel research, 49% of Americans now consume PBDMAs (Mintel 2016). However, their research also revealed that almost all those who consumed PBDMAs also consumed dairy milk, revealing that the switch to plant-based alternatives is not solely out of necessity but rather out of preference. Some of the most common

reasons for choosing plant-based foods and beverages include environmental concerns or animal welfare concerns related to dairy milk production and changing consumer preferences or perceptions regarding diet. Recent research has suggested that consumers are not only becoming more aware of the link between health and diet but are making conscious and proactive choices in their food purchasing choices to ensure a healthy lifestyle. There appears to be a perception among some consumers that a vegan or plant-based diet is synonymous with improved health and this could explain why certain consumers are choosing to switch to plant-based milk alternatives. In most grocery stores, PBDMAs are found in the "natural food" section and this could add to the perception of these beverages being a healthier option than dairy milk. Per Nielsen's Global Health and Wellness survey, on a global average of those trying to lose weight, 57% are choosing to eat more natural and fresh food (Nielsen 2015). Their survey results also demonstrated that consumers are showing a preference for naturally sourced, back to basics, low-impact products and the evidence seems to suggest that consumers are associating these qualities with plant-based foods and beverages (Crawford 2016).

Currently, Statistics Canada does not collect data on Canadian sales and consumption of PBDMAs. However, data from Nielson Home Scan data can provide some insight on the market for dairy milk alternatives in Canada. From January 2014 to January 2016, Canadian sales of almond milk grew trifold and sales of rice milk rose six percent, while sales of soy milk fell by seven percent (Fernando 2016). In Alberta alone, sales of PBDMAs grew 225% from 2011 to 2014 (Fernando 2016). Internationally, a similar trend can be observed. In the United States, almond milk sales grew by 250% from 2010 to 2015, reaching a value of $894.6 million (Crawford 2016). Soy milk sales came in second, at $297.7 million, followed by coconut milk ($61.3 million), rice milk ($18 million) and others ($50.2 million combined) (Crawford 2016).

Almond milk appears to be the most popular plant-based alternative among both Canadians and Americans. In 2013, the largest market share of the global dairy milk alternative market was Asia-Pacific (50.4%), followed by North America (30.6%) and finally, Europe, the Middle East, and Africa (19%). On a global scale, it is estimated that the market for dairy milk alternatives could reach $10.9 billion by 2019 (Market Wired 2016).

Based on the information provided in the background section, it is reasonable to state that the PBDMA beverage category poses a significant threat to the dairy milk category and therefore the dairy industry could benefit from additional research providing insight into the preferences and perceptions of consumers regarding these two beverages.

1.2 Motivation and Objectives

The objectives of the research reported in this thesis were to explore Canadians' perceptions with respect to the health value of dairy milk compared to PBDMAs, and to determine the impact of both health perceptions and socio-demographic factors on the choice to consume dairy milk and PBDMAs. To accomplish these objectives, a survey was administered to a sample of 1,036 Canadians to collect data on their perceptions of specific health claims related to dairy milk and PBDMAs consumption. A secondary goal of the research was to ascertain the market potential for a new dairy milk product in Canada; this was accomplished by the inclusion of willingness-to-purchase and willingness-to-pay questions in the survey.

The motivation for this research was to provide insight to the dairy industry on how consumers perceive the health value of dairy milk compared to its arguably biggest competing products (PBDMAs), thus helping the industry focus its marketing, advertising, educational and innovation efforts in areas that could influence consumer purchasing decisions. It could also

allow the dairy industry the opportunity to address any popular misconceptions consumers may have about the health value of dairy milk.

1.3 Outline

The remainder of this thesis is organized into five chapters. The next chapter provides an overview of the relevant literature, notes important findings from the reported studies and discusses how the research reported here differed from previous work and would add to the body of literature. The third chapter discusses the advantages and disadvantages of the online survey method that was selected for this research and describes the survey development and distribution process. The underlying theory for this study is presented in chapter four, as are the resulting empirical models used for analysis, the methods by which the data were analyzed, and a summary of the collected socio-demographic data. Chapter five presents the results of the statistical analysis including a summary of the descriptive statistics and the results of both the Wilcoxon signed-rank tests comparing perception claims and the binary logistic models of consumption choices. The sixth and final chapter concludes this thesis by highlighting its key findings and discussing their implications for the dairy industry, acknowledging limitations of the study, and suggesting possible research extensions of the present work.

Chapter 2: Literature Review

There is an abundance of literature on the topic of consumer perceptions of dairy products, stemming from the nearly universal trend of decreasing dairy milk consumption. While methodology, theory and demographic groups targeted may differ, the one common motivating factor in nearly every study looking at consumer perception of dairy products is the desire to better understand consumers and the ways in which perception influences their consumption and purchasing decisions. The goal of most such research is the development of strategies to reverse the trend of decreasing dairy milk consumption. However, due to their relatively recent growth in popularity, research pertaining to the perception of PBDMAs is far less common and there are only a handful of studies that investigate this topic.

The relevant literature can be organized into three categories: qualitative studies relating to perceptions of dairy products, quantitative studies related to perceptions of dairy products, and quantitative and comparative studies related to perceptions of both dairy milk and PBDMAs. The following sections will provide a summary of the different studies and pertinent findings from each category.

2.1 Qualitative Studies Investigating Consumer Perceptions of Dairy

One of the earliest studies on consumer perceptions of dairy was carried out by Horwath et al (1995) who compared influences on dairy milk consumption between young and elderly women in New Zealand to determine whether similar strategic approaches would be effective in targeting both demographic groups. Through interviews with 71 elderly women and 22 young women, the authors identified certain common themes: for example, most of the elderly women drank full-fat milk, while most of the young women drank reduced-fat milk. The main influence on young women's milk choice was health considerations, while older women valued taste or

texture. Reasons cited for low milk consumption were similar for both groups and included a dislike of the product, health concerns and habit. However, specific health reasons differed between both groups: while young women were more concerned with losing weight, and reducing their fat intake, elderly women were concerned with the impact of milk on medical conditions (e.g prevention of osteoporosis), as well as reducing fat and cholesterol intake. When asked whether increasing their milk consumption would benefit their health, most young women agreed, however only a quarter of elderly women agreed. Based on these findings, the authors concluded that strategic approaches to increase milk consumption should be tailored differently for young and elderly women; for young women, this could mean addressing concerns related to fat intake and for the elderly, this could mean communicating how to properly manage medical concerns while ensuring adequate milk intake.

Eddy et al (1999) chose to look specifically at dairy food perceptions of older women by conducting focus groups with that demographic group in the state of Virginia. Two main themes emerged throughout their discussions: health and nutrition related perceptions of dairy foods, and external influences on dairy food choices. In terms of health benefits, most women cited calcium intake as a benefit of milk consumption, yet most of the participants relied on calcium supplements, rather than milk, to achieve adequate calcium intake. The women were largely unable to list any other beneficial nutrients found in milk. Fat was cited as the most important health concern related to dairy food consumption. The two most important attributes for the women when choosing dairy foods were health perceptions and sensory attributes. The discussions also revealed that physicians had the strongest influence on the women's dairy food consumption, therefore the authors suggested that educators should consider this influence when designing programs to promote dairy food consumption in older women.

In a similar study, Hagy et al (2000) investigated middle-aged Virginian women's perceptions of dairy foods using focus groups. In general, the findings were in line with those reported in Eddy et al (1999) – these women also identified calcium as the main health benefit of dairy foods and fat as the main health concern associated with dairy food consumption. Participants also appeared to favour calcium supplements over dairy foods to achieve sufficient calcium intake. In contrast to Eddy et al (1999), women in this study also listed vitamins as a health benefit, though only a few could identify specific vitamins. Women spoke of the influence of their husbands and children on their dairy food choices, while in Eddy et al (1999), physicians were cited as the main influencers on dairy food choices. Study participants also discussed the role of convenience and pricing in their food purchasing choices, with most agreeing that the price of dairy foods was reasonable. Finally, the women revealed that while they were familiar with various dairy ad campaigns, they did not feel the ads were targeted at them and thus did not have an impact on their actions. Accordingly, the authors concluded that media ads could be useful to reach this specific demographic if nutritional messages were designed to appeal to their specific concerns.

Focusing on Canadian consumers' perspectives, Jung et al (2015) conducted group interviews consisting of men and women between the ages of 30 and 50 in British Columbia to determine their perceptions of the benefits and barriers to consuming milk and milk products. Participants were divided into groups based on gender and consumption levels. The benefits of consuming milk fell into three categories: physiological, role modeling, and taste benefits. Many participants were aware of the nutritional benefits of consuming dairy, such as the protein, calcium, and vitamins obtained; weight loss was also cited as a benefit of consumption. Parents also viewed it as important to consume dairy products to set a good example for their children.

Barriers to consuming dairy products were concerns about the fat and sugar content of milk leading to unhealthy weight gain, unease with the potential effects of hormones and antibiotics, convenience, taste, and time. The authors noted differences in beliefs between men and women, as well as between adequate consumers and under-consumers. For instance, women on average listed the price of milk and the short shelf life as barriers to consumption, whereas men did not. Similarly, under-consumers more often listed distaste of milk and time as barriers to consumption, compared to adequate consumers. A notable finding was that most participants acknowledge the perceived lack of credible information sources as a barrier to consumption. Strategies identified to encourage milk consumption among respondents included making consumption of dairy products more routine, combining milk products with other foods, and focusing to a greater extent upon the importance of dietary planning. This study found that, in contrast to previous literature, respondents were for the most part aware of the nutritional outcomes of consuming milk products, and this was of considerable importance to them.

Lacroix et al (2016) conducted a similar study to the work of Jung et al (2015) discussed above, but focusing solely on perceptions of milk and cheese. The authors ran focus groups in both Quebec and Ontario following a theory of planned behaviour (TPB) framework, which states that behavioural intention can be predicted by three constructs: attitudes, subjective norms, and perceived behavioural control. Data collected from the focus groups were transcribed, coded and sorted into the appropriate TPB construct. Reported benefits of consuming milk included health benefits, nutritional advantages, good taste, socio-affective advantages, and practicality. Reported disadvantages included undesirable health effects, unpleasant taste, nutritional disadvantages (fat, cholesterol, calories, etc.), a processed nature to the product, and impracticality. The most common cited barrier to consumption was reduced confidence in the

product; other barriers related to animal welfare, negative study results, and negative news in the media related to the dairy industry, as well as health concerns (lactose intolerance), high price, social influences, and the availability of substitutes, including PBDMAs. As with Jung et al (2015), differences in beliefs were noted between men and women, and infrequent vs. frequent dairy consumers. For instance, women more often listed animal welfare and environmental concerns as reasons for their reduced milk consumption, and only women reported buying organic milk. Men, on the other hand, reported being influenced by negative media news and revealed that they were reassured by Canadian quality control regulations. More frequent consumers described milk as an indispensable food, whereas less frequent consumers often cited that milk only tasted good cold and/or in combination with other foods. Consumers from the latter group were also more likely to express concerns about health effects of milk consumption (gastro-intestinal and mucus issues), as well as uneasiness about the idea of drinking another mammal's milk. While the overall findings were consistent with previous work, this was the first known study to report concerns among consumers about the origins of dairy milk.

Planned behaviour theory was also utilized by Nolan-Clark et al (2011) to study differences in perceptions of dairy foods between participants from a weight loss trial and non-participants in Australia to determine the impact of nutritional education on perceptions of dairy products. The authors hypothesized that participants in the trial would hold more positive views of dairy products due to the nutritional education they received during the weight loss trial. Focus groups were conducted with both groups and responses were categorized according to the three constructs of the TPB. Non-participants' perceptions of the health value of dairy products were in line with findings from previous studies (Eddy et al 1999; Hagy et al 2000), stating that calcium was the main health benefit and fat was the main health concern associated with

consumption of dairy products. Those who participated in the weight loss trial elaborated on other health benefits of dairy foods such as the protein content, vitamins and minerals, and did not associate dairy products with weight gain. The trial participants also had less perceived control barriers in terms of dairy product consumption compared to non-participants. In terms of normative beliefs, both groups discussed the influence of family on their purchasing behaviour, a finding also discussed in Hagy et al (2000). Since normative beliefs did not differ significantly between both groups, the authors suggested that this specific TPB construct might not be affected by nutrition education. As a result, they suggested that advertisers should concentrate their efforts on the other two constructs, behavioural and control beliefs, where significant differences were detected between the trial participants and non-participants. Overall, results confirmed the authors' hypothesis that a positive relationship existed between nutritional education received during the weight loss trial and perception of dairy products as participants in the trial viewed dairy products in a more positive light than non-participants, acknowledged their favourable effects on health and diet, and felt comfortable incorporating these foods into their diet. These results demonstrated that nutrition education could be effective in improving consumers' perceptions of dairy products and would therefore be a useful tool in the strategic efforts to promote and increase dairy foods consumption.

Social cognitive theory (SCT) provided the framework for a study by Mobley at al (2014) that explored the perceptions of older, low-income women in the Indianapolis area with respect to dairy milk. Much like TPB, SCT relies on the interaction of three constructs: behaviour, personal factors and the environment. These three constructs were used to develop questions and guide discussions during the focus groups. Participants expressed a preference for the taste of whole milk, while expressing a distaste for fat-free or reduced-fat varieties. The main health

benefits women associated with milk consumption were promotion of bone health and prevention of osteoporosis. They were aware of the calcium content, but other nutrients contained in milk were rarely discussed. The main concerns related to milk consumption centered around gastrointestinal issues, sometimes linked to lactose intolerance, and a belief that milk consumption did not offer any health benefits for older adults. Negative perceptions identified by participants included concerns regarding the cholesterol and sugar content, and effects on weight gain. Of the three types of factors involved in the SCT, personal factors appeared to have had the heaviest influence on the women's milk consumption habits, and thus the authors suggested this should be the focus of future educational efforts to improve milk consumption in this demographic group.

The above studies highlight some of the most common perceived benefits and concerns associated with dairy milk consumption. While qualitative research methods have advantages such as the ability to identify major themes, allowing the researchers to elaborate on the responses of participants, and explore other themes based on their responses, sample sizes have often been too small to draw conclusions about the entire population, thus limiting their usefulness in general applications. Also, due to the qualitative nature of the data collected in these studies, the amount of quantitative analysis is usually limited. Moving from qualitative studies to the quantitative studies highlighted in the next section facilitates a more rigorous exploration of the themes discussed so far, but with a focus on empirical models which could be more vigorously analyzed and tested.

2.2 Quantitative Studies Investigating Consumer Perceptions of Dairy

Brewer et al (1999) applied the theory of reasoned action (TRA), from which TPB is derived, to determine which factors influenced the consumption or avoidance of dairy milk in women in

Maryland. This theory postulates that a behaviour can be predicted by intention, which in turn is determined by attitudes and subjective norm. Participants were required to complete a questionnaire with a demographic and milk purchasing behaviour section, a food frequency section, a dairy intake section, and a milk attitude section; milk samples were also provided for participants to rate for sensory testing. While subjects enjoyed whole milk more than skim, they reported drinking more skim milk, indicating that health concerns were more important to participants than sensory attributes. Thus, this study provided evidence that milk consumption choices are not based solely on taste. Model pre-testing indicated that subjective norms did not have a significant effect on behaviour, thus the equations were specified with behaviour as a function of intention, attitude score and sensory evaluation. This model predicted 67% of the variability for skim milk, 45% for 1% milk, 60% for 2% milk and 67% for whole milk. However, intention to drink milk was low for all milk types, a disconcerting finding for the authors.

Kim et al (2003) also utilized TPB to predict both intention to consume as well as actual consumption of dairy products in older adults in the Minneapolis area. The questionnaire used to collect data included multiple statements related to each of the three constructs of the TPB, as well as two statements to measure intention. Scores for each item in a construct were summed to provide an overall score for that specific construct; the authors then used regression analysis to determine how well the TPB constructs predicted intention to consume and actual consumption and performed t-tests to assess any differences in consumption based on demographic characteristics. Variables that impacted consumption included race, the use of supplements and regular exercise. Regression analysis for intention to consume (model explained 42.4% of the variation in the dependent variable) found that both attitudes and perceived behavioural control

were related to intention, while subjective norms were not, supporting the findings of previous research, including Brewer et al (1999). The model for dairy product consumption was related to intention to consume and perceived behavioural control and explained 39.4% of the variation in consumption. These findings supported the validity of the TPB framework for predicting dairy product consumption.

Cashel et al (2000) compared milk consumption, calcium intake and the factors that impact these choices between pre-and postmenopausal Australian women. Two hundred and ninety-eight participants completed a food frequency questionnaire to measure calcium intake and Likert-type items that required participants to rate the importance of choosing foods with various food attributes such as low fat, high fibre, high calcium, low cholesterol, low calories and low added sugars. Chi-square analysis and ANOVA were used to test for differences in the data among the different demographic groups. It was discovered that older women drank more milk than younger women in general, and that older and younger women differed in both the type and quantity of milk they consumed, with the highest percentage of older women consuming skim milk and the highest percentage of younger women consuming whole milk. Choice of milk consumption was also shown to be influenced by employment status, living arrangements (i.e. living alone, living in an adult-only household or living in a household that includes children) and certain health conditions, such as high blood pressure, obesity and osteoporosis. Both groups of women rated “low in fat” as the most important food attribute, followed by “high in fibre.” Older women then chose “low in cholesterol” as the third most important attribute, while younger women ranked “high in calcium” as their third most important attribute. While older women were more likely to consume milks lower in calcium, their overall calcium intake was still higher than younger women because they were consuming more milk

overall than younger women. Concerns regarding fat intake were found to be influencing the type of milk women chose to consume and thus, acting as a barrier to increased calcium intake.

Wham and Worsley (2003) conducted two telephone surveys, one in 1997 and the other in 1998, to identify New Zealanders' attitudes and beliefs towards milk acting as barriers to consumption. The survey covered four themes related to milk perceptions: sensory factors, cost and usage, health and nutrition, and age and gender requirements. Through cross tabulation, the authors compared the responses from various demographic groups to discover any significant differences in perceptions. They also built a model to predict milk consumption based on demographic characteristics and attitudes using chi-squared automatic interaction detector, a decision tree classification method that segments a sample into groups to best predict the dependent variable. The prevalence of misinformation and lack of knowledge regarding the properties of dairy milk was quite evident in this study; a third of respondents agreed that fruit juices were healthier than milk. Respondents raised concerns about the fat and cholesterol content of milk as well as milk causing allergies in children. However, an overwhelming majority recognized that milk is a good source of calcium and promotes bone growth, which is in line with results from previous studies. Differences in perception were detected between both gender and age groups. Like previous studies, Wham and Worsley (2003) reported that women were more concerned about weight gain than men and thus more concerned about the fat content of milk. Women were also more aware of the calcium content of milk, more convinced of the nutritional benefits of milk, and more likely to agree that milk is good value for money. Older participants held more negative views of milk, both in terms of its nutritional value and taste. While younger respondents held more positive views of milk, they were still not choosing to drink milk. The model used to predict milk consumption based on demographic characteristics

and attitudes discovered that gender was the strongest demographic predictor and agreement with the statement “milk is expensive compared to fizzy drinks” was the strongest attitudinal predictor of milk consumption; women consumed less milk than men and those who agreed that milk was expensive compared to soft drinks were less likely to consume milk, implying price as a barrier to consumption.

In one study of Europeans’ perceptions of dairy, Chollet et al (2014) surveyed 726 Swiss residents between the ages of 50 to 81 years old to identify their dairy product consumption patterns and the reasons behind their under-consumption of dairy products. The Kruskal-Wallis test and pairwise comparisons were utilized to identify significant differences between demographic groups. The most consumed dairy product was reduced-fat milk, with an average of 4.5 portions per week. Women were found more likely to enjoy the taste of reduced-fat dairy products, while men’s motivation to consume these products were more likely to be based on recommendations from another person. While most respondents considered dairy products to be safe, healthy, and tasty, concerns were apparent with the digestibility of dairy milk. More than one quarter of respondents indicated that their milk consumption was decreasing with the main motivators being a desire to reduce their fat or cholesterol intake. Other reasons mentioned included lactose intolerance, changes of lifestyle, dislike of the product, and a desire to reduce weight. In contrast to previous work, this study did not find any significant differences in men and women’s consumption of low-fat milk nor their perceptions of the fat content in dairy.

Johansen et al (2011) used a questionnaire to assess and compare the motivations of young people in California, Denmark, and Norway for consuming calorie-reduced yogurt and cheese, as well as their ranking of the healthiness of these foods compared to others. While this study did not directly consider perceptions of dairy milk, the results still provide insight into

perceptions that are applicable to the entire dairy food products category. The dual sorting test, a stepwise approach to determine the relative importance of different factors, was used to identify the main motivators for consumption and a ranking test was used to assess perceived healthiness of various food products. A chi-square test, principle component analysis, and nominal logistic regression models were used to analyze the results from the dual sorting test. The results from the ranking test were compared using Friedman's test, the non-parametric equivalent of the one-way ANOVA with repeated measures. Overall, the most important reasons for consuming calorie-reduced cheese and yogurt were "low in fat", "keeps me healthy", "tastes good", "control weight" and "nutritious." Differences between countries and gender did exist in the ranking of the items with females consistently ranking "low in fat" and "control weight" higher than males, a result consistent with previous findings. In terms of ranking food products for health value, respondents from all three countries ranked salmon as the healthiest product from the list of available options. Californian and Danish respondents then ranked yogurt and milk as the second and third healthiest products, while Norwegian respondents ranked yogurt fourth and milk ninth. Cheese was ranked either seventh or eight by participants from all three countries. The study concluded that motivation for consuming calorie-reduced dairy products in all three countries were similar and revolved around health-related values.

2.3 Quantitative and Comparative Studies Investigating Consumer Perceptions of Both Dairy Milk and PBDMAs

Bus and Worsley (2003) conducted a consumer survey to investigate Australian consumers' health perception of whole milk, reduced fat milk and soy milk and to determine any effects of demographic characteristics on health perception of the three milk types. Respondents were randomly chosen from shoppers at two shopping centres in Melbourne and were randomly

assigned a questionnaire either on whole milk, reduced fat milk or soy milk. The questionnaire had two parts; the first focused on health perceptions of milk, asking participants to state which positive and negative health claims they associated with their specified milk type. The second part of the survey was comprised of demographic questions to facilitate comparisons between the responses of different demographic groups. Factor analysis showed that there were five main perceived health effect categories associated with the consumption of the different milk types: prevents diseases, causes serious diseases, causes allergies, diet food, and good for bones, teeth, and skin. Factor scores were calculated for each item to simplify the data analysis and then tested using two-way ANOVA to discover any differences or interactions of the mean factor scores between types of milk and demographic variables. Overall, participants viewed whole milk as most likely to cause allergies and serious disease, while it was perceived as the least useful for weight loss. Soy milk was perceived as most likely to prevent disease, including menopausal problems and cancer. The results showed that there were few significant differences in perception based on demographics. The authors also noted that there were many instances where participants responded "don't know" to a survey question, demonstrating a strong level of uncertainty among consumers regarding the health effects of consuming milk. Many misconceptions were also noted in the participants' responses, including 33% of participants stating that milk consumption could prevent anaemia, as well as an association between soy milk and "magical thinking" as described by the authors. These findings signaled a need for better public education in terms of the health effects of milk consumption.

Jones et al (2008) wished to determine if there were any significant differences in the perceptions of consumers in the United States and New Zealand as they related to the health benefits and product claims associated with soy and dairy products. Respondents from

Palmerston North, New Zealand and Raleigh, North Carolina answered a usage and attitude questionnaire featuring both multiselect and ranking questions, as well as a conjoint analysis questionnaire whose purpose was to determine which features were considered by consumers to be important in a protein bar and whether a protein bar could successfully be marketed in both countries. The data were grouped by country, age, and gender for comparative purposes. The usage and attitude responses were presented as percentages of the population that selected each option and a chi-square test was performed to determine any association between country and a particular option. The conjoint analysis data were transformed into utility values to measure the preference of different attributes by gender and age. Two-way ANOVA was used to determine any differences by country and component. Results indicated that participants from both countries were more inclined to believe that dairy, rather than soy, was a source of calcium, developed and maintained healthy bones, prevented cavities, and had a great taste. On the other hand, participants were more inclined to believe that soy products, rather than dairy, were cholesterol and fat free, reduced the chance of heart disease and cancer, decreased menopausal symptoms, and could help with weight control. These findings are quite similar with those from Bus and Worsley (2003). Differences in perception between the two countries were seen in terms of the better protein source: US consumers felt that soy products were higher in protein, whereas NZ consumers felt that dairy products were higher in protein. Other notable differences related to the perception of low carbohydrates, the presence of genetically modified ingredients, and the ability to provide lean muscle mass. In terms of the conjoint analysis, consumers in both countries chose similar desirable attributes in a protein bar. The most notable difference was the importance of the protein source: New Zealand consumers appeared to care more about the source of protein and their preferred source of protein was dairy. In comparison, consumers in

North Carolina did not reveal a real preference, although there was a slight, yet statistically insignificant, preference for a combination of soy and dairy. The study concluded that overall, both countries had similar perceptions of soy and dairy products, and in the areas where the two countries tended to differ, participants from North Carolina revealed a preference for soy products while those from New Zealand revealed a preference for dairy products.

In a recent study, McCarthy et al (2017) compared factors that are driving purchases of both fluid dairy milk and PBDMAs in order to uncover the underlying values behind consumers' purchasing decisions. A total of 999 participants were recruited from Raleigh, North Carolina and, based on their responses to product usage questions, were labelled as either dairy-only consumers, non-dairy-only consumers, or consumers of both beverage types. The authors conducted an online survey that included a conjoint analysis section, emotion questions and a Kano questionnaire, which required respondents to classify the beverages' attributes into one of five categories (attractive, indifferent, one-dimensional, must have or reverse). A portion of the respondents were also selected to participate in a one-on-one means-end chain interview. Utility scores were calculated based on the conjoint analysis and one-way ANOVA was used to analyze the scores and clusters. The emotion questions were analyzed by computing frequencies of responses and using a chi-square test for significance. Hierarchal value maps were created from the means-end chain interviews. The conjoint analysis revealed that dairy milk drinkers rated fat content, package size, and label claims as their most important attributes, while non-dairy milk drinkers rated sugar content, plant source, and package size as their most important attributes. For both products, higher levels of protein equated to higher utility scores; however, results also indicated that consumers did not view milk as a source of protein. The emotion questions revealed that all consumers expressed positive emotions toward their milk beverage of choice.

Both consumer groups indicated that milk consumption was linked to a desire for a balanced diet and healthy lifestyle. Dairy milk consumers viewed dairy milk as a staple in their diet, while non-dairy milk drinkers expressed ease of mind in their choice due to concerns about their health, animal welfare and environmental effects linked to dairy milk. The authors concluded that innovation in the lactose-free milk sector and public education regarding the nutrition value and misconceptions surrounding milk could encourage dairy milk consumption.

Based on the above information, this thesis would add to the body of literature because it would be the first study to analyze in a quantitative and comparative fashion the perceptions of Canadians towards the health value of dairy milk and PBDMAs with the purpose of providing insight into a potential factor contributing to the decrease in dairy milk consumption.

Chapter 3: Methodology

The purpose of this research was to ascertain whether differences exist between consumer perceptions of the health value of dairy milk and PBDMAs. As evidenced by the literature review, an appropriate and popular method of obtaining data on consumer perceptions and attitudes is through a consumer survey. This chapter discusses the methods by which the survey was carried out to obtain the necessary data to answer the research questions. First, a review of the advantages and disadvantages of the chosen survey method, the online survey, will be discussed. Next, the survey design and distribution process will be detailed, including the choice of survey platform, respondent panel, the logic behind the wording and ordering of questions, as well as the overall organization and content of the survey.

3.1 Advantages and Disadvantages of the Online Survey

As with any survey method, there are advantages and limitations of using an internet-based survey. While it is practical to avoid all limitations associated with this method, it is important to be aware of their impact when analyzing and interpreting the results. Online surveys offer the quickest delivery and response times (Fricker and Schonlau 2002), especially when compared with mail surveys, which require the survey administrator to print out and fold the survey, put the survey in an envelope, seal the envelope, address and stamp the envelope, deliver the envelope to a mailbox or post office, then allow several days before the survey is delivered to its intended recipient. The administrator must then wait for the respondent to fill out the survey and mail it back, then must manually input all the data into a computer program to perform further data analysis. Such a process is both time consuming and resource intensive. In contrast, once an online survey is constructed, the survey administrator only needs to push a button to send the survey out to the desired respondents, they receive responses in real time as respondents fill out

the survey and with most survey software, the administrator can export the data in a spreadsheet, resulting in a more time efficient and less resource intensive process with significantly less risk of human error during the data input stage. Compared to mail surveys, online surveys can also have increased response rates (Fricker and Schonlau 2002). For instance, with many online survey platforms, the survey administrator can specify the number of completed surveys they require for the research or they can simply leave the survey open until they receive the desired number of responses. With a mail survey, the administrator could send out a higher number of surveys to attempt to increase the response rate (although this also leads to increased costs), however, there is no way of guaranteeing they will receive a targeted number of completed surveys. Online surveys also offer a convenience factor for the respondent (Evans and Mathur 2005). For instance, with a telephone survey, the interviewer determines when the respondent will be called upon to answer the survey and if the respondent is busy, they are more likely to decline participating. Self-administered surveys, such as online or mail surveys, allow the respondent to fill out the survey at a time that is convenient for them and therefore can increase the response rate.

Another advantage of the online survey is the opportunity to customize the survey and use technological features to enhance both the efficiency and the respondent's experience. For example, most online survey platforms offer "skip logic" which allows the survey administrator to set up the survey so that respondents are guided only to the questions that are relevant to them (this will be further discussed below in section 3.2.2). Other features that are only available through online surveys are customizations such as the number of questions that the respondent views on each page, the option to include external links that provide additional information for interested respondents, and the ability to track certain features such as the number of respondents

who visit the survey and the amount of time it takes respondents to fill out the survey. Another advantage is that the administrator can choose from a multitude of different question formats with different levels of respondent interaction, which not only helps keep the respondents engaged, but also can improve response rates and reduce the risk of questions being answered improperly. For instance, if a paper survey includes a question that asks respondents to select one option from a list of several different categories and the respondent circles more than one option, the data cannot be used; the survey administrator cannot distinguish which of the two options was the final choice and would most likely need to treat the observation as missing. With the online survey, by using specific question formats, the administrator can ensure that the question is set up so that respondents can only choose one single response option.

One of the biggest criticisms of the online survey method is the coverage error since an online survey by nature requires respondents to have access to the internet (Fricker and Schonlau 2002). In the past, research has shown that those who had access to the internet were not fully representative of the general population and this group was skewed towards upper-class males (Evans and Mathur 2005). A 2012 survey of internet use in Canada reflected this trend; only 58% of the lowest quartile household income group had access to internet, while 97.7% of the highest quartile household income had access to the internet (Statistics Canada 2013). However, Fricker and Schonlau (2002) acknowledge that this issue will become less relevant as the internet becomes more universally accessible. As of July 1, 2016, it was estimated that 88.5% of the Canadian population had access to the internet at home (Internet Live Stats 2016). The demographic characteristics of the respondent panel for this survey will be compared to those of the Canadian population in section 4.3 below to determine to what extent the sample represented the population.

Other issues that arise with online surveys include data quality issues and abandonment of the survey. With self-administered surveys, there is the potential for data quality issues if the respondent misreads or misinterprets a question, chooses not to respond to a question or chooses not to respond honestly to a question (Fricker and Schonlau 2002). These issues occur more often with self-administered surveys, as the survey administrator is not present to clarify questions or to ensure a response is chosen, as would be the case for either a face-to-face interview or telephone survey (Fricker and Schonlau 2002). Another issue that arises with self-administered surveys is survey abandonment which could occur if the survey is too long or the questions are too complex, leading to the respondent becoming frustrated and unwilling to complete the survey (Sue and Ritter 2007). To limit the presence of these issues, first it is critical to be aware of the potential for these issues during the survey design and to build a survey that is clear and concise. Secondly, it is important to do pre-testing with the survey instrument to confirm that the questionnaire is clearly understood by all participants and is a reasonable length so as not to discourage respondents from participating in the survey (Rickards et al 2012).

3.2 Survey Design and Distribution

3.2.1 Survey Platform

There are dozens of online survey design platforms to choose from when building a survey and each offers its own advantages and disadvantages. After consulting several different survey platforms and weighing each option, Survio.com, a reputable online survey development website with over 1,000,000 users including well-known companies such as Microsoft, Ford and BMW, was chosen as the features it offered were well suited to the research design needs. First, while some survey platforms only offered yearly subscription options, which were usually beyond the cost feasibility of this project, Survio offered monthly subscription options at a reasonable price.

Second, some survey platforms limited either the number of questions that could be asked in a single survey or limited the amount of characters that could be asked in a single question. While this was done with the intent of helping survey administrators build effective surveys that would keep respondents engaged, it was not well suited for the current survey which needed to include features such as a consent form and somewhat detailed questions. Survio did not place any limits on survey length. Third, compared to other survey platforms, the process of building and modifying the survey in Survio was straight-forward and the final survey that respondents saw on the screen was clean and organized, making it easier for respondents to focus on the task at hand.

3.2.2 Designing the Survey Instrument

Survey design was arguably the most important step in the research process as it dictated the type of data collected and would undoubtedly influence the overall quality of the research results. It was important to keep in mind the research goals to ensure that the survey was constructed in such a way that the data collected were useful and appropriate for the required analysis (Rickards et al 2012). The survey design process was guided by the principles detailed in Dillman et al (2009) and Krosnick and Presser (2010); these are noted below as appropriate. The survey instrument (please see Appendix A) was divided into four topic areas: consumption and perception of dairy milk, consumption and perception of PBDMAs, market interest in ultrafiltered dairy milk, and demographic information.

Dillman et al (2009) suggest that a survey should begin with questions that are both easy to answer and are directly linked to the research purpose. This is done to build initial rapport with the respondents and get them engaged at the onset of the survey to help ensure they will provide thoughtful answers, resulting in higher quality data. Therefore, the first section of the

survey focused on respondents' dairy milk consumption habits. The first question in the survey (aside from a mandatory screening question) asked respondents whether they consumed dairy milk. This was both an easy question for respondents to understand and respond to and it was directly related to the research topic. If respondents answered yes, they were directed to two follow up questions to provide more details on their consumption habits. The first question asked which type of dairy milk they drank most often and the options given were skim (fat free) milk, milk containing 1% milk fat (1% milk), 2% milk, whole (3.25%) milk, lactose-free milk, and an "other" option which allowed respondents to type in their answer. The second question asked respondents how often they drank dairy milk and the options given were less than once a week, 1-3 times a week, 4-6 times a week, 7-13 times a week (once or twice a day), 14-20 times a week (two or three times a day), and 21 or more times a week (three or more times a day). For all three questions, the single select question type was used so that respondents could only choose one of the given options. If the respondent answered no to the first question asking about dairy milk consumption, a skip logic was implemented and they were automatically redirected past the two follow up question about type of dairy milk consumed or how often they drank dairy milk.

According to Krosnick and Presser (2010), items in a survey on the same topic should be grouped together and should begin with the more general questions and build towards more specific questions. Therefore, once respondents answered the basic consumption questions, they were presented with a series of questions to assess their perceptions of the health value of dairy milk. A common method to measure consumer attitudes or opinions is to use a Likert scale which presents respondents with a statement and asks them to indicate their level of agreement or disagreement typically from strongly disagree to strongly agree (Likert 1932). This format was used for respondents to evaluate sixteen claims related to the health value of dairy milk. The

matrix for these statements was split into two pages, so that all the rows of each matrix could be viewed on the web page without scrolling, in order to avoid overwhelming respondents with too much information at once. In addition, the matrix rows alternated between positive and negative claims to help prevent respondents from choosing the same answer for each question without giving it any thought. Presenting a positive claim followed by a negative claim was done to require respondents to carefully process each claim individually before providing an answer. The choice of items to include in the survey was based on previous findings detailed in the literature review above as well as a study by Mintel (2016) which compared Americans' perceptions of dairy milk and PBDMAs. Given that the purpose of the research was to compare respondents' perceptions of the health value for dairy milk and PBDMAs, respondents were asked to evaluate the same claims for both dairy milk and PBDMAs. Thus, some of the claims included were based on findings related to dairy milk or PBDMAs exclusively rather than comparative findings.

Table 2 lists the claims that respondents were asked to evaluate and the supporting literature. The first statement asked respondents to evaluate to what extent they agreed or disagreed that dairy milk is a good source of calcium; the literature showed that consumers are generally aware of the calcium content of dairy milk, therefore a high level of agreement was expected with this claim. Little research has explored whether consumers believe that PBDMAs are a good source of calcium. The next statement asked respondents the extent to which they agreed or disagreed that dairy milk has a high sugar content – this factor was identified as a concern in some studies in relation to dairy milk consumption though not as commonly as other concerns. The third statement asked respondents whether they agreed or disagreed that dairy milk is a good source of protein. Previous literature found that consumers were aware of the

Table 2. Summary of health and nutrition claims evaluated by a 5-point Likert scale

Claim	Supporting literature
1. Good source of calcium	Eddy et al (1999), Hagy et al (2000), Nolan-Clark et al (2011), Wham and Worsley (2003), Jones et al (2008)
2. High sugar content	Jung et al (2015), Mobley et al (2014)
3. Good source of protein	Jung et al (2015), Nolan-Clark et al (2011)
4. High levels of fat	Horwath et al (1995), Eddy et al, Hagy et al (2000), Jung et al (2015), Lacroix et al (2016), Nolan-Clark et al (2011), Wham and Worsley (2003)
5. Naturally sourced product	Lacroix et al (2016), Mintel (2016)
6. High levels of cholesterol	Horwath et al, Lacroix et al (2016), Mobley et al (2014), Wham and Worsley (2003)
7. Helps with weight loss	Jung et al (2015), Jones et al (2008), Mintel (2016)
8. High in calories	Lacroix et al (2016)
9. Promotes heart health	Jones et al (2008), Mintel (2016)
10. Causes gastro-intestinal issues	Lacroix et al (2016), Mobley et al (2014), Chollet et al (2014)
11. Aids in developing strong bones	Mobley et al (2014), Wham and Worsley (2003), Jones et al (2008)
12. Causes weight gain	Horwath, Jung et al (2015), Mobley et al (2014)
13. Healthy for kids	Mintel (2016)
14. Heart disease	Bus and Worsley (2003)
15. Essential component of a healthy diet	McCarthy et al (2017)
16. Causes allergies	Lacroix et al (2016), Wham and Worsley (2003), Bus and Worsley (2003)

protein content of dairy milk, however not to the same extent as calcium.

The fourth statement asked respondents the extent to which they agreed or disagreed that dairy milk has high levels of fat. The literature suggested that fat content is a common concern for consumers regarding dairy milk consumption; therefore, a high level of agreement for this statement in relation to dairy milk was expected. The next statement asked respondents to what extent they agreed that dairy milk is naturally sourced. While past studies have found that some consumers are uneasy about the idea of drinking another mammal's milk and the contamination of milk, Mintel (2016) found that, compared to PBDMAs, consumers were more likely to agree

that dairy milk was naturally nutritious, free of additives and fresh. The sixth statement asked about respondents' perception of the cholesterol content in dairy milk; previous studies found that consumers did have concerns with the cholesterol in dairy milk, and reducing cholesterol levels was sometimes given as a reason for decreasing milk consumption. On the other hand, PBDMAs do not contain any cholesterol and therefore it was expected that the level of agreement with this statement would be higher for dairy milk than for PBDMAs.

The seventh statement asked respondents to what extent they agreed or disagreed that dairy milk helps with weight loss efforts. One study (Jung et al 2015) listed weight loss as one of the benefits of dairy milk consumption, however this was not a common finding in the literature. On the other hand, when compared to dairy milk, two studies (Jones et al 2008, Mintel 2016) found that respondents were more likely to agree that PBDMAs could help with weight loss. Therefore, a higher level of agreement with this statement for PBDMAs than for dairy milk was expected. The eighth statement asked respondents to what extent they agreed or disagreed that dairy milk is high in calories. Lacroix et al (2016) found that consumers did list the calorie content of dairy milk as a disadvantage. No studies have compared consumer perceptions of the calorie content of dairy milk and PBDMAs. However, due to the fact that PBDMAs advertisements often focus on these beverages' comparatively lower calorie content, it was hypothesized that respondents would express a higher level of concern with the calorie content of dairy milk than PBDMAs. The ninth statement asked to what extent respondents disagreed or agreed that drinking dairy milk promotes heart health. Mintel research found that respondents were more likely to drink PBDMAs for heart health (Mintel 2016) and so it was hypothesized that the level of agreement with this statement would be higher for PBDMAs than for dairy milk.

The next statement asked respondents to what extent they agreed or disagreed that drinking dairy milk causes gastro-intestinal problems. The level of agreement for this statement was expected to be higher for dairy milk than for PBDMAs, as there were numerous recordings of concerns with the effect of drinking milk on the digestive tract in the literature, but no similar recordings for PBDMAs. The next statement asked respondents to indicate to what level they agreed or disagreed that drinking dairy milk aids in developing strong bones. Due to the link between calcium and bone development, this statement was closely linked to the first statement about calcium content and therefore similar response patterns for both statements were expected. The next statement asked to what level respondents agreed or disagreed that drinking dairy milk causes weight gain. This question was closely linked to the fourth statement about fat levels and thus, similar response patterns for both statements were expected. Specifically, a higher level of agreement for this statement with dairy milk than with PBDMAs was expected.

The thirteenth statement asked respondents to what extent they agreed or disagreed that dairy milk is healthy for kids. While Jung et al (2015) found that one of the reasons consumers cited for drinking dairy milk was to set a good example for their children, Mintel research revealed that American consumers were more likely to agree that PBDMAs are healthy for kids compared to dairy milk (Mintel 2016). The next statement asked respondents whether they agreed or disagreed that drinking dairy milk increases the risk of developing heart disease. Bus and Worsley (2003) found that dairy milk was perceived as more likely to cause serious disease, while Jones et al (2008) found that respondents were more likely to associate soy milk with a decreased chance of developing heart disease. As a result, a higher level of agreement with this statement for dairy milk than for PBDMAs was expected. The fifteenth statement asked respondents to indicate to what level they agreed or disagreed that dairy milk is an essential

component of a healthy diet. McCarthy et al (2017) found that dairy milk consumers were more likely to view dairy milk as a staple in their diet than plant-based dairy milk consumers and therefore, a higher level of agreement with this statement for dairy milk than for PBDMAs was expected. The last statement asked respondents to what extent they agreed or disagreed that drinking dairy milk causes allergies. There were several recordings of consumers expressing concerns with a perceived link between dairy milk consumption and the presence or development of allergies. These same concerns had not been expressed in the literature regarding PBDMAs, therefore, the level of agreement was expected to be higher with this statement for dairy milk than for PBDMAs.

The second section of the survey focused on respondents' consumption and perception of PBDMAs. For comparative purposes, the questions and answer choices were nearly identical to the first section on dairy milk. The only exception was for the question pertaining to the type of plant-based dairy milk alternative respondents drank most often, where the response options were almond milk, cashew milk, coconut milk, hemp milk, oat milk, rice milk, soy milk and an "other" option which allowed respondents to type in their answer. The section also included an extra question for respondents who indicated that they drank PBDMAs, asking them to identify the reasons they chose to drink PBDMAs. Respondents were presented with a list of eleven different reasons they might choose to consume PBDMAs: lactose intolerance, milk allergies, follow a vegan diet, environmental concerns related to dairy production, animal welfare concerns related to dairy production, health concerns related to dairy production, calorie content, shelf life, taste preference, availability, and price, as well as a twelfth option "other" which allowed them to type in any other reasons not covered in the list. For this question, respondents were not

restricted to choosing one single answer and were instructed to check all reasons that were applicable to them.

The third section of the survey focused on discovering the market potential for a new type of dairy product, ultrafiltered dairy milk. While not yet available in Canada, ultrafiltered dairy milk contains 50% more protein, 30% more calcium, and 50% less sugar than regular milk, while also being lactose-free. McCarthy et al (2017) suggested that innovation in the lactose-free milk sector could encourage dairy milk consumption; since this research was testing to see whether consumers were choosing PBDMAs because of perceived additional health benefits, it was of interest to determine whether there would be market potential for a healthier and innovative, lactose-free dairy milk option in Canada. If the results indicated that there was interest and intent to purchase such a product among Canadian consumers, the Canadian dairy industry may have a new market opportunity to explore. Respondents were initially presented with a brief description of ultrafiltered dairy milk and then asked whether they would consider purchasing this milk instead of their current dairy or plant-based alternative beverage choice. If they answered no, skip logic was implemented and they were redirected to the final section of the survey. If they answered yes, they were asked a series of follow up questions to determine the premium they would be willing to pay for the ultrafiltered dairy milk.

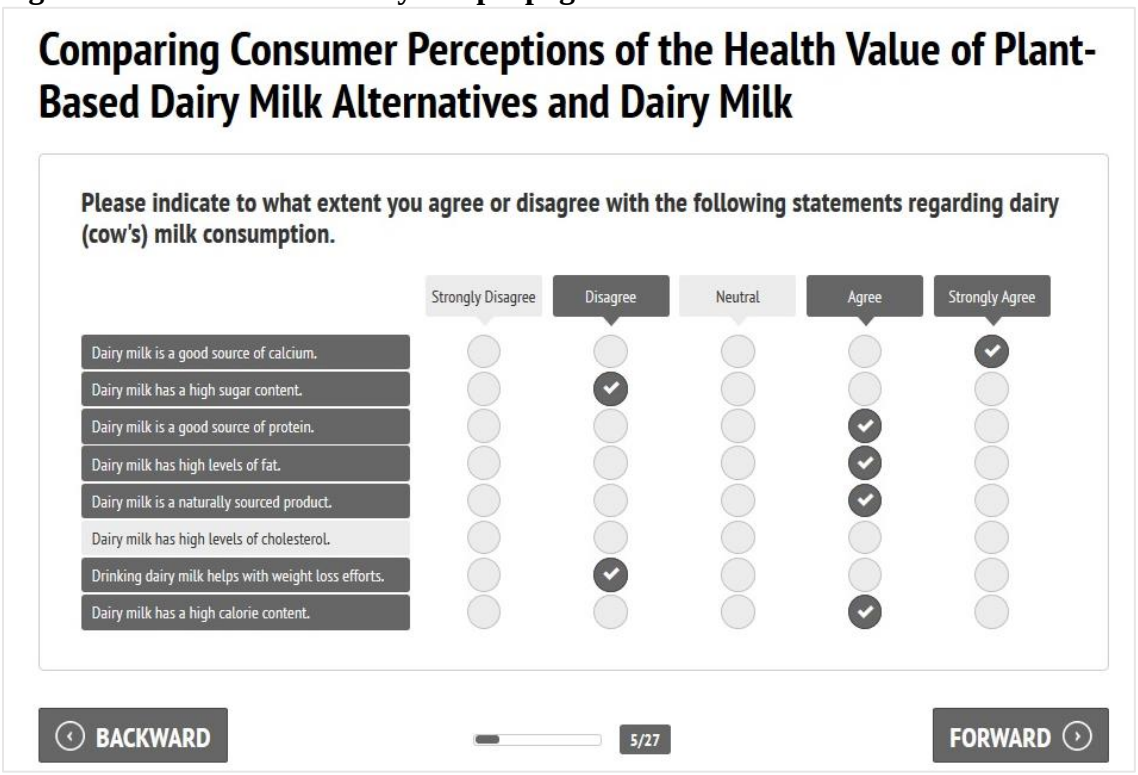
Respondents were first asked about the quantity in which they normally purchase milk, with the options being one litre, two litres, four litres or “other” where they could type in their answer. This question was meant to be an easy way to get respondents thinking about their milk purchasing behaviour. The next question asked respondents what they typically pay for the quantity of milk they buy; prices for milk at a local grocery store in Winnipeg were listed as a point of reference. If respondents were unsure what they pay for milk, they were instructed to

provide a best estimate using the reference pricing provided. Ultimately, the responses to this question were not of interest on their own but were used to help provide respondents with a reference point for the price they would be willing to pay for ultrafiltered milk and would be used to calculate the willingness-to-pay premium. The next question asked respondents to consider what maximum price they would be willing to pay for the ultrafiltered dairy milk; with these two prices, it was possible to calculate the premium that each individual would be willing to pay for ultrafiltered milk. For both questions asking for a specific price, the question format allowed for open-ended responses with respondents typing their answer in a text box. The advantage of this was that it provided continuous data for the calculated premium and did not cause any bias by presenting respondents with only reference categories of premiums from which to choose their maximum willingness to pay. The disadvantage was that open-ended responses can vary greatly in format and quality of response and since they require more thought and effort from the respondents than close-ended questions which simply require clicking a box, the response rate for the question could be impacted. At the end of this section, respondents were presented with four different items including availability/convenience, nutrition, price and taste, and were asked to rank them based on their level of impact on the respondent's milk purchasing decision by clicking and dragging each item to arrange them from most to least important. The purpose of this question was to determine to what extent nutritional value influences respondents' consumption decisions and to determine any differences among demographic groups. The results could guide the dairy industry's marketing efforts and provide some insight into which messages might be most effective to target and encourage different demographic groups to increase their dairy milk consumption.

The last section of the survey collected socio-demographic data about the respondents to analyze the impact that these variables might have on the respondents' answers to the survey questions. First, respondents were asked whether they used any nutritional supplements and exercised regularly; previous studies found that the use of nutritional supplements and exercise influenced the consumption of dairy milk (Kim et al 2003). In addition, these variables could be used as a proxy to measure an individual's efforts to encourage a healthy lifestyle. The demographic information asked included respondents' gender, year of birth, whether they had children under the age of 18, in which province they resided, their race, highest level of education, and income. These were all formatted as close-ended questions, giving respondents a choice of responses from which to choose the answer that best fit them, except for year of birth which required respondents to type in their own year of birth. Seeing as the income question was the most sensitive question in the survey, it was placed at the end as per Krosnick and Presser (2010) and respondents were asked to choose from a range of income categories rather than having to write in a specific amount. In addition, a "prefer not to say" option was included for every demographic question to avoid alienating respondents who did not feel comfortable sharing certain personal information.

Figure 3 highlights some of the survey's features and provides an example of what respondents saw on their screen while filling out the survey. As Figure 3 shows, the overall design of the instrument was clean and organized; there were no unnecessary elements added that could distract the respondents or lead them to feel overwhelmed with information. The title of the survey appeared at the top of each page acting as a reminder of the purpose of the survey. The questions on each page were framed by a rectangle, thus drawing the respondent to the information inside the rectangle. Using a consistent layout throughout the survey helped

Figure 3. Screenshot of survey sample page



respondents easily identify where they need to focus their attention (Dillman et al 2009). This particular screen illustrates the first matrix of questions for the perceptions of dairy milk. Each point on the Likert scale was clearly labeled from strongly disagree to strongly agree. A valuable feature that is highlighted in Figure 3 is that as respondents went through the matrix and chose a response for each statement, that specific row was shaded dark grey. This made it easier for respondents to become aware if they had accidentally passed over a row, as is the case in row 6 in Figure 3, or if their answer wasn't properly recorded thus diminishing accidental nonresponses. The figure also shows the backward and forward button which allowed respondents to move seamlessly back and forth through the survey if they needed to review any of their answers. The progress bar at the bottom was also included to help encourage respondents as they progressed through the survey.

The survey instrument also included a consent form and a short set of instructions at the beginning. The consent form, as required by the University of Manitoba's Joint-Faculty Research Ethics Board (JFREB), was displayed on the first screen when participants clicked on the link to the survey. The purpose of the consent form was to inform respondents of the details and purpose of the survey in which they would be participating, to provide a brief description of the tasks to be completed and time commitment required. The form also assured respondents that their participation in the study was voluntary and could be withdrawn at any time by simply exiting the browser window and that they could decline answering any questions in the survey if they wished. The consent form also included details of the security measures put in place to protect the respondents' anonymity and the data collected, as well as contact information for both the researcher and the JFREB should the respondent have any questions or concerns regarding the study. A link to a downloadable PDF version of the consent form was made available to participants if they wished to save a copy for their own records. At the bottom of the screen, participants were instructed to click on a button to begin the survey if they had read through the consent form and wished to participate in the survey. The process of clicking "begin survey" was interpreted as the respondent indicating their consent to participate in the study.

The second page provided a brief set of instructions and important information participants would require for completing the survey. It described the different topics that would be covered throughout the survey and what type of tasks would be required of the respondents. For the first two sections of the survey, which focused on collecting information on respondents' consumption and perceptions of both dairy milk and PBDMAs, respondents were instructed to remember that there were no right or wrong answers to the questions being asked as the purpose was simply to collect data on individual perceptions. This was explicitly stated in the hope that it

would discourage nonresponse linked to participants' doubt in their own knowledge about the health value of the beverages in question. Next, a cheap talk script (Cummings and Taylor 1999) was included for the third section of the survey, which focused on respondents' willingness to purchase ultrafiltered dairy milk, to alert respondents of the tendency participants have to unrealistically estimate the premium they would be willing to pay in a hypothetical situation such as the one presented in the study and thus to carefully consider what they would realistically pay for the ultrafiltered dairy milk. By making respondents explicitly aware of this tendency, the intention was to reduce the hypothetical bias (Carlberg and Froehlich 2011). Finally, respondents were assured that the demographic information collected in the final section of the survey would be used solely for data comparisons and to test for any response patterns based on demographic factors.

3.2.3 Pre-Testing

Pre-testing was an important step in the survey design process to ensure that the survey instrument was easy to understand and could be completed in a reasonable amount of time (Krosnick and Presser 2010). With an online survey, it was also important to pre-test to ensure that the links and redirects were working properly and respondents didn't have any technological issues with accessing or moving backward and forward through the survey. Pre-testing was done between July 26, 2017 and August 5, 2017. A total of 45 respondents completed the survey. Overall, respondents had no issues completing the survey and could do so in a reasonable amount of time.

3.2.4 Research Ethics Board

All research involving human subjects requires a detailed submission to and approval from the University of Manitoba's research ethics board before the research project can be implemented. Approval for this research project was granted by the JFREB on August 9, 2017.

3.2.5 Respondent Panel

The respondent panel for this survey was provided by Cint, an online panel marketplace that connects panel owners with sample buyers. Cint is ISO 20252 certified and a member of ESOMAR, a global organization that represents the interests of the market research profession and strives to enable better quality research. Their network has over 40 million consumers in 80 countries and they currently have 560,421 registered Canadian panelists (Cint 2017). Panel participants receive marketplace points for completing surveys which can only be redeemed at certain levels for rewards such as cash or credits to online stores. Each panel owner can customize the length of time between respondents receiving mailing invites to participate in surveys, which can range from once a month to three times a week at most. The incentive model is set in a way to encourage long-term participation in the panels and discourage respondents who are only looking for a quick cash grab. Data are kept on every participant to ensure they are not participating in too many surveys and are providing quality responses, and Cint has a panel quality team that frequently reviews data on individual panelists to identify disingenuous participants. Project costs can be quickly and easily estimated before implementation by simply imputing the number of respondents required, the incidence rate, the estimated length of interview and any necessary targeting criteria. Cint offers the option to target and filter respondents based on various factors, such as gender, age, country, etc. or they provide an option for census representation. Since the population of interest in this case was the entire Canadian

adult population, the census representation targeting was chosen, with a targeted sample size of 1,000. To implement the survey project, the survey link needed to be uploaded to Cint's dashboard, Cint Access, and redirect links needed to be incorporated into the survey both for participants who did not meet the requirements of eligibility for the survey and for those who had successfully completed the survey. From there, Cint's team managed the launch and distribution of the survey.

3.2.6 Survey Launch

The survey was "soft launched" by Cint at 12:30 pm CST on October 25, 2017, meaning that it was launched to 10% of the required sample to ensure that the survey links were properly working and the collected data could be retrieved and displayed correctly before distributing to the entire sample. Once the first 100 respondents filled out the survey and the resulting data were reviewed to ensure everything was working properly, the survey was fully launched to the entire sample. The quota of responses was filled within approximately five hours of launching the survey; however, due to a small number of respondents only partially filling out the survey and returning later to complete it, the total number of completed responses was 1,036. The survey closed at 9:30 am CST on October 26, 2017. The results were immediately available to download and export from Survio.

Chapter 4: Theory & Empirical Models

4.1 Economic Theory

The following sections detail the underlying economic principles reflected in this research. First, the consumer goods characteristics model will be explained in the context of investigating how attributes of a product, such as perceived health value, provide value to a good and can influence consumer demand. Next, discrete choice modeling and random utility theory will be discussed to lay the groundwork for modeling consumers' choice of milk beverage consumption and determining which factors influence these decisions.

4.1.1 Consumer Goods Characteristics Model

Lancaster (1966) was the first to propose that goods should not be viewed as a whole when determining value, but rather the focus should be on the value created by the characteristics that the good possesses. His approach was based on three assumptions; utility is derived from the characteristics that a good possesses, not from the good itself; goods possess many characteristics and each characteristic can be present in more than one good; and combining goods will yield different characteristics than when considering the goods separately (Lancaster 1966). Ladd and Suvannunt (1976) expanded on this research by conceptualizing the consumer goods characteristics model (CGCM), which considered a product as a collection of its characteristics and suggested that consumer demand was therefore a function of the characteristics possessed by a good. Their paper explored two themes: (1) that the price paid for a good was equal to the sum of the marginal monetary value of the good's combined characteristics, and (2) consumer demand functions for goods were affected by the characteristics of the goods. The authors asserted that consumers derive utility from the combination of characteristics that a good possesses; for instance, a consumer who was lactose-

intolerant would not derive the same utility out of dairy milk as they would out of lactose-free milk or PBDMAs, due to dairy milk's attribute of containing lactose which could cause the consumer discomfort. Consumers then made their purchasing decisions based on the different characteristic combinations that would provide them with the highest utility level. The authors explored this concept in greater depth by first building a Lagrangian function to solve for the optimal quantities of products that provided the combination of product characteristics that would maximize utility subject to their budget constraint (Ladd and Suvannunt 1976):

$$L = U(x_{01}, x_{02}, \dots, x_{0m+n}) - \lambda(\sum p_i q_i - I) \quad (1)$$

where U represented total utility, x_{0m+n} represented the consumption input-output coefficients, p_i represented the price of the *i*th good, q_i represented the quantity of the *i*th good consumed and *I* represented the consumer's fixed income. Then solving the Lagrangian for the optimal quantities:

$$\frac{\partial L}{\partial q_i} = 0 = \sum \left(\frac{\partial U}{\partial x_{0j}}\right)\left(\frac{\partial x_{0j}}{\partial q_i}\right) + \left(\frac{\partial U}{\partial x_{0m+i}}\right)\left(\frac{\partial x_{0m+i}}{\partial q_i}\right) - \lambda p_i \quad (2)$$

Using differentiation on Equation (2) and the budget constraint, combined with the effect of change in price of good x on quantity of good y and the Slutsky-Hicks-Allen substitution term (S_{ir}), the authors derived the following equation:

$$\frac{\partial q_{r*}}{\partial x_{uv}} = -\left(\frac{1}{\lambda^*}\right) \sum \left(\frac{\partial U_i}{\partial x_{uv}}\right) S_{ir} \quad (3)$$

Assuming that an increase in characteristic *v* increased the marginal utility of product *u* but did not impact the marginal utility of other products, Equation (3) could be rewritten as:

$$\frac{\partial q_{r*}}{\partial x_{uv}} = -\left(\frac{1}{\lambda^*}\right)\left(\frac{\partial U_u}{\partial x_{uv}}\right) S_{ur} \quad (4)$$

This suggested that changing the amount of a certain product characteristic in one good impacted the demand for other goods (Ladd and Suvannunt 1976). This reflected the second theme of the paper, which applied directly to this research as it pertained to exploring product differentiation between dairy milk and PBDMAs. As a result, differences in the health perceptions of dairy milk and PBDMAs could impact the demand for these products. Thus, Ladd and Suvannunt's model provided the motivation for investigating the first research question.

4.1.2 Discrete Choice Modeling and Random Utility Theory

The second research question required an investigation and comparison of the factors, including socio-demographic variables and health perceptions, that affected consumers' choice to consume dairy milk and PBDMAs, as well as the indication of interest in purchasing ultrafiltered dairy milk. The choice being observed in each scenario was to either consume (or in the case of ultrafiltered milk, indicate intent to purchase) or not; this represented a discrete choice and theory dictates that the consumer would choose the alternative that provided the greater utility (Greene 2010). By incorporating the random utility theory, a general model for the discrete choice could be derived.

According to the random utility theory, total utility, while known to the decision maker, cannot be fully observed by the investigator (Manski 1977). Thus, utility (U) is composed of an observable component (V) and a random, unobservable component (ε). The random component encompasses both the unobservable attributes and the randomness in individuals' preferences, and due to the presence of this random component, the problem at hand can be defined as stochastic. Thus, when modeling discrete choices, the attempt is to measure probabilities of an outcome occurring and the impact of independent variables on these probabilities (Vojáček and Pecáková 2010). Under the random utility theory, utility can be expressed as follows:

$$U_{ij} = V_{ij} + \varepsilon_{ij} = \boldsymbol{x}'_{ij}\boldsymbol{\beta} + \varepsilon_{ij}, \qquad j = 1,2,\dots,J \tag{5}$$

where U_{ij} represents the utility achieved by individual *i* from choosing alternative *j* among a set of *J* options, V_{ij} represents the observable component, which as seen in Equation (5), can also be expressed as $\boldsymbol{x}'_{ij}\boldsymbol{\beta}$ where $\boldsymbol{x}'_{ij}$ represents the vector of observable attributes [X_{j1}, X_{j2}, …, X_{jH}], and $\boldsymbol{\beta}$ represents the vector of associated parameters $[\beta_0, \beta_1, \dots, \beta_H]$ and ε_{ij} represents the random, unobservable component. In accordance with consumer theory, an individual will choose the option that brings them the highest level of utility. As a result, the probability that an individual *i* will choose option *j* over option *j'* (π_{ij}) can be expressed as:

$$\pi_{ij} = P\left(V_{ij} + \varepsilon_{ij} > V_{ij'} + \varepsilon_{ij'}\right) = P\left(\varepsilon_{ij'} - \varepsilon_{ij} < V_{ij} - V_{ij'}\right) = P(\varepsilon_i < V_i) \tag{6}$$

The application of this general model to build the necessary empirical models for this study's specific research questions will be further expanded on in section 4.2.4.

4.2 Procedures for Statistical Analysis

Statistical analysis was conducted using SPSS Version 25. Survey results were initially exported from Survio to Microsoft Excel where the data were organized and recoded before exporting to SPSS for further analysis. The statistical analysis included computing descriptive statistics, conducting the Wilcoxon signed-rank test (Wilcoxon 1945) to compare respondents' perceptions of the health claims for both dairy milk and PBDMAs, calculating importance scores for the factors that influenced milk beverage purchasing decisions, and running binary logistic regressions to determine which variables influenced the choice to consume dairy milk and PBDMAs as well, as the indication of willingness-to-purchase ultrafiltered dairy milk.

4.2.1 Descriptive Statistics

Descriptive statistics were reported to provide an overall sense of how the survey was answered. Since most of the data collected were either ordinal, such as the Likert scale health perception claims, or categorical, such as the type of milk consumed, statistics such as the mean or standard deviation would not provide much insight into the data. Rather, frequencies of responses were computed and reported, as well as percentage shares of each response option. Where applicable, responses for the dairy milk and PBDMAs questions were reported side-by-side for comparative purposes. The only questions that collected continuous data were the price point references used to calculate the premium respondents would be willing to pay for ultrafiltered milk. To obtain the percentage premium, a new variable column was calculated in SPSS by subtracting the price respondents reported paying for their current milk beverage selection from the price they reported they would be willing to pay for ultrafiltered dairy milk and dividing this by the price they currently paid for milk. For this question, the mean premium was computed and reported for the total sample, as well as comparatively for different demographic groups.

4.2.2 Wilcoxon Signed-Rank Test

Because the data collected on respondents' perceptions of the various health claims measured by the Likert scale were ordinal, non-parametric testing was required (Field 2009). The Wilcoxon signed-rank test (Wilcoxon 1945) is essentially the non-parametric equivalence of the t-test and was used to assess whether a statistically significant difference existed in respondents' perceptions of each individual health claim between dairy milk and PBDMAs, as below (Laerd Statistics 2015a):

H_0 = the median difference between respondents' perception scores for dairy milk and PBDMAs is equal to zero

H_A = the median difference between respondents' perception scores for dairy milk and PBDMAs is not equal to zero

Perception scores were obtained from recoding the level of agreement on the Likert scale into numerical values; "strongly disagree" was recoded as 1, "disagree" was recoded as 2, "neutral" was recoded as 3, "agree" was recoded as 4 and "strongly agree" was recoded as 5. The data could then be tested using the Wilcoxon signed-rank test.

To obtain the test statistic for the Wilcoxon signed-rank test, the difference of scores between dairy milk and PBDMAs was calculated and ranked for each respondent for a specific health claim (Field 2009). For example, taking the first claim "good source of calcium," the score an individual chose for PBDMAs was subtracted from their score for dairy milk. If any difference was equal to zero, the observation would be excluded from the ranking. The remaining differences for all respondents were ranked from smallest to largest regardless of whether the difference was positive or negative. Once all differences were ranked, the ranks for all the positive differences were summed as were the ranks for all the negative differences. The test statistic for the Wilcoxon signed-rank test was equal to the smallest value of the two summed ranks. Whether the test statistic was based on the negative or positive ranks revealed which beverage had the higher perception score or the higher level of agreement; if the test statistic was based on negative ranks, there was a higher level of agreement for dairy milk than for PBDMAs for the particular claim being tested, and vice versa if the test statistic was based on positive ranks. Using this test statistic, a z-score could be computed to determine whether there was a statistically significant difference between scores for dairy milk and PBDMAs (Field 2009).

When running the Wilcoxon signed-rank test in SPSS, all the above calculations were automatically computed, including the score differences, as well as the summed ranks, test statistics, z-scores and associated *p*-values. The results from the Wilcoxon signed-rank test for all 16 health claims will be presented and discussed below in section 5.2.

4.2.3 Importance Scores

Respondents were asked to rank four different factors (availability/convenience, nutrition, price and taste) in terms of their impact on their milk purchasing decisions. These rankings were then transformed into importance scores to determine which factors the respondents prioritized and to determine whether demographic groups differed in their rankings. Equation (7) shows how the importance scores were calculated for each factor (i):

$$Score_i = \frac{X_{1i}W_1 + X_{2i}W_2 + X_{3i}W_3 + X_{4i}W_4}{N} \quad (7)$$

First, weights were assigned to each rank. The higher a factor was ranked, the more weight it carried; a ranking of one carried a weight of four (W_1), a ranking of two carried a weight of three (W_2), a ranking of three carried a weight of two (W_3) and a ranking of four carried a weight of one (W_4). Each weight was multiplied by the number of respondents who assigned that ranking to that specific factor. For instance, in Equation (7), X_{1i} represents the number of respondents who ranked factor i first, X_{2i} is the number of respondents who ranked factor i second, and so on. The four terms were then summed and divided by the total number of respondents who ranked factor i, and this represented the importance score for factor i. These calculations were executed in Microsoft Excel. The importance scores for all four factors were then compared to determine the ranking order for the total sample and the different demographic groups. The results are presented below in section 5.3.

4.2.4 Binary Logistic Models

Recall Equation (6) that was derived in the theory section to model discrete choices:

$$\pi_{ij} = P(\varepsilon_i < V_i) \tag{6}$$

To transform this into a measurable, econometric model, the disturbance term, ε_i, needed to be specified; due to its ease of interpretation and use in similar studies investigating influences on food consumption choices (Onyango et al 2007; Oraman and Unakitan 2010; Yin et al 2010; Slamet et al 2016), the logistic distribution was assigned to the disturbance term. The estimated value in the binary logistic regression is the logit, L, which is the natural log transformation of the odds (Orme and Combs-Orme 2009). Equation (8) illustrates this relationship:

$$\mathrm{L} = \ln\left[\frac{\hat{\pi}}{1-\hat{\pi}}\right] \tag{8}$$

The odds are defined as the estimated probability of an event occurring ($\hat{\pi}$) divided by the estimated probability of the event not occurring (1- $\hat{\pi}$). Under the logistic distribution assumption, the probability of choosing option *j* can be expressed as:

$$\pi_{ij} = \frac{e^{Vi}}{1+e^{V_i}} \tag{9}$$

and the probability of choosing option *j'* can be expressed as:

$$\pi_{ij'} = 1 - \pi_{ij} = \frac{1}{1+e^{V_i}} \tag{10}$$

By combining these formulas, it can be shown that the odds of choosing option *j* can be expressed as:

$$\frac{\pi_{ij}}{1-\pi_{ij}} = e^{Vi} \tag{11}$$

And finally, by taking the natural log of both sides of this equation, the resulting binary logistic equation is derived:

$$ln\left[\frac{\pi_{ij}}{1-\pi_{ij}}\right] = V_i \text{ or } L_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \ldots + \beta_n X_{ni} \quad (12)$$

The parameters (β) were estimated in SPSS using maximum likelihood estimation and these estimated coefficients represented the change in the logit of the dependent variable associated with a one-unit change in the independent variable (Laerd Statistics 2015b). This value did not have much intuitive meaning on its own, however a transformation could be applied to the β values using an anti-log such that the resulting value represented the odds ratio. SPSS included the odds ratios in the output of the logistic regression and these values could be interpreted as the change in odds for each one-unit increase of the independent variable.

4.2.4.1 Dummy Coding

To run the binary logistic regressions, it was necessary to apply dummy coding to all the multicategory independent variables to reduce them to a series of binary independent variables. Each independent variable was coded as either 0 or 1, where 0 usually represented absence of the condition or characteristic and 1 represented the presence of the condition or characteristic (Orme and Combs-Orme 2009). SPSS can automatically create these binary variables; however, the researcher must specify in SPSS those variables which are categorical. Where necessary, certain demographic groups were combined due to low cell counts in individual groups or to provide more meaningful comparative groups. With dummy coding, it was also necessary to exclude one category of the independent variable from the equation to avoid the dummy variable trap. For the gender variable, males were coded as 0, while females were coded as 1. Age was formatted as a continuous variable and therefore did not require dummy coding. Those with children under 18 were coded as 1, while those without children under 18 were coded as 0. For the province data, different groupings were combined to provide more meaningful comparisons

and to account for categories with low numbers of cases. Respondents from British Columbia, Alberta, Saskatchewan and Manitoba were combined and created a new category labeled as the Western provinces. New Brunswick, Newfoundland and Labrador, Nova Scotia, Prince Edward Island and Yukon were combined to create a new category labeled the Maritime provinces. While Yukon is not a Maritime province, the sole observation for this province needed to be included in a category and the Maritime group was selected for this purpose. Three binary province variables were included in the regression models (Ontario, Quebec and Maritimes) and so if all three variables equaled zero, the respondent was from a Western province. For the race variable, due to the high ratio of Caucasian respondents, the other race categories (Aboriginal/Indigenous, Asian, Black, Latin American/South American and other) were combined to create a new category labeled as non-Caucasians. The category of non-Caucasians included ethnic groups which research has shown have a higher prevalence of lactose intolerance compared to Caucasians (Jackson and Savainano 2001; Jarvis and Miller 2002) and therefore it was of interest to investigate whether and how this would impact consumption choices. Caucasian respondents were coded as 0 and non-Caucasians were coded as 1. For education levels, the first three categories (primary school, some high school and completed high school or GED) were combined to create a new variable labeled high school diploma or lower. Four binary education variables were included in the regression models (some postsecondary, certificate or diploma, bachelor's degree, master's degree or Ph.D.) and so if all four variables equaled zero, the respondent had achieved a high school diploma or less. Finally, for the income variables, the two highest categories ($125,000-$149,999 and $150,000 and over) both had low counts and were therefore combined to create a new variable labeled $125,000 and over. Five binary income variables were included in the regression models ($25,000-$49,999, $50,000-$74,999, $75,000-

$99,999, $100-$124,999 and $125,000 and over) and so if all five variables equaled zero, the respondent had an annual household income of less than $25,000. The additional respondent characteristics were also included in the binary logistic regression models. The use of nutritional supplements and regular exercise were both coded as 1, while respondents who indicated they did not take supplements or did not exercised regularly were coded as 0 respectively.

4.2.4.2 Binary Logistic Model for Dairy Milk Consumption

The first binary logistic regression attempted to discover which socio-demographic variables influenced respondents' decision to consume dairy milk, as well as to determine the extent to which health perceptions of dairy milk influenced the decision to consume. The equation for the binary logistic regression which attempted to estimate the odds that a respondent drank dairy milk (L_{DM}) was:

$$\begin{aligned} L_{DM} = {} & \beta_0 + \beta_1 NS + \beta_2 RE + \beta_3 GENDER + \beta_4 AGE + \beta_5 CHILD + \beta_6 ON \\ & + \beta_7 QC + \beta_8 MP + \beta_9 RACE + \beta_{10} EDU_{SomePostsecondary} \\ & + \beta_{11} EDU_{Certificate/Diploma} + \beta_{12} EDU_{Bachelor} + \beta_{13} EDU_{Master/PhD} \\ & + \beta_{14} INCOME_{\$25,000\text{-}\$49,999} + \beta_{15} INCOME_{\$50,000\text{-}\$74,999} + \beta_{16} INCOME_{\$75,000\text{-}\$99,999} \\ & + \beta_{17} INCOME_{\$100,000\text{-}\$124,999} + \beta_{18} INCOME_{\$125,000+} + \beta_{19} SCORE_{DM} \end{aligned} \quad (13)$$

The independent variables included in the model were the use of nutritional supplements (NS), regular exercise (RE), gender, age, children under 18 (CHILD), province (ON for Ontario, QC for Quebec and MP for maritime provinces), race, education level (EDU), income and health scores for dairy milk. The health scores were calculated by summing the sixteen numerical responses to the Likert scale dairy milk perception claims to obtain a single numerical value per respondent that represented their overall health perception of dairy milk. First, the eight negative health claims had to be reverse coded so that the meaning of the responses across the sixteen health claims aligned; a higher score equated to a more positive perception of the health value of

dairy milk. For example, if a respondent had chosen “strongly disagree” for the claim “dairy milk has a high sugar content”, this would be recoded from 1 to 5 as disagreeing with a negative health claim equates to a positive perception. To determine the reliability of the health score scale, Cronbach’s alpha was computed in SPSS. Values above 0.8 indicate a high level of internal consistency (Field 2009). The results from this regression analysis are presented in section 5.4.1.

4.2.4.3 Binary Logistic Model for PBDMAs Consumption

The second binary logistic regression explored which demographic variables influenced respondents’ decision to consume PBDMAs, as well as to determine to what extent, if any, health perceptions of PBDMAs influenced the decision to consume. The equation for the binary logistic regression which attempted to estimate the odds that a respondent dank PBDMAs (L_{PBDMA}) was:

$$\begin{aligned} L_{PBDMA} = {} & \beta_0 + \beta_1 NS + \beta_2 RE + \beta_3 GENDER + \beta_4 AGE + \beta_5 CHILD + \beta_6 ON \\ & + \beta_7 QC + \beta_8 MP + \beta_9 RACE + \beta_{10} EDU_{SomePostsecondary} \\ & + \beta_{11} EDU_{Certificate/Diploma} + \beta_{12} EDU_{Bachelor} + \beta_{13} EDU_{Master/PhD} \\ & + \beta_{14} INCOME_{\$25,000\text{-}\$49,999} + \beta_{15} INCOME_{\$50,000\text{-}\$74,999} + \beta_{16} INCOME_{\$75,000\text{-}\$99,999} \\ & + \beta_{17} INCOME_{\$100,000\text{-}\$124,999} + \beta_{18} INCOME_{\$125,000+} + \beta_{19} SCORE_{PBDMA} \end{aligned} \quad (14)$$

The independent variables included in the model were the use of nutritional supplements (NS), regular exercise (RE), gender, age, children under 18 (CHILD), province (ON for Ontario, QC for Quebec and MP for maritime provinces), race, education level (EDU), income and health scores for PBDMAs. The health scores for PBDMAs were obtained in the same manner as described in the section above for the health scores for dairy milk. The only difference between equations (13) and (14) was that the health score and dependent variable in this case were in respect to PBDMAs rather than dairy milk. This was done for ease of comparing the variables

that influenced the two models. The results from this regression analysis are presented in section 5.4.2.

4.2.4.4 Binary Logistic Model for Willingness to Purchase Ultrafiltered Dairy Milk

The third binary logistic regression attempted to discover which socio-demographic variables influenced respondents' willingness-to-purchase ultrafiltered dairy milk, as this could guide marketing efforts. The equation for the binary logistic regression which attempted to estimate the odds that a respondent was willing to purchase ultrafiltered dairy milk (L_{WTP}) was:

$$\begin{aligned} L_{WTP} = {} & \beta_0 + \beta_1 NS + \beta_2 RE + \beta_3 GENDER + \beta_4 AGE + \beta_5 CHILD + \beta_6 ON \\ & + \beta_7 QC + \beta_8 MP + \beta_9 RACE + \beta_{10} EDU_{SomePostsecondary} + \beta_{11} EDU_{Certificate/Diploma} \\ & + \beta_{12} EDU_{Bachelor} + \beta_{13} EDU_{Master/PhD} + \beta_{14} INCOME_{\$25,000\text{-}\$49,999} \\ & + \beta_{15} INCOME_{\$50,000\text{-}\$74,999} + \beta_{16} INCOME_{\$75,000\text{-}\$99,999} + \beta_{17} INCOME_{\$100,000\text{-}\$124,999} \\ & + \beta_{18} INCOME_{\$125,000+} + \beta_{19} CONS_{JustDM} + \beta_{20} CONS_{NoDM} \end{aligned} \quad (15)$$

The independent variables included in the model were the use of nutritional supplements (NS), regular exercise (RE), gender, age, children under 18 (CHILD), province (ON for Ontario, QC for Quebec and MP for maritime provinces), race, education level (EDU), income and type of consumer (CONS). For the type of consumer variable, two categories (drink just PBDMAs and drinks neither) both had low counts and were therefore combined to create a new variable labeled "doesn't drink dairy milk." Two binary consumer type variables were included in the regression models (just drinks dairy milk and doesn't drink dairy milk) and so if both variables equaled zero, the respondent drank both dairy milk and PBDMAs. Whether consumption type influenced willingness-to-purchase ultrafiltered dairy milk was also of interest given that one purpose of the study was to determine whether introducing this new milk product in the Canadian market would help the dairy industry recapture consumers who do not consume dairy milk. Results from this regression analysis are presented in section 5.4.3.

4.2.4.5 Testing the Assumptions of Binary Logistic Regression

There are several assumptions associated with binary logistic regression, some inherent in the study's design and some that needed to be tested after running the regression. Assumptions based on the study design included having one dichotomous dependent variable, having one or more independent variables that were measured at either the continuous or categorical level, independence of observations, and having a minimum of 15 observations for each independent variable, though some suggest a minimum of 50 observations per independent variable (Laerd Statistics 2015b). The assumptions that needed to be tested included no multicollinearity, a linear relationship between the continuous independent variables and the logit of the dependent variable, and no significant outliers or influential points (Laerd Statistics 2015b). SPSS could not test directly for multicollinearity with logistic regression, however by running a linear regression using the same dependent and independent variables as the binary logistic regression in question and selecting the "Collinearity diagnostics" option, the necessary statistics to detect multicollinearity could be obtained. The main statistics of interest in the output were the tolerance values and the variance inflation factor (VIF); Field (2009) suggested that tolerance values below 0.2 should be cause for concern as should VIF values above 10. To test the linearity assumption, a new variable had to first be computed for each continuous independent variable in the model that was the log of the variable in question. Secondly, the binary logistic regression had to be run a second time but including an interaction term between the continuous independent variable and the log of itself. To meet the assumption of linearity, the interaction term could not be significant, that is to say the *p*-value needed to be greater than 0.05 (Field 2009). Finally, to test for outliers and influencers, the residual statistics that were provided in the output of the logistic regression in SPSS were assessed. SPSS provided a case wise list of

residuals that were above ±2. According to Field (2009), no more than 5% of the standardized residuals should fall outside of ±1.96 and no more than 1% should fall outside of ±2.58. In addition, any value above 3 should be further investigated. Cook's distance, the value of which should be below one, was computed in SPSS to determine whether there were influencers in the data (Field 2009). These assumption tests were conducted for all three binary regression models and the findings are discussed in the respective binary logistic regression result sections.

4.3 Sample Data Summary

Table 3 provides a breakdown of the sample by demographic categories. As mentioned in the methodology section, for every demographic question respondents were given the choice of "prefer not to say" if they did not feel comfortable providing an answer. As can be seen in Table 3, the "prefer not to say" option was chosen by less than 1% of the sample for most questions except the questions on race and income which could be the two most sensitive questions in the survey and one would expect a higher level of nonresponse for these questions. Overall, it appears providing the "prefer not to say" response reduced nonresponse as the demographic question with the highest number of nonresponses was the age question, which due to its formatting as an open-ended question could not accommodate a "prefer not to say" option. With that being said, only five respondents did not provide an answer to the age question which equates to 0.48% of the sample. Thus, the socio-demographic section of the survey was well completed by respondents.

4.3.1 Gender

According to Statistics Canada (2017a), females currently make up 50.4% of the Canadian population while males make up the remaining 49.6%. In comparison, females made up 58.6%

Table 3. Demographic profile of survey sample

Gender	Female	607	58.6%
	Male	424	41.0%
	Other	1	0.1%
	Prefer not to say	3	0.3%
Age	Under 25	82	8.0%
	25-34	264	25.6%
	35-44	232	22.5%
	45-54	190	18.4%
	55-64	159	15.4%
	65 and older	104	10.1%
Children under 18	Yes	330	31.9%
	No	697	67.5%
	Prefer not to say	6	0.6%
Province	Alberta	107	10.3%
	British Columbia	137	13.2%
	Manitoba	53	5.1%
	New Brunswick	33	3.2%
	Newfoundland and Labrador	25	2.4%
	Nova Scotia	30	2.9%
	Ontario	454	43.8%
	Prince Edward Island	1	0.1%
	Quebec	160	15.4%
	Saskatchewan	33	3.2%
	Yukon	1	0.1%
	Prefer not to say	2	0.2%
Race	Aboriginal/Indigenous	9	0.9%
	Asian	155	15.1%
	Black	23	2.2%
	Caucasian	777	75.5%
	Latin American/South American	9	0.9%
	Other/Multiple ethnicity	35	3.4%
	Prefer not to say	21	2.0%
Education Level	Primary school	1	0.1%
	Some high school	43	4.2%
	Completed high school or GED	179	17.3%
	Some postsecondary, but not complete	149	14.4%
	Completed postsecondary certificate or diploma	280	27.1%
	Completed Bachelor's degree from a university	277	26.8%
	Completed Master's degree or Ph.D. from a university	99	9.6%
	Prefer not to say	7	0.7%
Annual household Income	Under $25,000	131	12.7%
	$25,000 - $49,999	225	21.8%
	$50,000 - $74,999	219	21.2%
	$75,000 - $99,999	174	16.9%
	$100,000 - $124,999	103	10.0%
	$125,000 - $149,999	44	4.3%
	$150,000 and over	61	5.9%
	Prefer not to say	75	7.3%

of the survey's sample population, while 41% of the sample were males. Therefore, the sample did slightly overrepresent females and underrepresent males. A reason for this overrepresentation could be that women are more likely than men to be the primary shopper in the household (Nielsen 2016) and therefore, more likely to fill out a survey on the topic of food and beverages. Additionally, Nielsen (2016) also found that women are more likely than men to engage in social media activities, such as participating in online surveys. Respondents were also provided with an "other" option for those who did not identify as strictly male or female and one respondent chose this option. Three respondents chose "prefer not to say" and one respondent did not provide an answer for the gender question.

4.3.2 Year of Birth

Participants were asked to provide their year of birth and age categories were created from this data. As mentioned above, this question had the highest level of nonresponse which could be a result of the open-ended formatting of the question. Table 4 summarizes the age groupings for

Table 4. Age distribution of survey sample compared to adjusted Canadian population

	≤ 24	**25-34**	**35-44**	**45-54**	**55-64**	**≥ 65**
Survey sample	8.0%	25.6%	22.5%	18.4%	15.4%	10.1%
Adjusted Canadian population	8.6%	17.82%	16.9%	17.5%	17.6%	21.5%

the survey sample and compares that to the adjusted Canadian population (Statistics Canada 2017a). Since the target sample was Canadian adults, the comparative statistics for the Canadian population needed to be adjusted to account only for Canadian adults to accurately compare the percentage distributions. Thus, the adjusted statistic for the Canadian population age categories only accounted for Canadians aged 20 years and older. However, for the sample survey, the eligibility requirement was 18 years or older so for the comparative category of 24 years of age or less, the survey sample ranged from 18-24 while the adjusted Canadian population statistic

covered the range of 20-24. There were 13 respondents in the survey who were 18 or 19 years old, thus excluding them from the comparison would lead to a slightly lower percentage in the 24 and under category. Looking at Table 4, there were three age categories where the sample and Canadian population statistics were quite similar; the 24 and under category, the 45-54 age category and the 55-64 age category. Two age categories, 25-34 and 35-44, were overrepresented in the sample, while the oldest age category, 65 years and older, was underrepresented. This result was not surprising, as one of the criticisms of the online survey described in section 3.1 was the coverage error. Older generations were less likely to have internet access or the technical skills required to access and complete an online survey thus explaining their underrepresentation in the sample.

4.3.3 Children Under 18

Approximately one third of the survey sample indicated that they had children under the age of 18, while two thirds indicated that they did not. Two respondents chose the "prefer not to say" option, while an additional three respondents did not provide an answer for this question. According to the 2016 Canadian census, 38.6% of private households had at least one child living in the same dwelling (Statistics Canada 2017b). This number was slightly higher than the statistic from the sample population, however this could be explained by the fact that the census did not impose an age limit on the definition of a child as long as they were living in the same household whereas the survey restricted the definition to children under the age of 18.

4.3.4 Province

Province of residence was the only demographic question that did not have any missing responses. Table 5 compares the distribution of survey respondents by province to the actual Canadian population (Statistics Canada 2017c). Since the table does not consider respondents who chose "prefer not to say" there are negligible differences between the distribution presented in this table and in Table 3. For the most part, the distribution between the sample and the actual Canadian population were quite similar. Nontrivial differences between survey sample and actual population proportion were evident for Ontario and Quebec; Ontario was overrepresented in the sample population, while Quebec was underrepresented. This underrepresentation could be due to the fact that the survey was only provided in English and therefore, Quebec residents may have been dissuaded from completing the survey if they were not as proficient in English. Even though Quebec was underrepresented, it was still the province with the second highest percentage of respondents which was in line with the statistics for the actual Canadian population.

Table 5. Distribution of survey sample compared to Canadian population by province

	Survey Sample	Canadian population
Alberta	10.4%	11.7%
British Columbia	13.3%	13.1%
Manitoba	5.1%	3.7%
New Brunswick	3.2%	2.1%
Newfoundland and Labrador	2.4%	1.4%
Nova Scotia	2.9%	2.6%
Ontario	43.9%	38.7%
Prince Edward Island	0.1%	0.4%
Quebec	15.5%	22.7%
Saskatchewan	3.2%	3.2%
Other	0.1%	0.3%

4.3.5 Race

Table 6 presents the distribution of the survey sample and the Canadian population by race (Statistics Canada 2017b). Only two respondents did not provide an answer for this question. As

Table 6. Distribution of survey sample compared to Canadian population by race

	Survey Sample	Canadian population
Aboriginal/Indigenous	0.9%	4.9%
Asian	15.4%	15%
Black	2.3%	3.5%
Caucasian	77.1%	72.9%
Latin American/South American	0.9%	1.3%
Other/Multiple ethnicity	3.5%	2.6%

with Table 5 above, the breakdown for the sample's racial profile does not consider respondents who chose the "prefer not to say" option. Therefore, there are negligible differences between the percentages presented here and in Table 3. Comparing the data for the two populations, they were quite similar. There was a difference of approximately 4% for both the Aboriginal category, as well as the Caucasian category, with Aboriginals being slightly underrepresented in the sample and Caucasians slightly overrepresented.

4.3.6 Level of Schooling

The next demographic question asked respondents what was the highest level of education they had completed. Seven respondents chose the "prefer not to say" response while one respondent left the question unanswered. Table 7 shows the breakdown of respondents who did provide an answer to the question and the distribution for the Canadian population (Statistics Canada 2017d). An easier way to compare the data was to group certain categories together. For instance, by combining the first three groups the results indicated that 21.7% of the survey sample had achieved a high school diploma or GED at most. In comparison, 36.9% of the

Table 7. Distribution of survey sample compared to Canadian population by level of schooling

	Survey Sample	Canadian population
Primary school	0.1%	5.2%
Some high school	4.2%	11.7%
Completed high school or GED	17.4%	20.0%
Some postsecondary, but not complete	14.5%	6.7%
Completed postsecondary certificate or diploma	27.2%	31.6%
Completed Bachelor's degree	26.9%	16.8%
Completed Master's degree or Ph.D.	9.6%	7.9%

Canadian population had achieved a high school diploma or GED at most. At the other end of the spectrum, 36.6% of the sample had obtained some sort of university degree (either undergraduate or graduate), whereas only 24.7% of the Canadian population had obtained some sort of university degree. Therefore, it could be concluded that the survey sample had higher levels of education in comparison to the Canadian population.

4.3.7 Annual Household Income

The last question of the survey asked respondents to indicate their annual household income. As mentioned earlier, this question had the highest number of "prefer not to say" responses in the entire survey, with 75 respondents choosing not to disclose their income. Another four respondents did not provide an answer for the question. Thus, 957 respondents (92.3% of the sample) provided a valid data point for the income question. Statistics Canada did not provide any datasets that offered an accurate comparison for this question. The closest dataset consisted only of the incomes of couple families (Statistics Canada 2017e), whereas the survey data did not distinguish between households with one or more earners. Thus, in comparing the data in Table 8, while it appears as though the survey sample had a much lower income than the Canadian population (the table shows that 42.9% of the Canadian population's income is above $100,000

Table 8. Distribution of survey sample compared to Canadian population by income

	Survey Sample	Canadian population
Under $25,000	13.7%	5.9%
$25,000-$49,999	23.5%	16.9%
$50,000-$74,999	22.9%	18%
$75,000-$99,999	18.2%	16.4%
$100,000-$149,999	15.4%	22.5%
$150,000 and over	6.4%	20.4%

while only 21.8% of the sample have an income above $100,000), the large variance between the two datasets could be explained by this discrepancy in distinction.

4.3.8 Additional Respondent Characteristics

In addition to the demographic questions, respondents were also asked about their use of nutritional supplements and regular exercise as these variables have been shown to influence dairy milk consumption in the literature. Table 9 summarizes the responses for this question;

Table 9. Breakdown of responses to the additional respondent characteristic questions

	Yes	No
Do you take nutritional supplements?	578	456
	55.9%	44.1%
Do you exercise regularly?	622	412
	60.2%	39.8%

only two respondents did not provide a response for both question respectively. Slightly more than half of respondents (55.9%) indicated that they did take nutritional supplements, while 60.2% indicated that they exercised regularly.

Chapter 5: Results

5.1 Descriptive Statistics

5.1.1 Consumption Habits

Table 10 provides a summary of the responses to the survey's first question pertaining to respondents' consumption of dairy milk and PBDMAs; both questions were answered by all

Table 10. Responses to consumption questions

	Yes	No	Total Observations
Do you drink dairy milk?	937 (90.4%)	99 (9.6%)	1,036
Do you drink PBDMAs?	508 (49%)	528 (51%)	1,036

1,036 respondents. An overwhelming majority of respondents (90.4%) consumed some form of dairy milk, while approximately half (49%) consumed PBDMAs; these results were similar to those from Mintel's study, which revealed that 91% of Americans drank dairy milk and 49% drank PBDMAs (Mintel 2016). Table 11 presents an alternative breakdown of the data,

Table 11. Breakdown of respondents by consumption type

Consumption Type	Number of Respondents
Only drinks dairy milk	478 (46.1%)
Drinks both dairy milk and PBDMA	459 (44.3%)
Drinks neither dairy milk, nor PBDMA	50 (4.8%)
Only drinks PBDMA	49 (4.7%)

separating respondents based on whether they consumed both types of beverage, neither, just dairy milk or just PBDMAs. Comparing these results to Table 10, out of the 937 respondents who drank dairy milk, approximately half drank dairy milk exclusively. Less than 5% of respondents indicated drinking PBDMAs exclusively, while 44.3% drank both dairy milk and PBDMAs. This was also in line with findings from Mintel (2016) and provided further evidence that the switch to PBDMAs may not be solely out of necessity, but to some extent out of preference as 90.3% of those who drank PBDMAs also drank dairy milk.

The next question in each section asked respondents which type of either dairy milk or plant-based dairy milk alternative they drank most often; results are shown in Tables 12 and 13, respectively. Both questions were answered by all respondents who qualified, that is 937 responses for the dairy milk question and 508 responses for the PBDMAs question. For dairy

Table 12. Breakdown of respondents by type of dairy milk consumed

Dairy Milk Type	Number of Respondents
Skim milk (0%)	102 (10.9%)
1% milk	200 (21.3%)
2% milk	483 (51.5%)
Whole milk (3.25%)	116 (12.4%)
Lactose-free milk	27 (2.9%)
Other	9 (1%)

milk, 2% milk was consumed by the majority (51.5%) of respondents, followed by 1% milk (21.3%), whole milk (12.4%), skim milk (10.9%), lactose-free milk (2.9%) and other (1%), which included responses such as chocolate milk, half and half, powdered or canned milk. These results matched the data presented in the background section on dairy milk consumption from Statistics Canada. Turning to the responses for PBDMAs, the results indicated that almond milk was the most popular choice among PBDMAs (56.7%), followed by soy milk (24.6%), and coconut milk (12.6%). The other varieties combined accounted for the remaining 6%. These results were also in line with the data on PBDMAs sales presented in the background section.

Table 13. Breakdown of respondents by type of PBDMA consumed

Plant-Based Dairy Milk Alternative Type	Number of Respondents
Almond milk	288 (56.7%)
Cashew milk	10 (2%)
Coconut milk	64 (12.6%)
Hemp milk	6 (1.2%)
Oat milk	7 (1.4%)
Rice milk	6 (1.2%)
Soy milk	125 (24.6%)
Other/Blend	2 (0.4%)

The next question in the survey section assessing respondents' consumption habits focused upon frequency of consumption. Table 14 summarizes the responses for both dairy milk and PBDMAs; only five responses were missing from the dairy milk group and two from the

Table 14. Responses to frequency of consumption questions

Frequency	Number of Respondents (Dairy Milk)	Number of Respondents (PBDMAs)
Less than once a week	74 (7.9%)	155 (30.6%)
1-3 times a week	247 (26.5%)	221 (43.7%)
4-6 times a week	256 (27.5%)	79 (15.6%)
7-13 times a week (once or twice a day)	284 (30.5%)	41 (8.1%)
14-20 times a week (two or three times a day)	47 (5%)	7 (1.4%)
21 or more times a week (three or more times a day)	24 (2.6%)	3 (0.6%)
Total observations	932	506

PBDMAs group. Comparing the responses from the two groups, dairy milk was consumed much more frequently on a weekly basis than PBDMAs. While nearly three quarters (74.3%) of plant-based dairy milk alternative drinkers consumed PBDMAs 3 times a week or less, 65.6% of dairy milk drinkers consumed dairy milk at least 4 times a week or more.

An additional question was included in the PBDMAs section which asked participants to indicate the reasons why they consume PBDMAs. Table 15 summarizes responses to this question and sorts the claims from most popular to least. Of all the factors listed, taste was chosen most frequently as a reason for choosing PBDMAs. The second and third most popular reasons (calorie content and health concerns related to dairy milk consumption) drew on the theme of this study and provide evidence that respondents may be substituting dairy milk with PBDMAs for health reasons. Most people who chose "other" cited reasons such as adding variety to their diet, a family member or friend prefers PBDMAs, reduced sugar content, or requirement for a specific recipe.

Table 15. Reasons for consuming PBDMAs

Reason	Number of Respondents
Taste preference	213 (42.1%)
Calorie content	100 (19.8%)
Health concerns related to dairy milk consumption	96 (19%)
Lactose intolerance	87 (17.2%)
Availability	83 (16.4%)
Shelf life	78 (15.4%)
Animal welfare concerns related to dairy production	74 (14.6%)
Environmental concerns related to dairy production	71 (14%)
Other	60 (11.9%)
Price	53 (10.5%)
Milk allergies	45 (8.9%)
Follow a vegan diet	36 (7.1%)

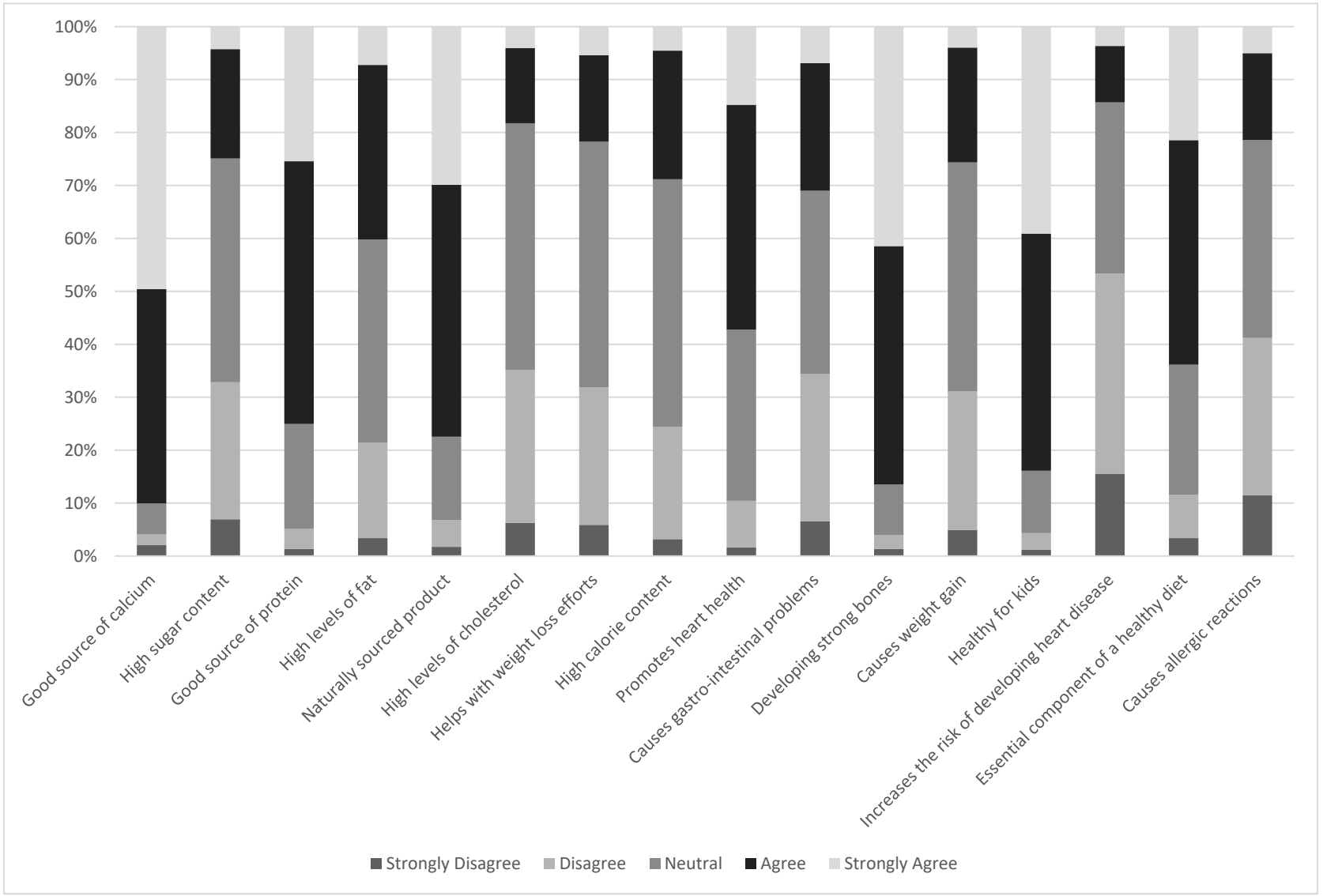
5.1.2 Likert Scale Questions

The second section of the survey focused on assessing respondents' perceptions of various health and nutrition claims related to the consumption of both dairy milk and PBDMAs. For the time being, the responses for dairy milk and PBDMAs will be described separately, as they will be compared later in section 5.2.

5.1.2.1 Perceptions of Dairy Milk

Figure 4 illustrates the distribution of responses to Likert scale questions relating to perceptions of dairy milk. Overall, the Likert scale questions for dairy milk perceptions were thoroughly answered. The statement with the most missing responses was "drinking dairy milk causes gastro-intestinal problems" with four missing responses. A useful way to interpret the graphs is to compare the overall level of agreement and disagreement for each claim. Identifying the lower end of the black bar indicates how many respondents agreed (either choosing "agree" or "strongly agree") for each statement. For example, for the first claim in Figure 4, "dairy milk is a good source of calcium", the bottom of the black bar reads at 10%, indicating that roughly 90% of respondents agreed with this claim. The statements with the highest level of agreement were

Figure 4. Responses to the Likert scale questions on dairy milk

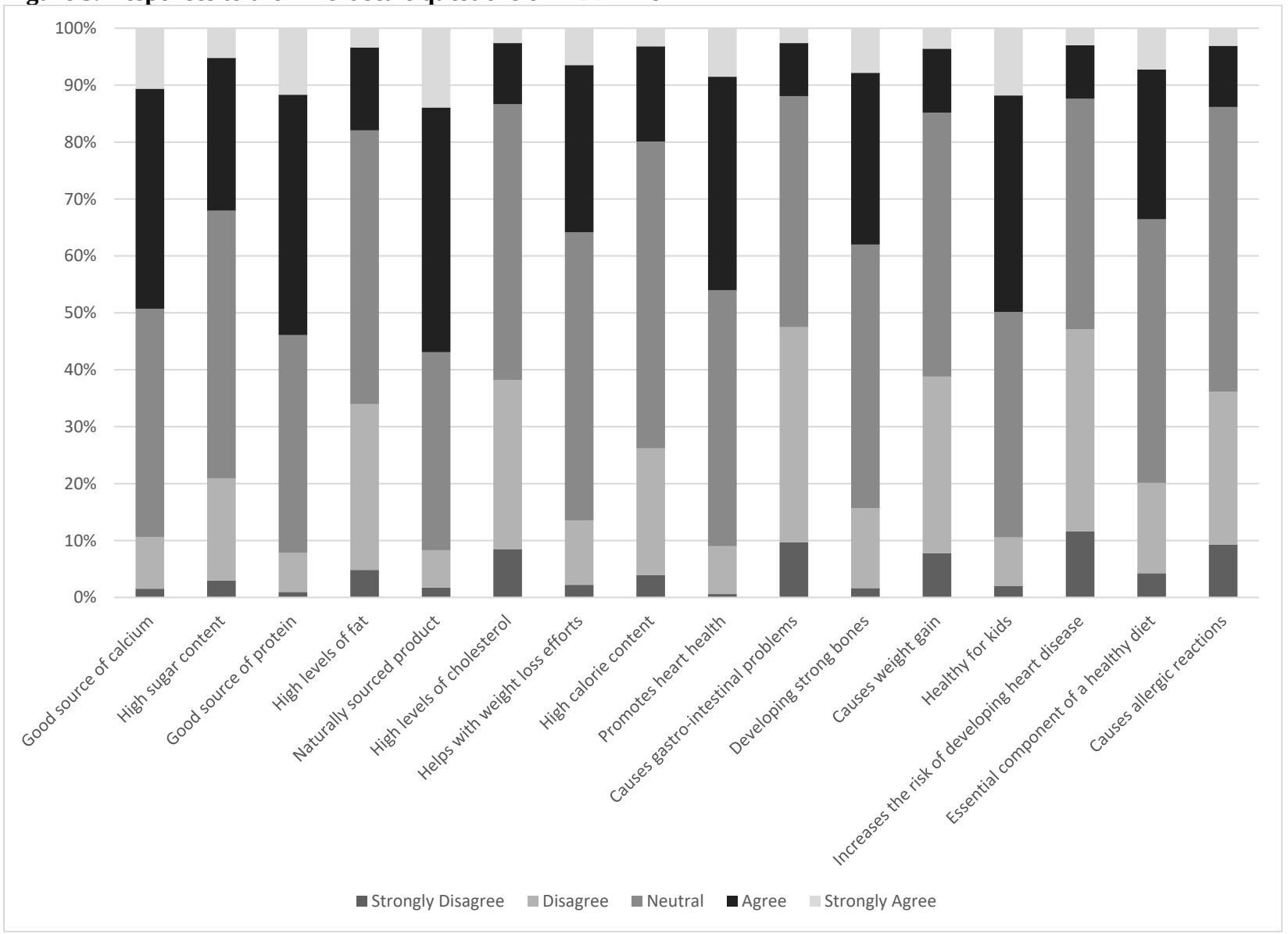


"dairy milk is a good source of calcium" (90.05%), "drinking dairy milk aids in developing strong bones" (86.47%), "dairy milk is healthy for kids" (83.88%), "dairy milk is a naturally sourced product" (77.47%) and "dairy milk is a good source of protein" (75.05%). These findings were in line with those in the literature review, stating that dairy milk's most well-known benefits are the calcium content and its contribution to strong bones, as well as the protein content. The statements with the highest level of disagreement were "drinking dairy milk increases the risk of developing heart disease" (53.33%), "drinking dairy milk causes allergic reactions" (41.22%), "dairy milk has high levels of cholesterol" (35.14%), "drinking dairy milk causes gastro-intestinal problems" (34.40%), "dairy milk has a high sugar content" (32.82%), "drinking dairy milk helps with weight loss efforts" (31.88%) and "drinking dairy milk causes weight gain" (31.07%). The health concern statement with the highest level of agreement was "dairy milk has high levels of fat" (40.19%) which was also in line with findings from the literature which cite dairy milk's fat content as a common concern for consumers. All the statements with the highest levels of agreement related to health or nutrition benefits, while six out of seven statements with the highest level of disagreement related to health or nutrition concerns. This implies that respondents had an overall positive perception of the health and nutritional value of dairy milk.

5.1.2.2 Perceptions of PBDMAs

Figure 5 shows responses to Likert scale questions relating to perceptions of PBDMAs. Overall, the Likert scale questions were thoroughly answered. The statement with the most missing responses (five) was "drinking PBDMAs causes weight gain." The statements with the highest level of agreement were "PBDMAs are a naturally sourced product" (56.91%), "PBDMAs are a good source of protein" (53.91%), "PBDMAs are healthy for kids" (49.85%), "PBDMAs are a

Figure 5. Responses to the Likert scale questions on PBDMAs



good source of calcium" (49.28%) and "drinking PBDMAs promotes heart health" (46.03%). Four out of the five statements appeared in the top five statements with the highest level of agreement for both dairy milk and PBDMAs. However, the level of agreement for dairy milk for each statement was significantly higher than for PBDMAs which could be an indication that respondents were more confident in their knowledge of the health value of dairy milk than PBDMAs. As further evidence, when comparing the percentage of respondents who chose the neutral option for dairy milk and PBDMAs, the average was 30.48% of respondents for dairy milk and 44.74% for PBDMAs. This could be an indication that respondents were less confident in their knowledge of PBDMAs and as a result less likely to commit to a strong opinion in relation to the survey's perception statements. The statements with the highest level of disagreement were "drinking PBDMAs causes gastro-intestinal problems" (47.48%), "drinking PBDMAs increases the risk of developing heart disease" (47.14%), "drinking PBDMAs causes weight gain" (38.8%), "PBDMAs have high levels of cholesterol" (38.20%), "drinking PBDMAs causes allergic reactions" (36.11%) and "PBDMAs have high levels of fat" (33.98%). The health/nutrition concern statement with the highest level of agreement was "PBDMAs have a high sugar content" (32.05%). While fat content appeared to be respondents' main health concern related to dairy milk consumption, the main health concern for PBDMAs was the sugar content. All the statements with the highest levels of agreement related to health or nutrition benefits, while all the statements with the highest level of disagreement related to health or nutrition concerns. This implies that respondents had an overall positive perception of the health and nutrition value of PBDMAs. It was difficult to draw conclusions regarding whether significant differences existed in the overall perceptions of the health value of dairy milk and

PBDMAs simply from comparing the distribution graphs; this question will be further investigated in section 5.2 using the Wilcoxon signed-rank test.

5.1.3 Ultrafiltered Dairy Milk

Respondents were asked whether they would consider purchasing ultrafiltered dairy milk instead of their current selection; results from this question are presented in Table 16. Only four

Table 16. Responses to willingness-to-purchase ultrafiltered dairy milk question

	Yes	No	Total Observations
Total sample	699 (67.7%)	333 (32.3%)	1,032
Drink both types	369 (80.7%)	88 (19.3%)	457
Drink neither	14 (28%)	36 (72%)	50
Drink just PBDMA	19 (38.8%)	30 (61.2%)	49
Drink just dairy milk	297 (62.4%)	179 (37.6%)	476

respondents did not provide an answer for this question. Just over two-thirds of respondents indicated that they would be interested in purchasing ultrafiltered dairy milk, while one-third indicated that they would not be interested in purchasing ultrafiltered dairy milk. Some respondents who indicated they would not be interested in the ultrafiltered dairy milk left remarks at the end of the survey indicating concerns with over-processing and preferring an unaltered, natural product. Responses were also broken down by consumption type to determine whether the introduction of ultrafiltered dairy milk in the Canadian market would encourage non-dairy consumers to transition to dairy milk. The group that had the highest percentage of willingness-to-purchase ultrafiltered dairy milk (80.7%) was the group that drank both dairy milk and PBDMAs. Both groups that did not consume dairy milk (drink neither and drink just PBDMAs) had a significantly lower indication of willingness-to-purchase ultrafiltered dairy milk

when compared to the groups that did consume dairy milk. However, nearly 40% of those who drank solely PBDMAs responded that they would be willing to purchase ultrafiltered dairy milk, indicating that there is potential for the dairy industry to recapture a portion of plant-based dairy milk alternative consumers with ultrafiltered dairy milk.

Next, respondents who indicated that they would be interested in purchasing ultrafiltered dairy milk were asked a series of questions to determine the premium they would be willing to pay for ultrafiltered dairy milk. Out of the 699 respondents who indicated they would be interested in purchasing ultrafiltered dairy milk, 652 (93.3%) provided valid reference pricing for both their current milk selection and what they would pay for the ultrafiltered dairy milk. From these values, a premium for the ultrafiltered milk was calculated for each individual (Table 17). The calculated premiums ranged in value from -100% to 150%, with a mean of 15.47%. Table 17 also provides a breakdown of the variation in the premium based on different socio-demographic groups for comparison. When looking at the variation in average premium by demographic groups, there did not appear to be an excessive amount of variation, although a few findings were noteworthy. The age group that had the highest average premium (22.79%) were those 18-24. Typically, this age group would include students or individuals who were at the beginning of their career and therefore not necessarily financially stable. The fact that this age group was willing to pay the highest average premium for ultrafiltered milk could be an indication of millennials increasing interest in innovative health food products and their willingness to invest in their dietary health. Interestingly, the group that only drank PBDMAs was willing to pay the highest premium (20.92%) of all consumption types, although these results could be skewed by the low number of respondents in this group (17) compared to those who either drank dairy milk exclusively (284) or drank both dairy milk and PBDMAs (338).

Table 17. Average willingness-to-pay premium for ultrafiltered dairy milk

Demographic Category		Average Premium	Total Obsv.
Gender	Male	16.66%	260
	Female	14.63%	390
Age	18-24	22.79%	51
	25-34	15.36%	168
	35-44	15.82%	160
	45-54	16.83%	114
	55-64	13%	99
	65 and older	10.05%	58
Children under 18	No	16.43%	427
	Yes	13.2%	221
Provinces	Western	14.15%	201
	Ontario	17.27%	294
	Quebec	15.15%	96
	Maritimes	11.87%	60
Race	Aboriginal/Indigenous	2.48%	2
	Asian	15.56%	124
	Black	14.35%	13
	Caucasian	15.38%	470
	Latin American/South American	10.54%	6
	Other	22.04%	24
Schooling	High school or less	14.74%	122
	Some postsecondary	15.5%	93
	Certificate or diploma	15.73%	175
	Bachelor's degree	16.3%	192
	Master's degree or Ph.D.	14.1%	65
Income	Under $25,000	14.79%	80
	$25,000-$49,999	16.72%	117
	$50,000-$74,999	12.77%	140
	$75,000-$99,999	16.67%	113
	$100,000-$124,999	16.75%	72
	$125,000-$149,999	16.81%	29
	$150,000 and over	23.59%	42
Uses supplements	No	14.01%	256
	Yes	16.42%	396
Regular exercise	No	13.95%	238
	Yes	16.42%	412
Drink dairy milk	No	17.4%	30
	Yes	15.38%	622
Drink PBDMA	No	13.16%	297
	Yes	17.4%	355
Consumption type	Drink both	17.23%	338
	Drink neither	12.8%	13
	Drink just PBDMA	20.92%	17
	Drink just dairy milk	13.18%	284

It should be noted that while efforts were taken to make the respondents aware of the hypothetical nature of the question, this could still have had an impact on the accuracy of the responses.

5.2 Wilcoxon Signed-Rank Test for Comparing Perceptions of Health Claims

While descriptive statistics were useful to provide an overall image of respondents' health perceptions of both dairy milk and PBDMA, further testing was required to determine any statistically significant differences in perception between both beverages. Due to the nature of the Likert scale questions, the data collected were ordinal and not normally distributed; thus an appropriate non-parametric method, such as the Wilcoxon signed-rank test, was required. Section 4.2.2 outlined the purpose of and process for conducting the Wilcoxon signed-rank test. The test was performed on each pair of claims; for example, the first pair tested was "dairy milk is a good source of calcium" versus "PBDMAs are a good source of calcium." Table 18 presents the results of the Wilcoxon signed-rank test for all 16 claims tested. Statistically significant results were found for 15 out of the 16 health and nutrition claims tested, providing evidence that there were significant differences in perceptions of the health value of PBDMAs and dairy milk.

Table 18. Wilcoxon signed-rank test results for health perception claims

Claim	(Dairy-PBDMA)	N	Z-test	Significance
Good source of calcium	Negative Ranks	65		
	Positive Ranks	657	-19.295	>0.0005
	Ties	312		
High sugar content	Negative Ranks	381		
	Positive Ranks	233	-6.637	>0.0005
	Ties	422		
Good source of protein	Negative Ranks	162		
	Positive Ranks	429	-10.764	>0.0005
	Ties	442		
High levels of fat	Negative Ranks	174		
	Positive Ranks	431	-10.914	>0.0005
	Ties	430		

Table 18. Wilcoxon signed-rank test results for health perception claims (cont'd)

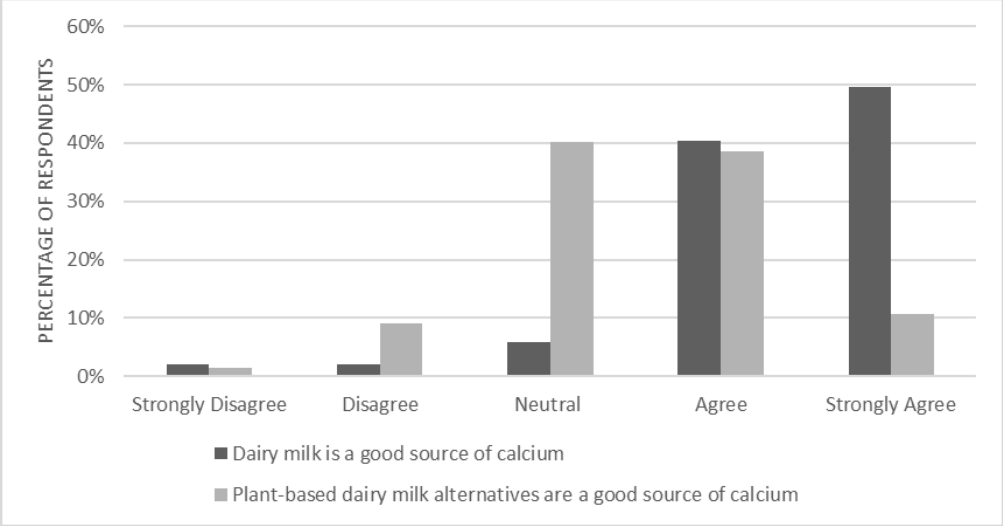
Claim	(Dairy-PBDMA)	N	Z-test	Significance
Naturally sourced product	Negative Ranks	162	-10.358	>0.0005
	Positive Ranks	449		
	Ties	422		
High levels of cholesterol	Negative Ranks	246	-3.384	0.001
	Positive Ranks	303		
	Ties	485		
Helps with weight loss efforts	Negative Ranks	399	-10.060	>0.0005
	Positive Ranks	162		
	Ties	473		
High calorie content	Negative Ranks	209	-4.050	>0.0005
	Positive Ranks	291		
	Ties	533		
Promotes heart health	Negative Ranks	202	-4.647	>0.0005
	Positive Ranks	345		
	Ties	487		
Causes gastro-intestinal problems	Negative Ranks	192	-10.268	>0.0005
	Positive Ranks	391		
	Ties	445		
Aids in developing strong bones	Negative Ranks	76	-20.314	>0.0005
	Positive Ranks	679		
	Ties	278		
Causes weight gain	Negative Ranks	198	-6.307	>0.0005
	Positive Ranks	332		
	Ties	498		
Healthy for kids	Negative Ranks	119	-16.003	>0.0005
	Positive Ranks	573		
	Ties	341		
Increases the risk of developing heart disease	Negative Ranks	298	-2.696	0.007
	Positive Ranks	231		
	Ties	503		
Essential component of a healthy diet	Negative Ranks	164	-12.908	>0.0005
	Positive Ranks	510		
	Ties	359		
Causes allergic reactions	Negative Ranks	266	-0.219	0.827
	Positive Ranks	258		
	Ties	509		

5.2.1 Good Source of Calcium

The first three rows of Table 18 present the results of the Wilcoxon signed-rank test for the first claim "good source of calcium." The third column shows the results of taking the difference of

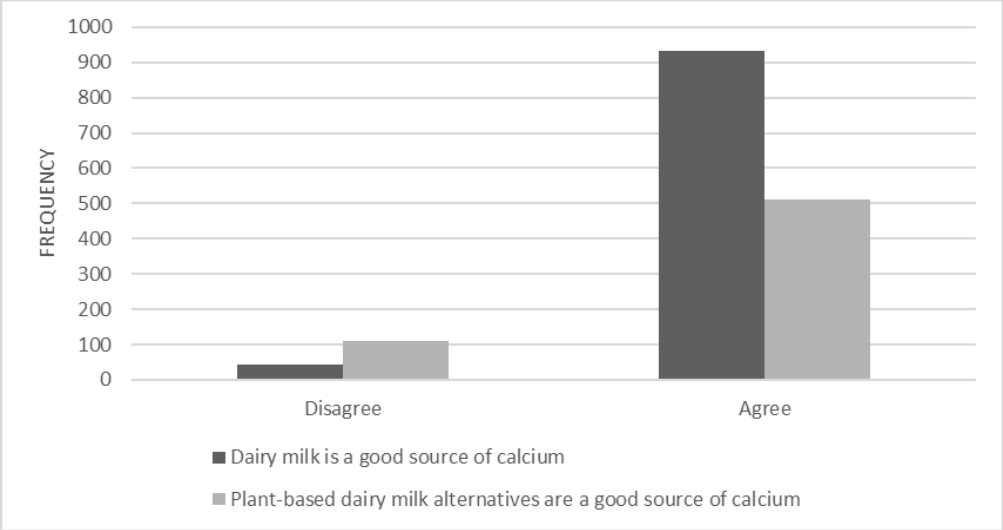
each respondent's score for PBDMAs and dairy milk; there were 65 respondents with negative ranks (meaning that they had a higher level of agreement with the claim for PBDMAs than dairy milk), 657 positive ranks (meaning that they had a higher level of agreement with the claim for dairy milk than PBDMAs) and 312 ties (meaning that they had the same level of agreement with the claim for both dairy milk and PBDMAs). The fourth and fifth columns show the corresponding z-score calculated by SPSS (z = -19.295) and significance ($p < 0.0005$). Thus, there was a statistically significant higher level of agreement with the statement "dairy milk is a good source of calcium" than with "PBDMAs are a good source of calcium." Recall that a high level of agreement for this claim with dairy milk was hypothesized. Figure 6 offers a visual representation of the data for this claim. Overall, the data appear skewed to the left, indicating an

Figure 6. Comparing responses for the claim "good source of calcium" between dairy milk and PBDMAs, by percentage of respondents



overall level of agreement with the claim for both beverages. While the percentage of respondents who chose "agree" for this claim was similar for both beverage types, significant differences became apparent when looking at the percentage of respondents who chose "neutral" or "strongly agree." Figure 7 provides an alternative view of the data; the neutral option was removed, the option "strongly disagree" was aggregated with "disagree" and "strongly agree"

Figure 7. Comparing responses for the claim "good source of calcium" between dairy milk and PBDMAs, by frequency

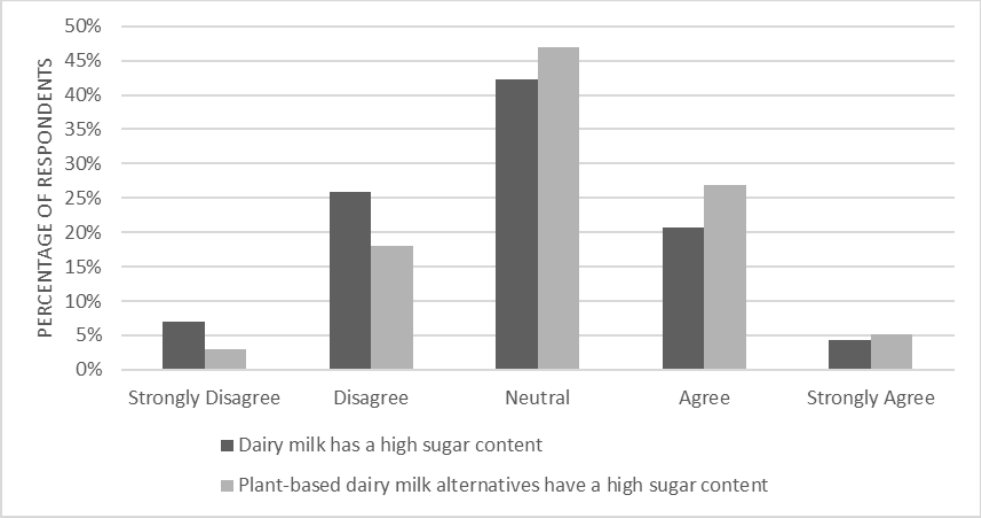


with "agree" to isolate the overall level of agreement and disagreement for the claim and the frequency of responses was chosen as a measure instead of percentage of respondents. This graph confirms the higher level of agreement among respondents for dairy milk than for PBDMAs.

5.2.2 High Sugar Content

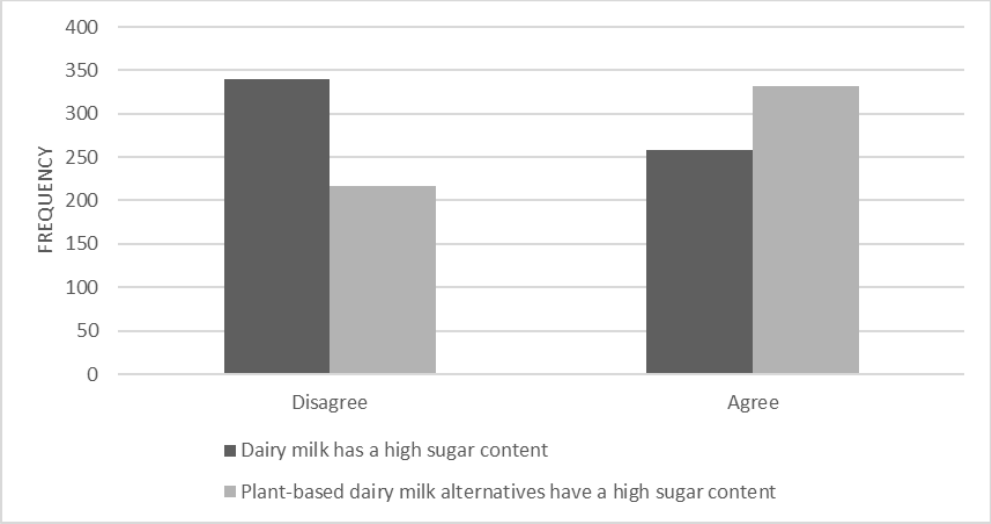
Referring to Table 18, there were 381 respondents with negative ranks, 233 with positive ranks and 422 with ties for the claim "high sugar content." The corresponding z-score calculated by SPSS (z = -6.637) and significance ($p < 0.0005$) indicate that there was a statistically significant higher level of agreement among respondents with the statement "PBDMAs have a high sugar content" than with "dairy milk has a high sugar content." This finding confirmed the results from the descriptive statistics as this claim had one of the highest levels of disagreement for dairy milk, yet it was the health concern claim that had the highest level of agreement for PBDMAs. Figure 8 offers a visual representation of the distribution of responses for this claim. Compared to the first claim, the responses were much less skewed and more centrally distributed which

Figure 8. Comparing responses for the claim "high sugar content" between dairy milk and PBDMAs, by percentage of respondents



indicated less certainty and consensus among respondents. Figure 9 compares respondents who chose either a position of agreement or disagreement. This graph once again provides visual evidence of the results from the Wilcoxon signed-rank test, as the higher level of agreement with the claim for PBDMAs than for dairy milk can be seen. Also, the graph highlights that while respondents were more likely to agree with this claim for PBDMAs, they were more likely to disagree for dairy milk indicating conflicting perceptions between both beverage types.

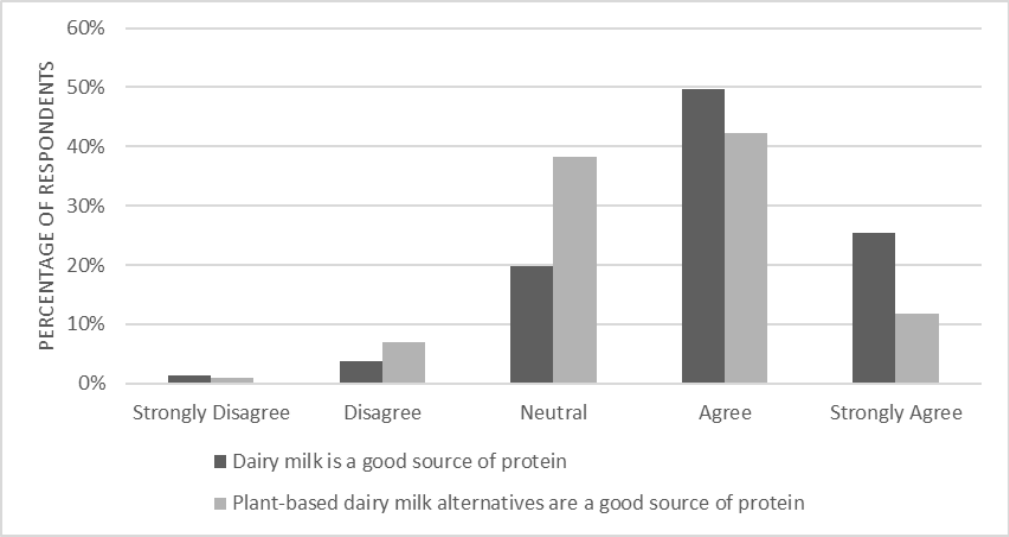
Figure 9. Comparing responses for the claim "high sugar content" between dairy milk and PBDMAs, by frequency



5.2.3 Good Source of Protein

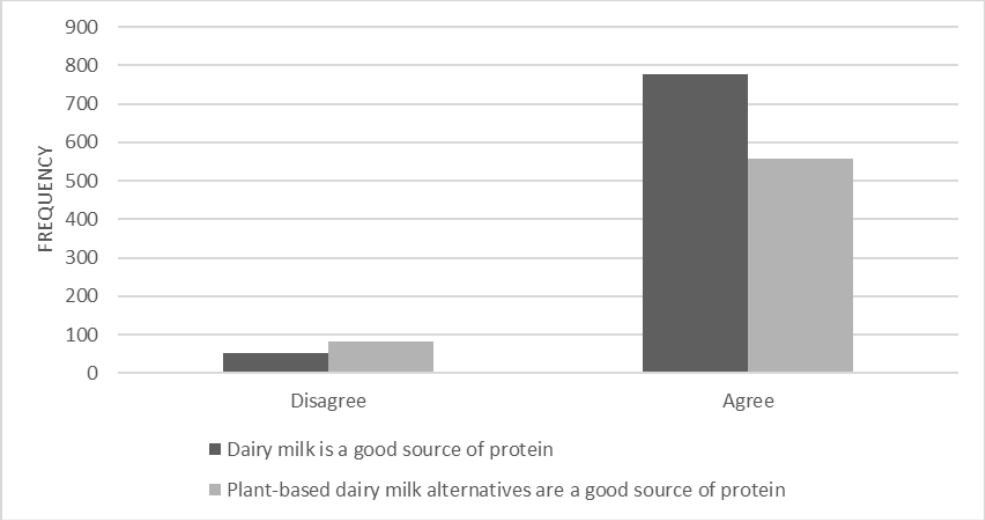
There were 162 respondents with negative ranks, 429 positive ranks and 442 ties for the claim "good source of protein." The corresponding z-score calculated by SPSS was $z = -10.764$ and the significance was $p < 0.0005$. Thus, there was a statistically significant higher level of agreement with the statement "dairy milk is a good source of protein" than with "PBDMAs are a good source of protein." Figure 10 compares the distribution of responses for this claim between dairy milk and PBDMAs. This graph looks quite similar to the first claim (good source of calcium)

Figure 10. Comparing responses for the claim "good source of protein" between dairy milk and PBDMAs, by percentage of respondents



with the data skewed to the left, indicating overall agreement with the claim. However, as hypothesized, the level of agreement is not as high as for the calcium claim. In Figure 11, responses are sorted into either "agree" or "disagree" categories and provide a visual confirmation of the Wilcoxon signed-rank test results, as there is a higher level of agreement with the claim for dairy milk than for PBDMAs.

Figure 11. Comparing responses for the claim "good source of protein" between dairy milk and PBDMAs, by frequency



5.2.4 High Levels of Fat

Referring to Table 18, there were 174 respondents with negative ranks, 431 with positive ranks and 430 with ties for the claim "high levels of fat." The corresponding z-score calculated by SPSS (z = -10.914) and significance ($p < 0.0005$) indicate that there was a statistically significant higher level of agreement with the statement "dairy milk has high levels of fat" than with "PBDMAs have high levels of fat." This was the expected result as the literature has shown that fat content is a common concern associated with the consumption of dairy milk. However, these results indicate that it is not an equivalent concern with the consumption of PBDMAs. Looking at Figure 12, the distribution is centrally distributed which indicates a lack of consensus among respondents. However, when comparing the percentage of "agree" and "strongly agree" for dairy milk and PBDMAs, more respondents overall chose to agree for dairy milk. For a better visualization, Figure 13 shows only respondents who chose either an agreement or disagreement position. More than twice as many respondents agreed that dairy milk had high levels of fat than PBDMAs. While the neutral option was chosen by almost 50% of respondents for the PBDMAs

Figure 12. Comparing responses for the claim "high levels of fat" between dairy milk and PBDMAs, by percentage of respondents

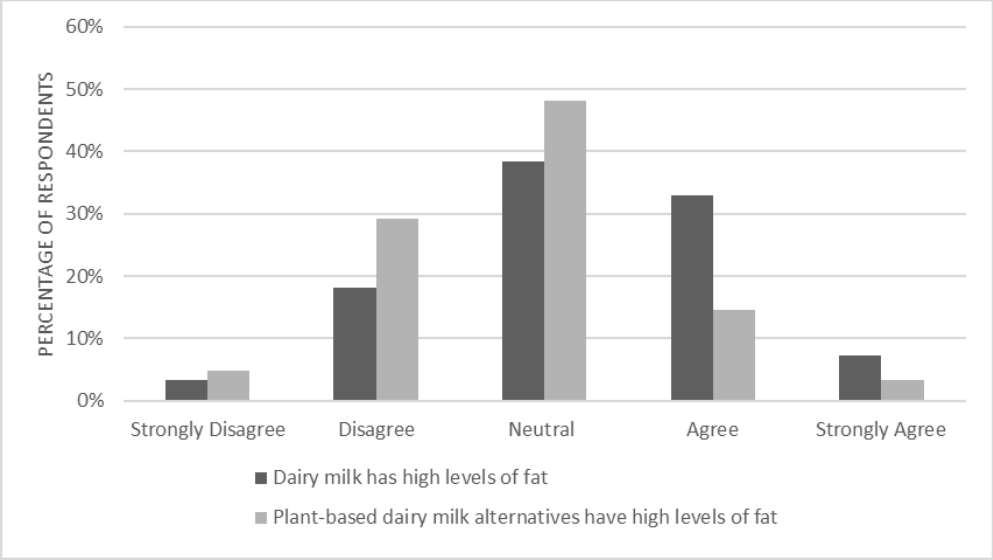
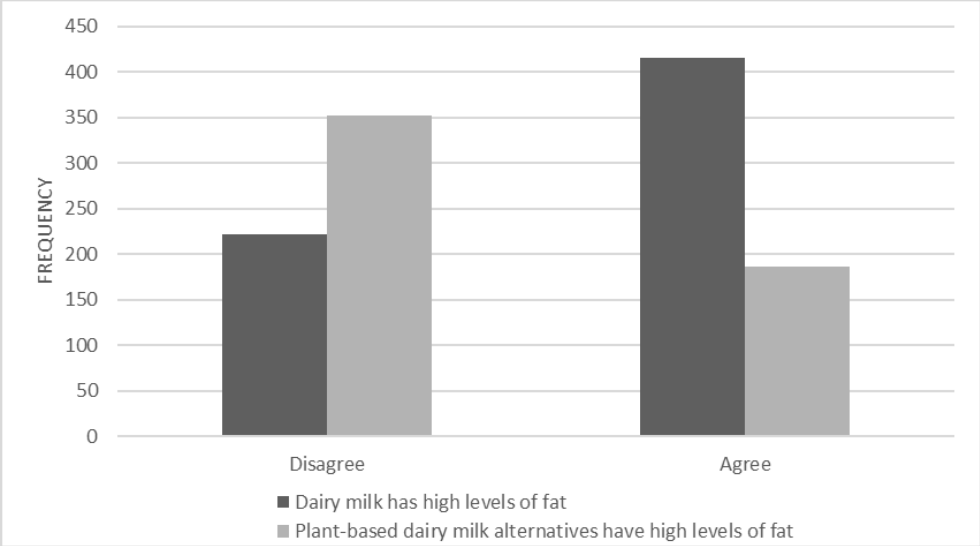


Figure 13. Comparing responses for the claim "high levels of fat" between dairy milk and PBDMAs, by frequency

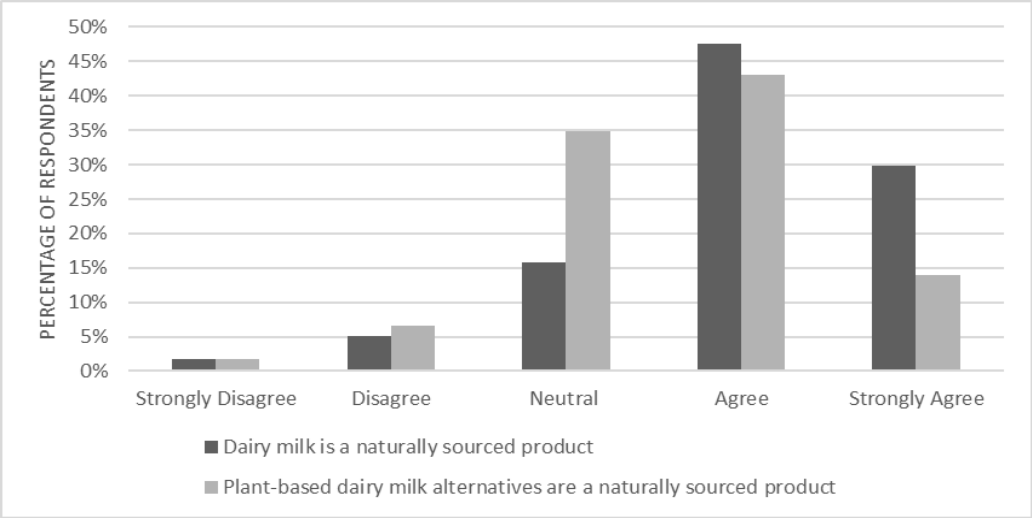


question, Figure 13 shows that more than a third of respondents disagreed with this claim, therefore supporting the finding that fat content is not a significant concern associated with PBDMAs consumption.

5.2.5 Naturally Sourced Product

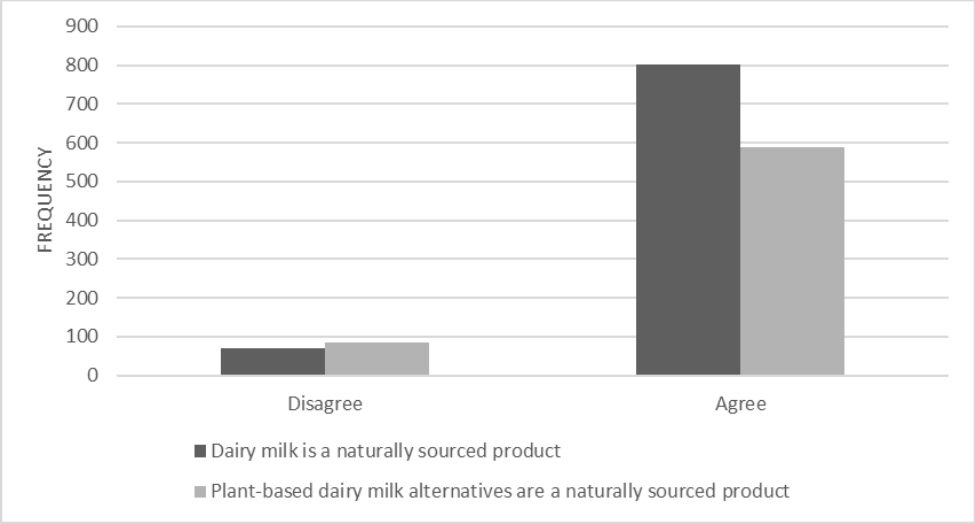
There were 162 respondents with negative ranks, 449 with positive ranks and 422 with ties for the claim "naturally sourced product." The corresponding z-score calculated by SPSS (z = -10.358) and significance ($p < 0.0005$) indicate that there was a statistically significant higher level of agreement among respondents with the statement "dairy milk is a naturally sourced product" than with "PBDMAs are a naturally sourced product." Figure 14 illustrates the

Figure 14. Comparing responses for the claim "naturally sourced product" between dairy milk and PBDMAs, by percentage of respondents



distribution of responses for this claim. The skewed nature of the histogram reflects consensus amongst respondents in agreement with this claim. Figure 15 compares respondents who agreed and disagreed with the claim. While less than 10% of respondents disagreed with this claim for both dairy milk and PBDMAs, an additional 200 respondents agreed with the claim for dairy milk than for PBDMAs.

Figure 15. Comparing responses for the claim "naturally sourced product" between dairy milk and PBDMAs, by frequency



5.2.6 High Levels of Cholesterol

The sixth claim to be tested was "high levels of cholesterol" and the results are summarized in Table 18. There were 246 negative ranks, 303 positive ranks and 485 ties. The fourth and fifth columns show the corresponding z-score calculated by SPSS (z = -3.384) and significance (p = 0.001). Thus, there was a statistically significant higher level of agreement with the statement "dairy milk has high levels of cholesterol" than with "PBDMAs have high levels of cholesterol." The distribution of responses for this claim can be seen in Figure 16. The central distribution indicates a lack of consensus among respondents for this claim. Almost half of respondents chose neutral indicating that they either had no opinion on this claim or were unsure of their opinion. Figure 17 breaks down the results into respondents who either agreed or disagreed with the claim. Overall, respondents were more likely to disagree with this claim indicating that cholesterol was not a significant concern for respondents. The graph illustrate that more respondents did agree with this claim for dairy milk than for PBDMAs. However, the fact that 138 respondents agreed that PBDMAs have high levels of cholesterol could signal a need for better public education as PBDMAs do not contain any cholesterol.

Figure 16. Comparing responses for the claim "high levels of cholesterol" between dairy milk and PBDMAs, by percentage of respondents

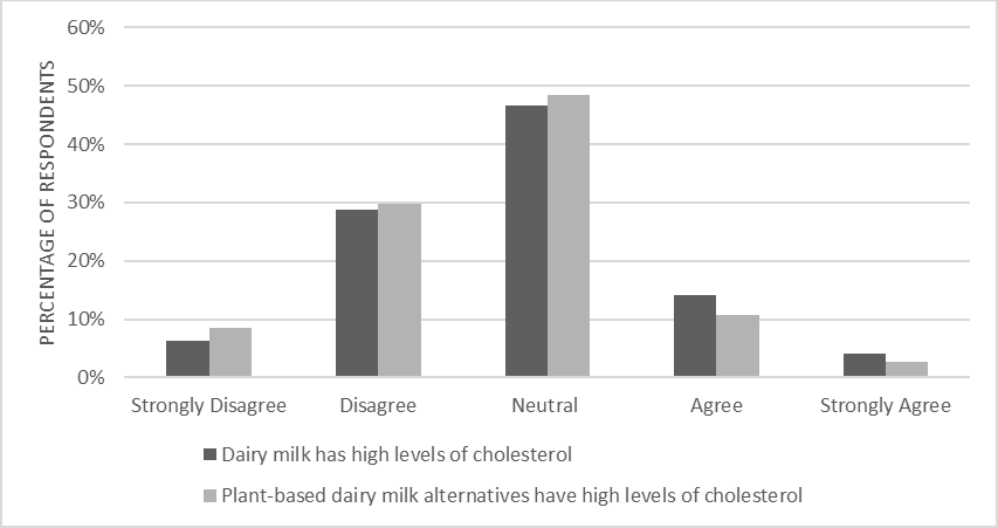
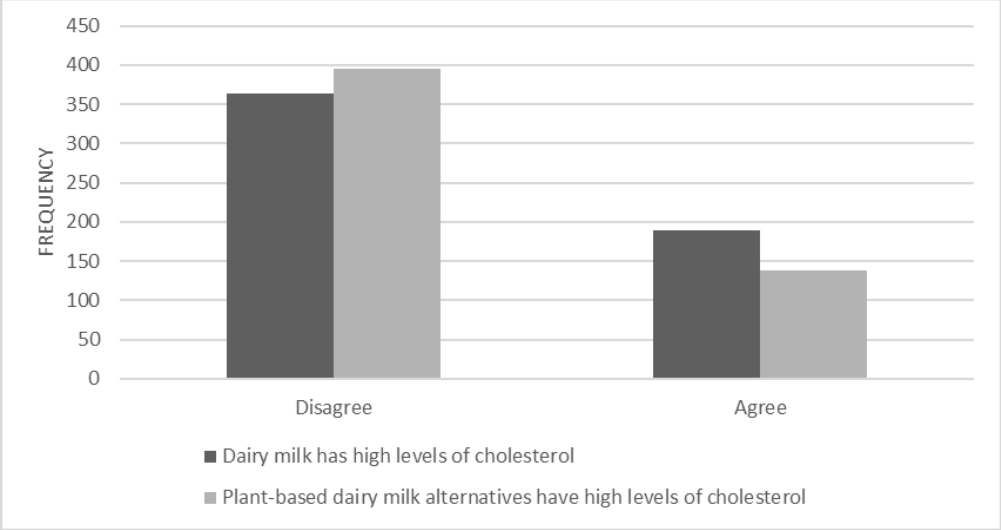


Figure 17. Comparing responses for the claim "high levels of cholesterol" between dairy milk and PBDMAs, by frequency

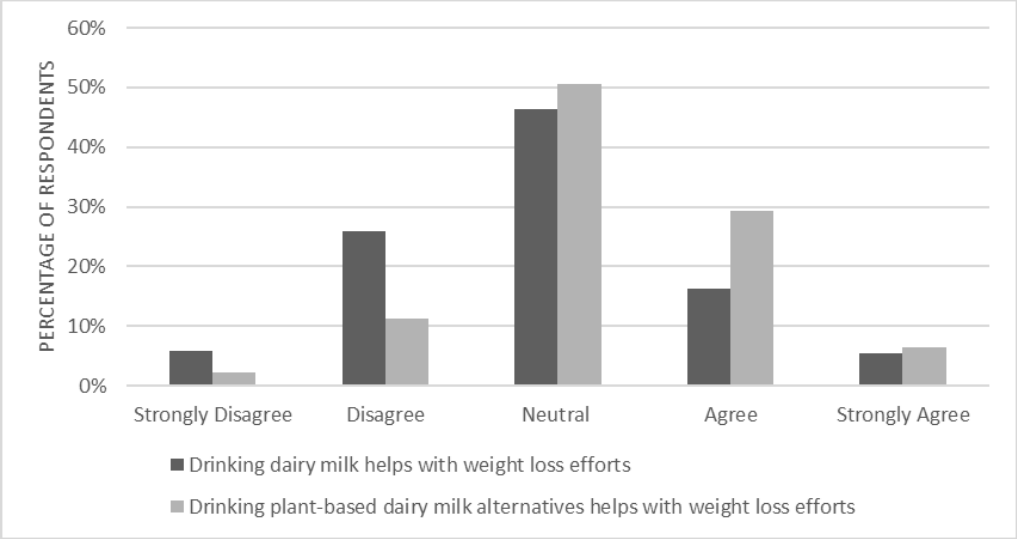


5.2.7 Helps with Weight Loss Efforts

The seventh claim to be tested was "helps with weight loss efforts." There were 399 negative ranks, 162 positive ranks and 473 ties. The corresponding z-score calculated by SPSS (z = -10.060) and significance ($p < 0.0005$) indicate that there was a statistically significant higher level of agreement with the statement "drinking PBDMAs helps with weight loss efforts" than

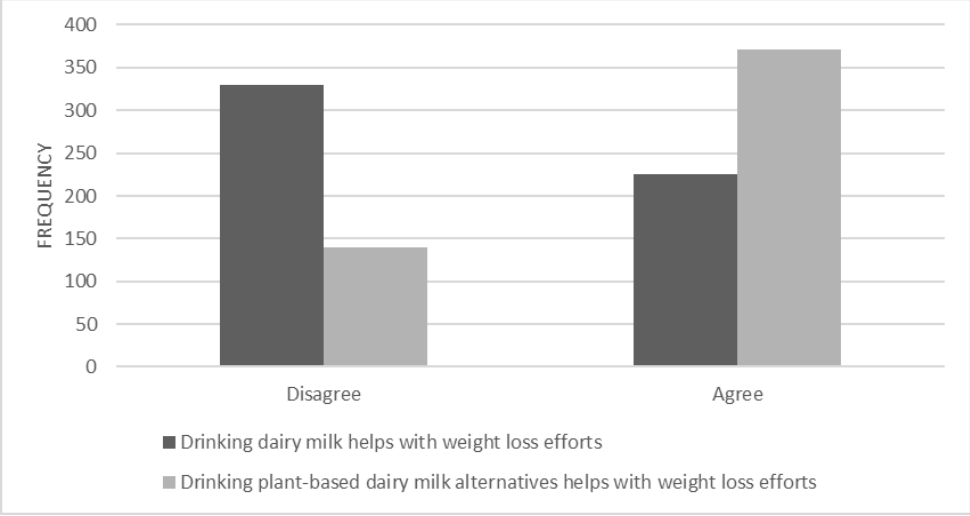
"drinking dairy milk helps with weight loss efforts." Figure 18 shows the distribution of responses for this claim. The central distribution demonstrates the lack of consensus on this

Figure 18. Comparing responses for the claim "helps with weight loss efforts" between dairy milk and PBDMAs, by percentage of respondents



claim. However, by looking at the "disagree" and "agree" options, it is clear that more respondents agreed with the claim for PBDMAs and more respondents disagreed with the claim for dairy milk. This is further evidenced in Figure 19 which only considers respondents who

Figure 19. Comparing responses for the claim "helps with weight loss efforts" between dairy milk and PBDMAs, by frequency

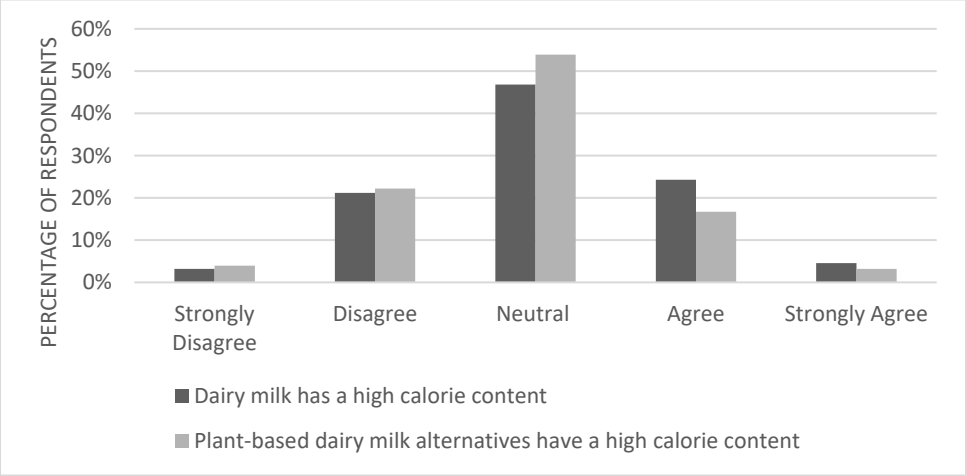


chose an agreement or disagreement position. In this case, most respondents disagreed with this claim for dairy milk and agreed for PBDMAs. This finding could signal an area of concern for the dairy industry to address, as consumers who are looking to lose weight might be more likely to choose PBDMAs than dairy milk.

5.2.8 High Calorie Content

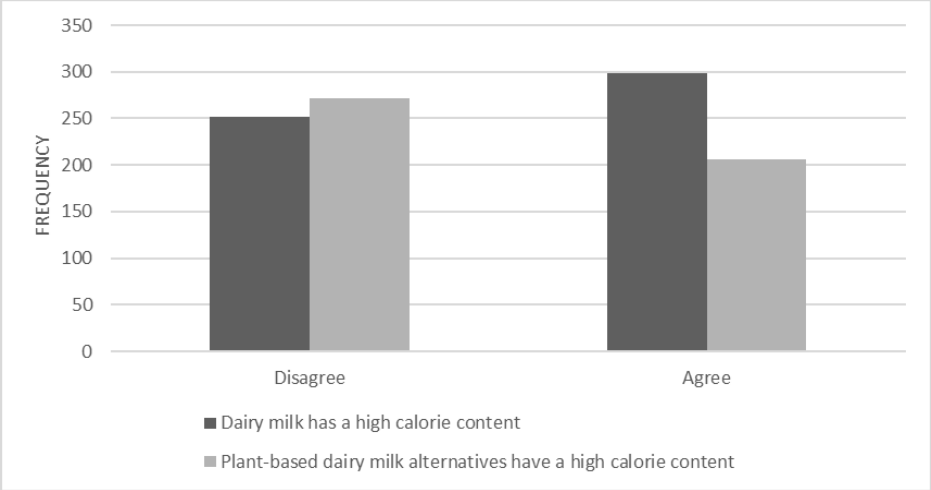
For the claim "high calorie content", 209 respondents had negative ranks, 291 had positive ranks and 533 had ties. The corresponding z-score calculated by SPSS ($z = -4.050$) and significance ($p < 0.0005$) indicate that there was a statistically significant higher level of agreement with the statement "dairy milk has a high calorie content" than "PBDMAs have a high calorie content." Figure 20 compares the distribution of responses for this claim. The central distribution of

Figure 20. Comparing responses for the claim "high calorie content" between dairy milk and PBDMAs, by percentage of respondents



responses indicates a lack of consensus among respondents. This finding is further evidenced in Figure 21 which only considers respondents who chose an agreement or disagreement option. While it is evident from the graph that the category with the most responses is agreement with the claim that dairy milk has a high calorie content, the spread between all four categories is less

Figure 21. Comparing responses for the claim "high calorie content" between dairy milk and PBDMAs, by frequency



than 100 responses indicating a high level of variance in respondents' opinions for this claim. Respondents were more likely to agree with this claim for dairy milk and more likely to disagree regarding PBDMAs indicating a discrepancy in health perceptions between the two beverages.

5.2.9 Promotes Heart Health

The next claim to be examined was "promotes heart health." There were 202 negative ranks, 345 positive ranks and 487 ties. The corresponding z-score calculated by SPSS was $z = -4.647$ and the significance was $p < 0.0005$. Thus, there was a statistically significant higher level of agreement with the statement "drinking dairy milk promotes heart health" than "drinking PBDMAs promotes heart health." Figure 22 illustrates the distribution of responses for this claim. The data for both beverages is skewed to the left indicating an overall level of agreement with the claim. When looking at the breakdown of agreement and disagreement in Figure 23, there is a very similar level of disagreement for both beverages, however there is a higher level of agreement with the claim for dairy milk than for PBDMAs. These results are somewhat surprising, as the Mintel study found that respondents were more likely to consume PBDMAs

Figure 22. Comparing responses for the claim "promotes heart health" between dairy milk and PBDMAs, by percentage of respondents

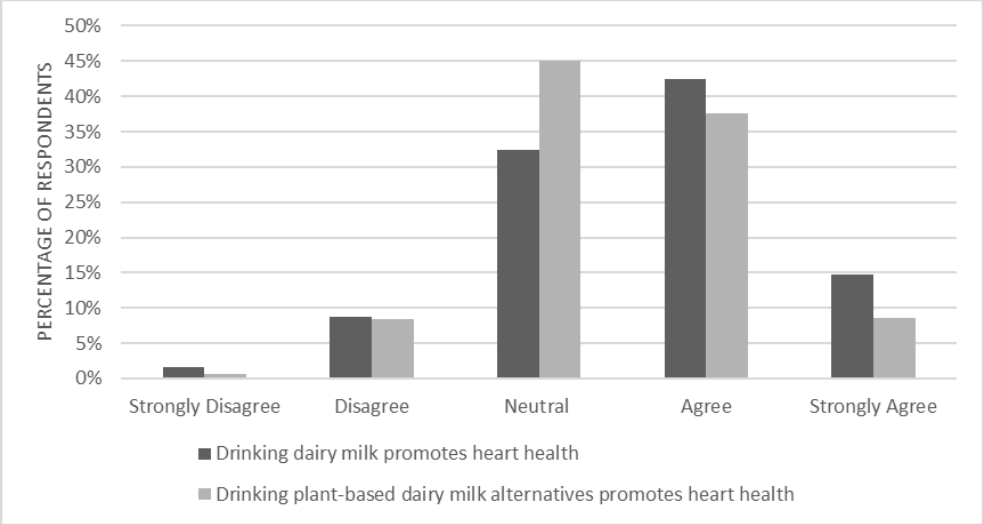
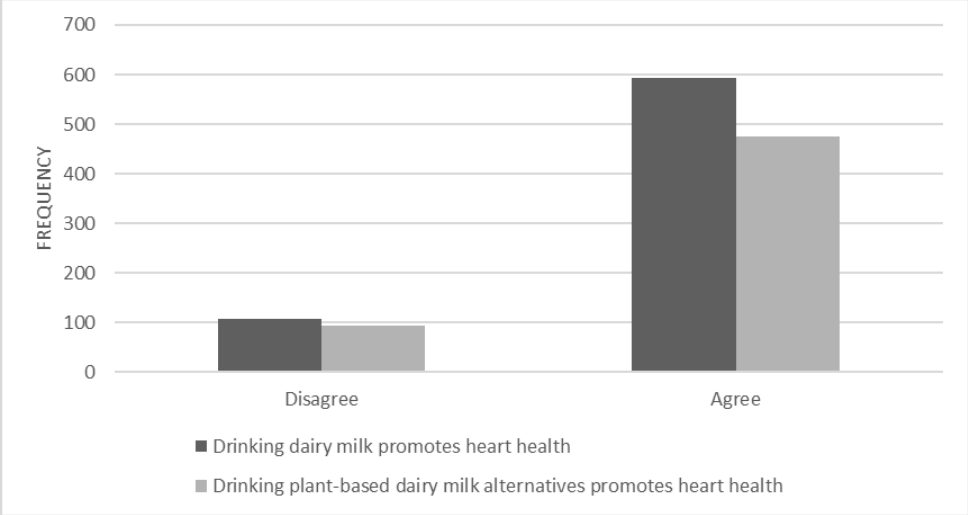


Figure 23. Comparing responses for the claim "promotes heart health" between dairy milk and PBDMAs, by frequency

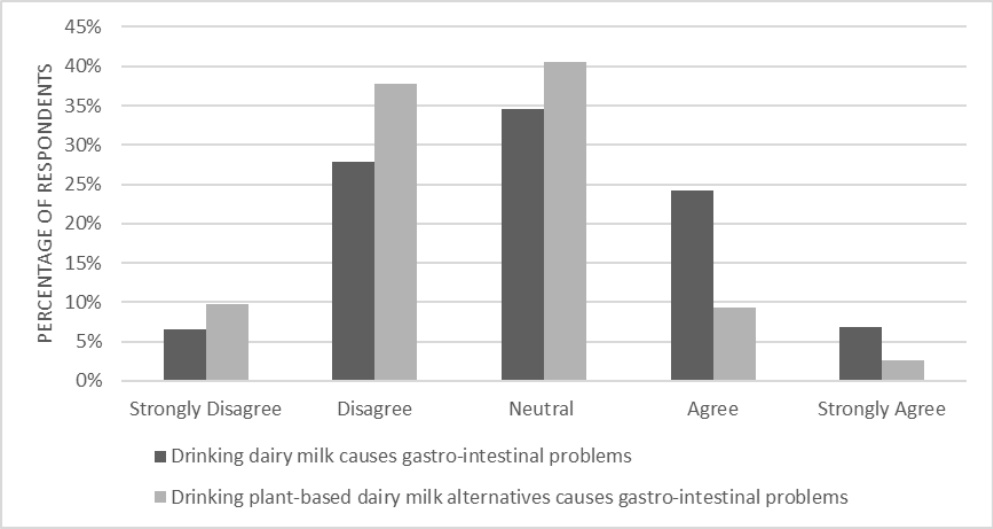


for heart health therefore, it was expected that there would be a higher level of agreement for this claim with PBDMAs. This may indicate an area where Canadian perceptions differ from that of Americans.

5.2.10 Causes Gastro-Intestinal Problems

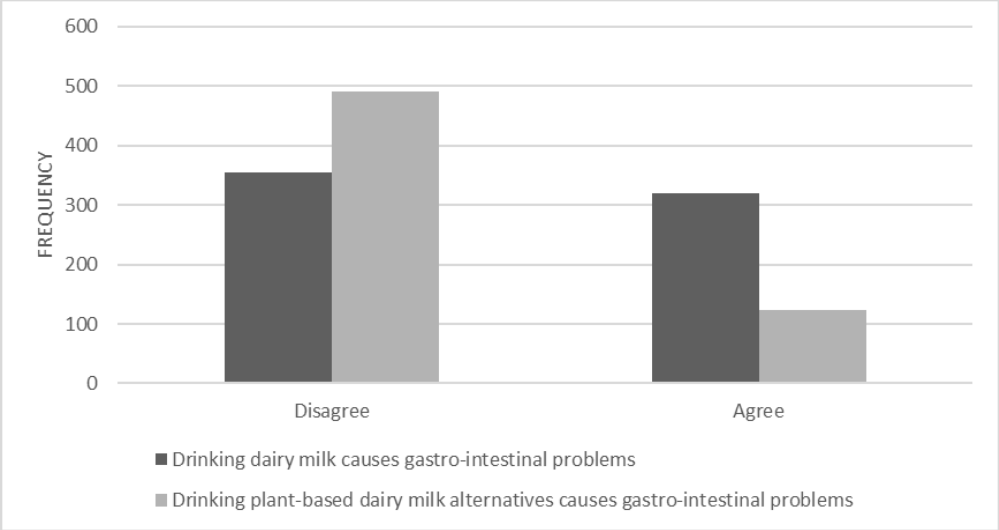
The next claim to be tested was "causes gastro-intestinal problems." There were 192 negative ranks, 391 positive ranks and 445 ties. The corresponding z-score calculated by SPSS (z = -10.268) and significance (p <0.0005) indicate that there was a statistically significant higher level of agreement with the statement "drinking dairy milk causes gastro-intestinal problems" than "drinking PBDMAs causes gastro-intestinal problems." This is in line with the literature, as consumers have expressed concerns about the gastro-intestinal effects of consuming dairy products. Figure 24 depicts the distribution of responses for this claim. The data does appear to

Figure 24. Comparing responses for the claim "causes gastro-intestinal problems" between dairy milk and PBDMAs, by percentage of respondents



be slightly skewed to the right, indicating a higher level of disagreement than agreement for this claim with both beverage types. By looking at the breakdown of agreement and disagreement in Figure 25, this can be further validated. The graph shows a higher level of disagreement for both beverages. However, the proportion of disagree to agree responses is much larger for PBDMAs than dairy milk indicating that overall respondents were more likely to associate gastro-intestinal problems with the consumption of dairy milk rather than PBDMAs.

Figure 25. Comparing responses for the claim "causes gastro-intestinal problems" between dairy milk and PBDMAs, by frequency



5.2.11 Aids in Developing Strong Bones

The eleventh claim tested was "aids in developing strong bones." Referring to Table 18, there were 76 respondents that had negative ranks, 679 had positive ranks and 278 had ties. The fourth and fifth columns show the corresponding z-score calculated by SPSS (z = -20.314) and significance ($p < 0.0005$). These results indicate that there was a statistically significant higher level of agreement with the statement "drinking dairy milk aids in developing strong bones" than "drinking PBDMAs aids in developing strong bones." The distribution of responses for this claim can be seen in Figure 26. The data appears to be more so skewed to the left for dairy milk than for PBDMAs, indicating a higher level of agreement for this claim with dairy milk. By aggregating the results into either the agree or disagree category in Figure 27, the difference in level of agreement becomes even more clear. This graph is almost identical to Figure 7 which illustrated responses to the claim "good source of calcium." The literature has shown that consumers are aware of the link between calcium intake and bone development therefore it was expected that the distribution of responses would be very similar for the two claims.

Figure 26. Comparing responses for the claim "aids in developing strong bones" between dairy milk and PBDMAs, by percentage of respondents

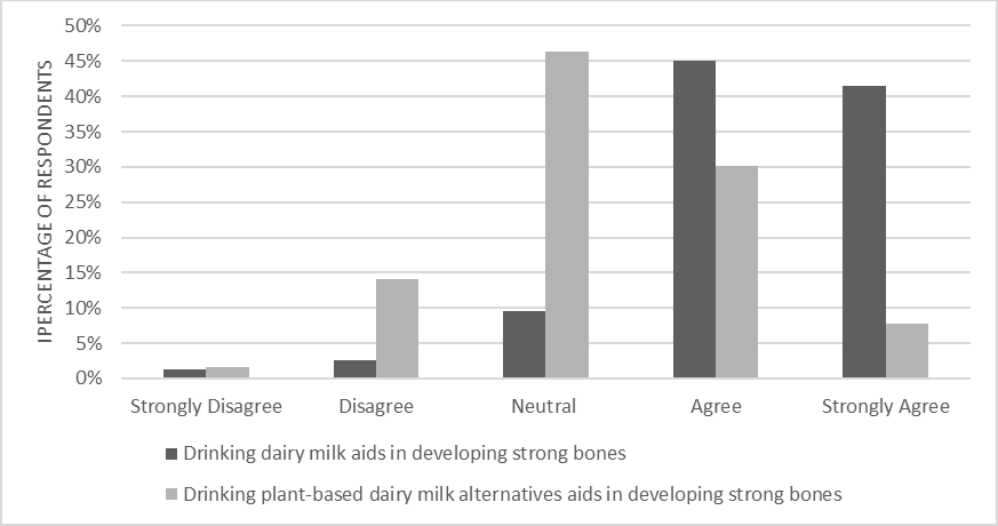
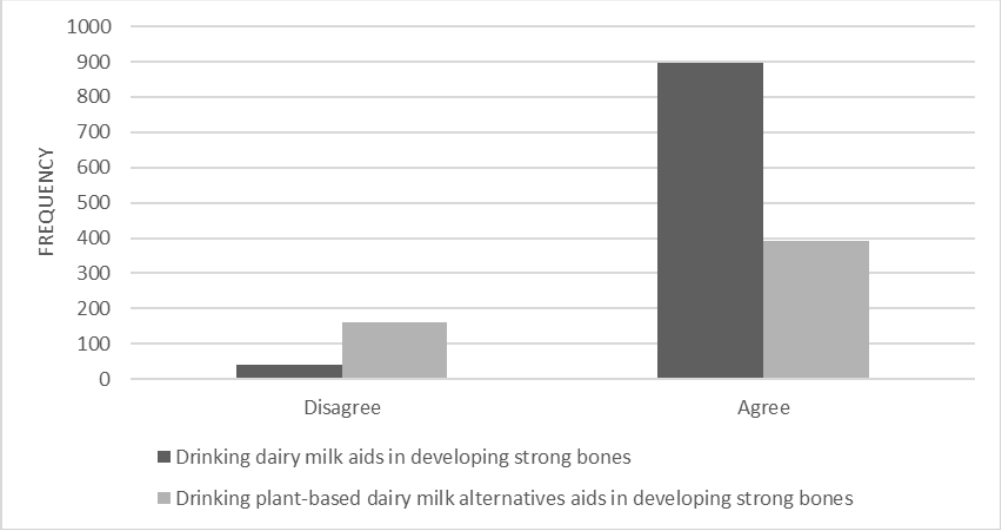


Figure 27. Comparing responses for the claim "aids in developing strong bones" between dairy milk and PBDMAs, by frequency

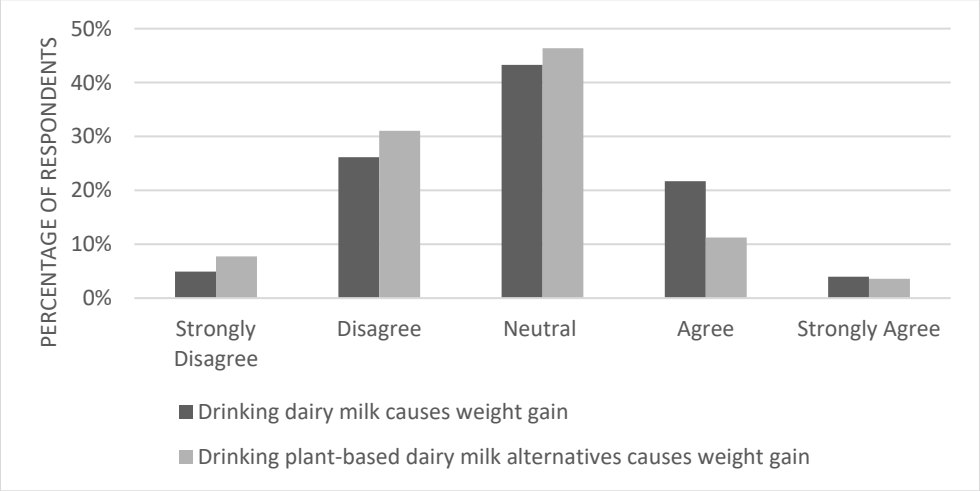


5.2.12 Causes Weight Gain

There were 198 negative ranks, 332 positive ranks and 498 ties for the twelfth claim "causes weight gain." The corresponding z-score calculated by SPSS (z = -6.307) and significance ($p <$ 0.0005) indicate that there was a statistically significant higher level of agreement with the statement "drinking dairy milk causes weight gain" than "drinking PBDMAs causes weight

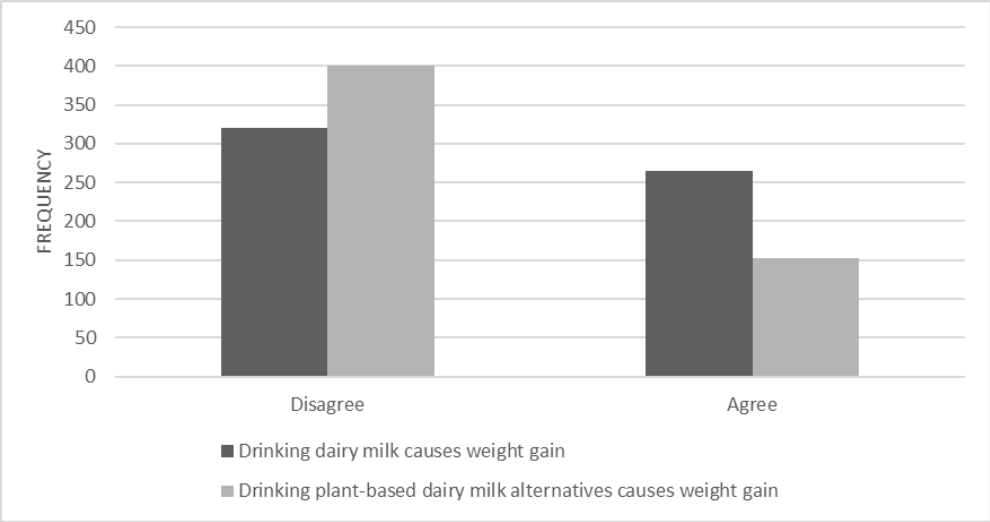
gain." This conclusion seems intuitive based on above results which determined that respondents were more concerned with the fat content in dairy milk than in PBDMAs and were more likely to agree that PBDMAs helped with weight loss efforts. Figure 28 shows the distribution of responses for this claim. For both beverages, the data appears to be slightly skewed to the right,

Figure 28. Comparing responses for the claim "causes weight gain" between dairy milk and PBDMAs, by percentage of respondents



indicating that respondents tended to disagree with this claim. Further confirmation of this can be seen in Figure 29 which reports the aggregated results of respondents who chose either an

Figure 29. Comparing responses for the claim "causes weight gain" between dairy milk and PBDMAs, by frequency

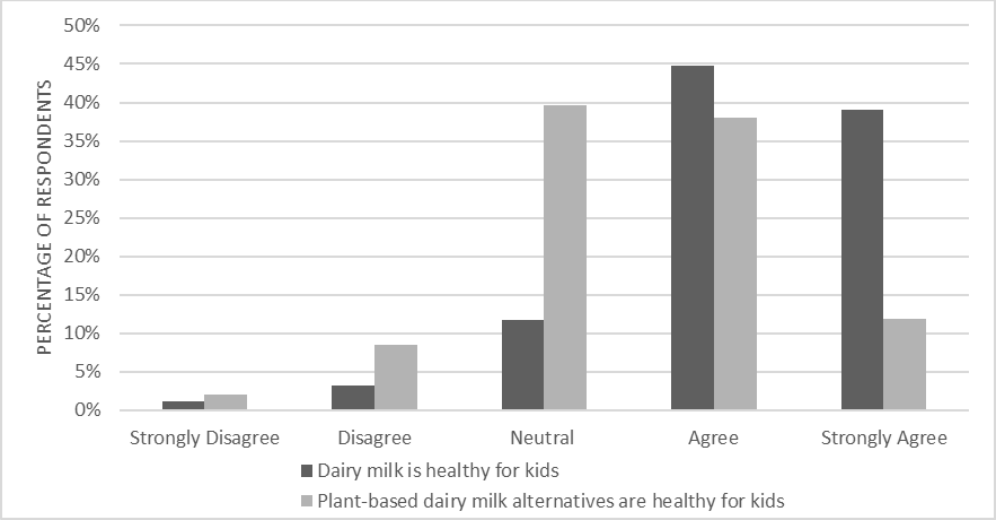


agreement or disagreement position. Figure 29 confirms that more respondents disagreed (than agreed) with the claim "causes weight gain" for both dairy milk and PBDMAs. However, when comparing responses for the two beverage types, there is a higher proportion of respondents who disagreed for PBDMAs than for dairy milk.

5.2.13 Healthy for Kids

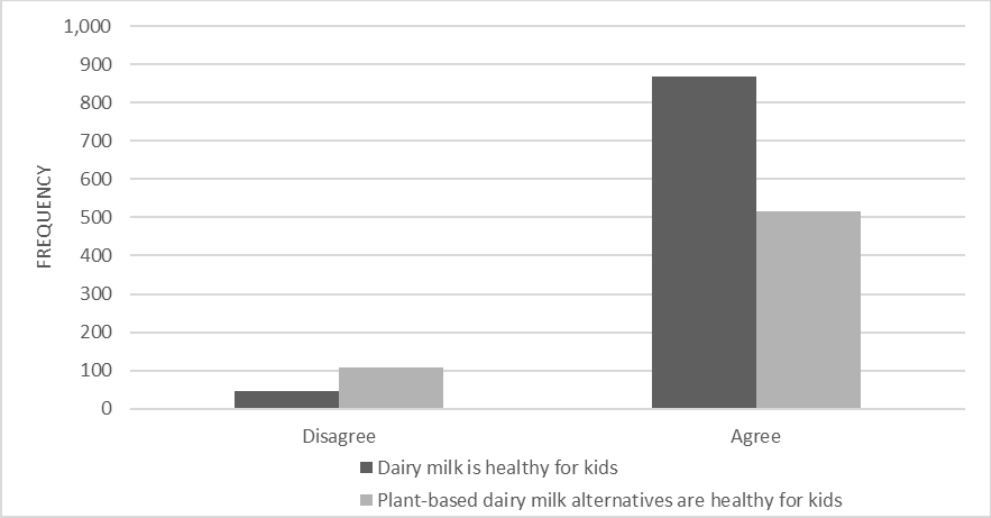
The next claim to be tested was "healthy for kids" Referring to Table 18, there were 119 negative ranks, 573 positive ranks and 341 ties. The fourth and fifth columns show the corresponding z-score calculated by SPSS (z = -16.003) and significance ($p < 0.0005$). Thus, there was a statistically significant higher level of agreement with the statement "dairy milk is healthy for kids" than "PBDMAs are healthy for kids." Figure 30 illustrates the distribution of responses for this claim. Responses for both beverages appear to be skewed to the left indicating an overall

Figure 30. Comparing responses for the claim "healthy for kids" between dairy milk and PBDMAs, by percentage of respondents



level of agreement with the claim. However, the agree and strongly agree columns are both greater for dairy milk than for PBDMAs. Figure 31 includes only the data for respondents who

Figure 31. Comparing responses for the claim "healthy for kids" between dairy milk and PBDMAs, by frequency



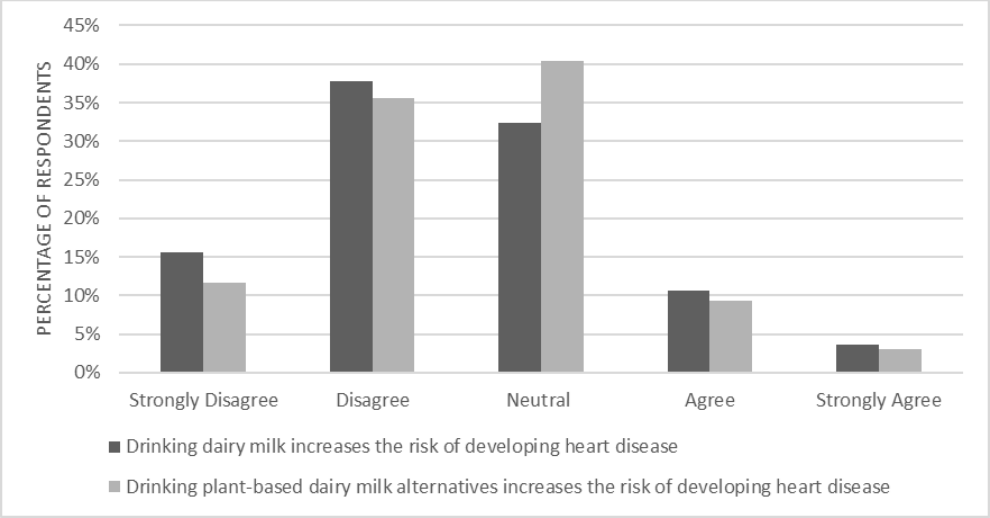
chose an agreement or disagreement position for this claim. While both beverages have low levels of disagreement for this claim, an additional 354 respondents agreed with this claim for dairy milk than for PBDMAs. Interestingly, Mintel research found that 69% of American consumers agreed PBDMAs were healthy for kids while 62% agreed that dairy milk was healthy for kids (Mintel 2016). In comparison, this research found that 49.85% agreed that PBDMAs were healthy for kids while 83.88% agreed that dairy milk was healthy for kids. These findings highlight another potential discrepancy in perceptions of Canadians and Americans.

5.2.14 Increases the Risk of Developing Heart Disease

The results from the Wilcoxon signed-rank test for the claim "increases the risk of developing heart disease" indicate that there were 298 negative ranks, 231 positive ranks and 503 with ties. The corresponding z-score calculated by SPSS (z = -2.696) and significance (p = 0.007) indicate a statistically significant higher level of agreement with the claim "drinking PBDMAs increases the risk of developing heart disease" than "drinking dairy milk increases the risk of developing

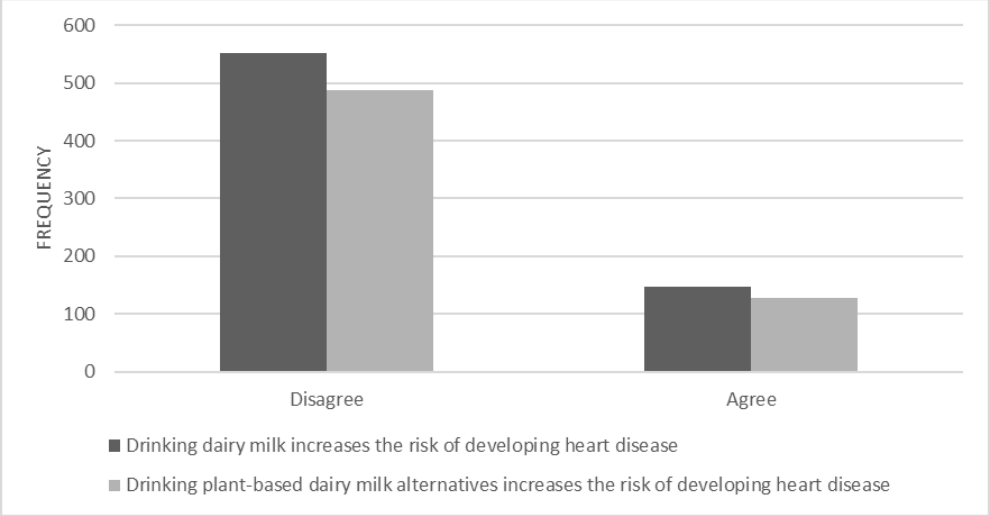
heart disease." Figure 32 shows the distribution of responses for this claim. Responses for both beverages appear to be skewed to the right, indicating overall disagreement with this claim.

Figure 32. Comparing responses for the claim "increases the risk of developing heart disease" between dairy milk and PBDMAs, by percentage of respondents



However, the data for dairy milk appears more skewed than for PBDMAs. This is further evidenced in Figure 33 which only considers respondents who chose an agreement or

Figure 33. Comparing responses for the claim "increases the risk of developing heart disease" between dairy milk and PBDMAs, by frequency

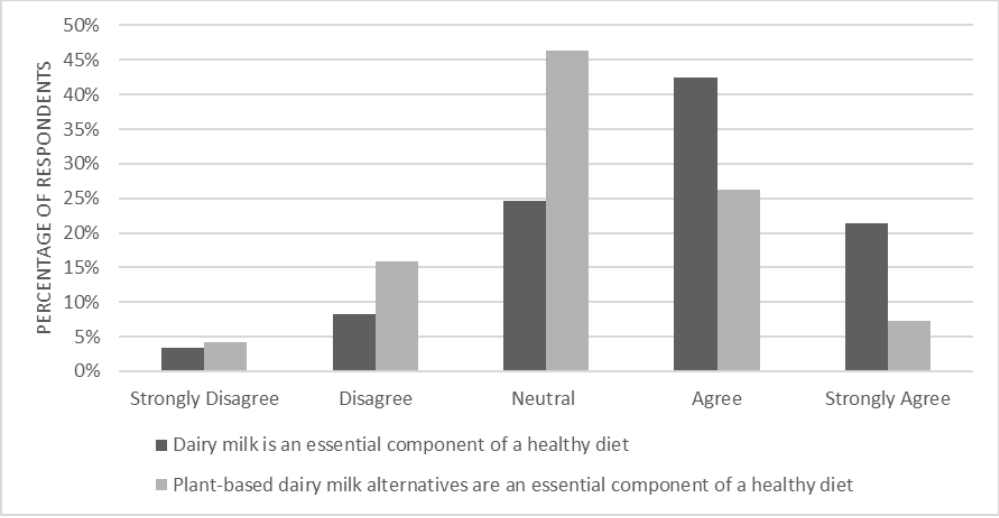


disagreement position. This graph shows that there were slightly more respondents who agreed with this claim for dairy milk than for PBDMAs, which appears to conflict with the findings from the Wilcoxon signed-rank test. However, an alternative approach is to look at the disagreement columns; there are more respondents who disagreed with the claim for dairy milk than for PBDMAs.

5.2.15 Essential Component of a Healthy Diet

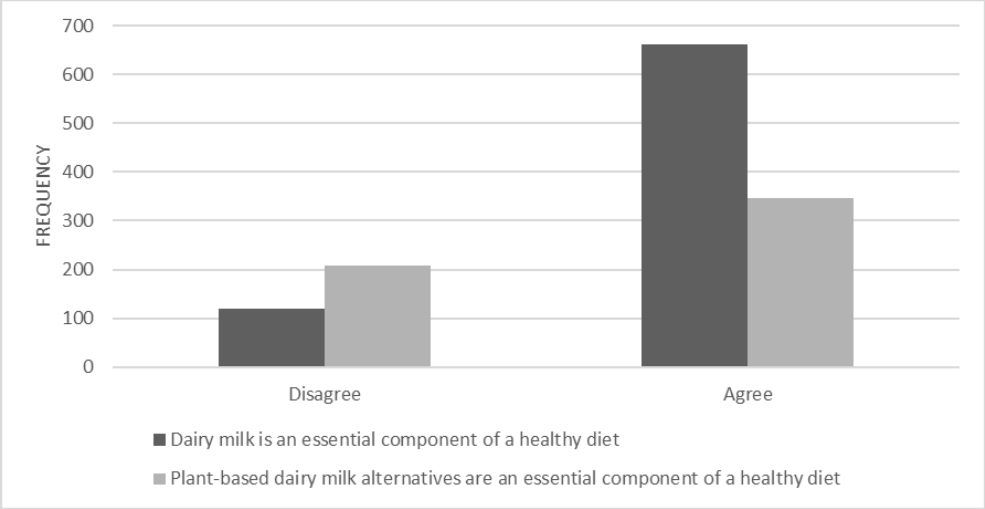
The next claim to be tested was "essential component of a healthy diet." There were 164 negative ranks, 510 positive ranks and 359 ties. The corresponding z-score calculated by SPSS (z = -12.908) and significance ($p < 0.0005$) indicate a statistically significant higher level of agreement with the statement "dairy milk is an essential component of a healthy diet" than with "PBDMAs are an essential component of a healthy diet." Figure 34 illustrates the distribution of responses for this claim. The data appears to be skewed to the left, indicating a higher level of agreement with this claim (more so for dairy milk than PBDMAs). The aggregation of agreement and disagreement positions illustrated in Figure 35 further confirms this distribution. While

Figure 34. Comparing responses for the claim "essential component of a health diet" between dairy milk and PBDMAs, by percentage of respondents



respondents were more likely to agree (than disagree) with this claim for both beverage types, almost twice as many respondents agreed for dairy milk than for PBDMAs.

Figure 35. Comparing responses for the claim "essential component of a healthy diet" between dairy milk and PBDMAs, by frequency



5.2.16 Causes allergic reactions

The final claim to be tested was "causes allergic reactions." The results can be found in the last row of Table 18 and indicate that 266 respondents had negative ranks, 258 had positive ranks and 509 had ties. The fourth and fifth columns show the corresponding z-score calculated by SPSS (z = -0.219) and significance (p = 0.827). These results indicated that the median of differences for this claim was not statistically different than zero, that is to say there was not a statistically significant difference in perception scores between dairy milk and PBDMAs for this claim. Figure 36 illustrates the distribution of responses for this claim. The data is slightly skewed to the right, indicating a higher level of disagreement with this claim. Further evidence of this can be seen in Figure 37 which only considers respondents who chose either an agreement or disagreement position for this claim. Overall, respondents were more likely to disagree with this claim for both dairy milk and PBDMAs. The result from the Wilcoxon signed-rank test is

Figure 36. Comparing responses for the claim "causes allergic reactions" between dairy milk and PBDMAs, by percentage of respondents

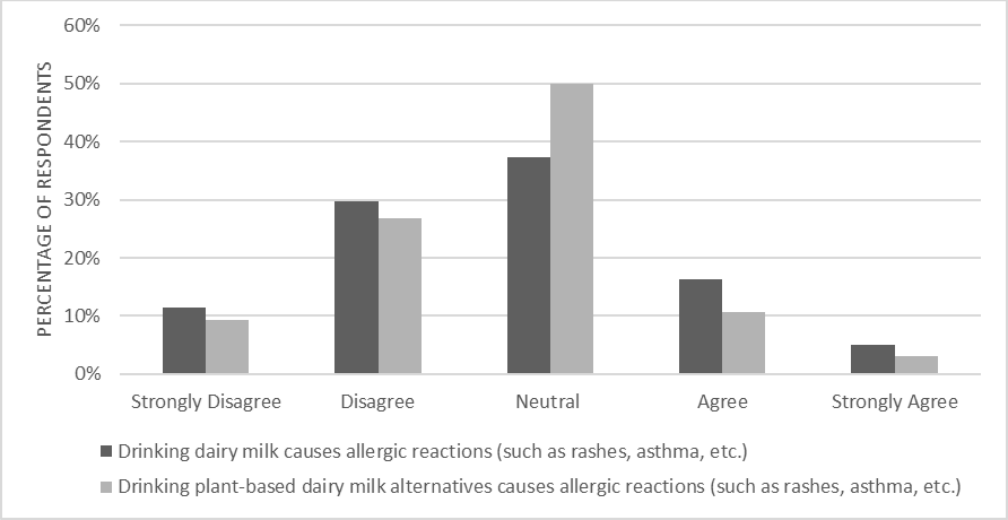
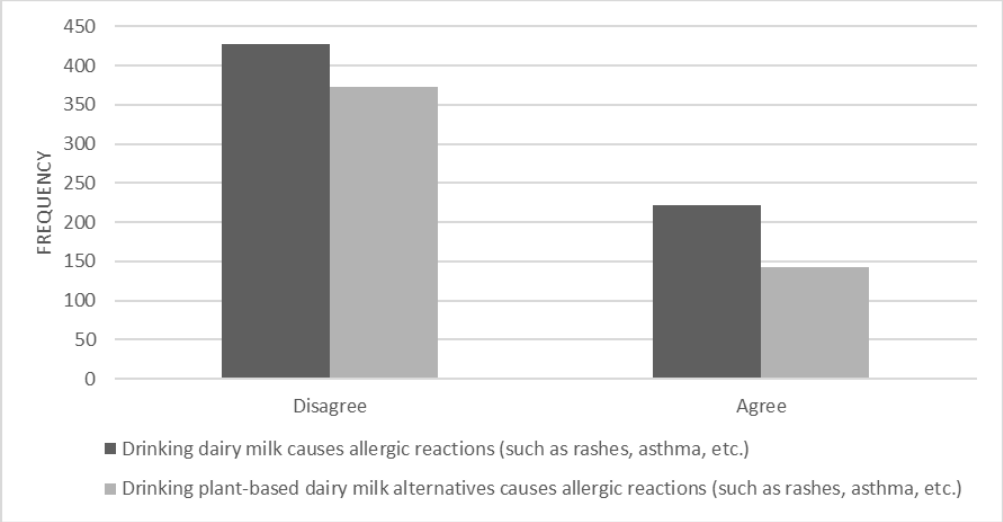


Figure 37. Comparing responses for the claim "causes allergic reactions" between dairy milk and PBDMAs, by frequency



somewhat unexpected as it was hypothesized that there would be a higher level of agreement for dairy milk for this claim, as there was a higher prevalence of reported concerns regarding allergic reactions in the literature for dairy milk.

5.2.17 Summary of Findings from the Wilcoxon Signed-Rank Test

Table 19 summarizes the claims that were associated with each beverage type according to the Wilcoxon signed-rank test. As can be seen in Table 19, more health claims were found to be associated with dairy milk than PBDMAs; there were 12 claims more likely to be associated with

Table 19. Summary of health/nutrition claims associated with each beverage

Dairy milk	**PBDMAs**
Good source of calcium	High sugar content
Good source of protein	Helps with weight loss efforts
High levels of fat	Increases the risk of developing heart disease
Naturally sourced product	
High levels of cholesterol	
High calorie content	
Promotes heart health	
Causes gastro-intestinal problems	
Aids in developing strong bones	
Causes weight gain	
Healthy for kids	
Essential component of a healthy diet	

dairy milk and three more likely to be associated with PBDMAs. This result was congruent with expectations, for two reasons: first, most claims chosen to be included in the survey came from a literature review that focused much more on claims associated with dairy milk than PBDMAs, and secondly, dairy milk is a much more familiar product for most consumers and therefore respondents were more likely to be aware of the nutritional value or more confident in their opinion of the nutritional value of this product compared to a newer category of products, such as PBDMAs. Nonetheless, conclusions can still be drawn from these findings.

Overall, it can be concluded that respondents had a positive image of dairy milk as they were more likely to agree that it was an essential component of a healthy diet and healthy for kids than PBDMAs. They also recognized the nutritional value of dairy milk as suggested by the fact that they were more likely to agree that it was a good source of calcium and protein than

PBDMAs. However, in accordance with findings from past research, respondents did express concerns with the fat content in dairy milk and were more likely to agree that PBDMAs helped with weight loss efforts. For most claims, when looking at whether respondents were more likely to agree or disagree, the position with the most responses was the same for dairy milk and PBDMAs. However, for four of the claims, where respondents were more likely to agree with the claim for one beverage, they were more likely to disagree for the other beverage indicating a significant discrepancy in perceptions between the two beverages. These claims include "high sugar content" (Figure 11), "high levels of fat" (Figure 15), "helps with weight loss" (Figure 21) and "high calorie content" (Figure 23). While respondents were more likely to disagree with the statements "dairy milk has a high sugar content" and "drinking dairy milk helps with weight loss efforts", they were more likely to agree with the statements' plant-based dairy milk alternative counterpart. Respondents were more likely to disagree with the claims "PBDMAs have high levels of fat" and "PBDMAs have a high calorie content" while more likely to agree with the statements' dairy milk counterpart. This provides further evidence that respondents' concern regarding dairy milk consumption's role on weight control issues are not similarly present when considering PBDMAs consumption.

5.3 Importance Scores

Respondents were asked to rank four different factors (availability/convenience, nutrition, price and taste) in terms of their importance in their milk purchasing decisions. Importance scores were calculated from these rankings; Table 20 shows the rankings for the total sample. Taste was ranked as the most important factor in terms of milk purchasing decisions (score =2.76), followed closely by nutrition (2.74), then price (2.50) and lastly, availability (2.00).

Table 20. Importance score rankings

Demographic category		Factors	Weighted avg. score	Rank
Total sample	N=1,036	Taste	2.76	1
		Nutrition	2.74	2
		Price	2.50	3
		Availability	2.00	4

Table 21 shows the comparison of rankings when considering different demographic groupings. Out of the 38 demographic groupings compared, half of them had the same ranking order as the total sample. Of the 19 that did not have the same ranking as the total sample, 16 of them ranked nutrition as the most important factor, followed by taste, price and availability (these rankings are shaded in light grey). The three remaining ranking orders are shaded in dark grey.

While females chose the same ranking as the total sample, males ranked nutrition as the most important factor. Two age groups also ranked nutrition as the most important factor (25-34 and 65 and older), while all the other age groups ranked taste as the most important factor. Those with children under 18 ranked nutrition first, perhaps indicating that they are prioritizing their children's health in their milk choices, while those without children under 18 ranked taste as the most important factor. All the provinces ranked taste as the most important factor, except for Quebec which ranked nutrition first. Caucasians ranked taste first, while non-Caucasians ranked nutrition first. As for educational attainment, only those with a high school education or less followed the same ranking as the total sample. Most of the other groups (some postsecondary, Bachelor's degree, Master's degree or Ph.D.) ranked nutrition first. However, those who had a certificate or diploma ranked taste first, followed by price, nutrition and availability. In terms of income, most income groups followed the same ranking as the total sample. However, the under $25,000 category ranked price first, followed by taste, nutrition and availability. This was the

Table 21. Comparative importance score rankings by demographic groups

Demographic Category		Weighted Average Ranking Scores Ranking			
		Availability	Nutrition	Price	Taste
Gender	Male (N=424)	2.05 4	2.71 2	2.55 3	2.69 1
	Female (N=607)	1.96 4	2.76 1	2.47 3	2.81 2
Age	18-24 (N=82)	2.27 4	2.61 2	2.49 3	2.63 1
	25-34 (N=264)	1.98 4	2.79 1	2.58 3	2.65 2
	35-44 (N=232)	2.00 4	2.69 2	2.53 3	2.78 1
	45-54 (N=190)	2.05 4	2.61 2	2.51 3	2.84 1
	55-64 (N=159)	1.90 4	2.86 2	2.35 3	2.89 1
	65 and older (N=104)	1.88 4	2.90 1	2.39 3	2.82 2
Children under 18	Yes (N=330)	1.94 4	2.91 1	2.39 3	2.76 2
	No (N=697)	2.02 4	2.66 2	2.55 3	2.76 1
Province	Western (N=330)	1.98 4	2.78 2	2.39 3	2.86 1
	Ontario (N=454)	2.04 4	2.67 2	2.61 3	2.69 1
	Quebec (N=160)	2.01 4	2.85 1	2.44 3	2.70 2
	Maritimes (N=89)	1.87 4	2.79 2	2.48 3	2.87 1
Race	Caucasian (N=777)	1.95 4	2.67 2	2.52 3	2.85 1
	Non-Caucasian (N=231)	2.13 4	2.93 1	2.45 3	2.48 2
Schooling	High school or less (N=223)	2.06 4	2.70 2	2.52 3	2.72 1
	Some postsecondary (N=149)	2.09 4	2.68 1	2.57 3	2.66 2
	Certificate/Diploma (N=280)	1.91 4	2.52 3	2.63 2	2.94 1
	Bachelor’s degree (N=277)	1.94 4	2.97 1	2.36 3	2.74 2

Table 21. Comparative importance score rankings by demographic groups (cont'd)

Demographic Category		Weighted Average Ranking Scores Ranking			
		Availability	Nutrition	Price	Taste
Schooling (cont'd)	Master's or Ph.D. (N=99)	2.16 4	2.91 1	2.34 3	2.59 2
Income	Under $25,000 (N=131)	2.26 4	2.47 3	2.78 1	2.50 2
	$25,000-$49,999 (N=225)	2.05 4	2.73 2	2.46 3	2.76 1
	$50,000-$74,999 (N=219)	1.88 4	2.88 1	2.49 3	2.75 2
	$75,000-$99,999 (N=174)	1.94 4	2.70 2	2.57 3	2.79 1
	$100,000-$124,999 (N=103)	2.05 4	2.74 1	2.55 3	2.66 2
	$125,000-$149,999 (N=44)	2.14 4	2.57 2	2.23 3	3.07 1
	$150,000 and over (N=61)	1.90 4	2.97 2	2.11 3	3.02 1
Uses supplements	Yes (N=578)	1.96 4	2.86 1	2.46 3	2.71 2
	No (N=456)	2.04 4	2.59 2	2.55 3	2.82 1
Regular exercise	Yes (N=622)	1.94 4	2.91 1	2.44 3	2.71 2
	No (N=412)	2.09 4	2.48 3	2.58 2	2.84 1
Consume dairy milk	Yes (N=937)	1.98 4	2.74 2	2.51 3	2.77 1
	No (N=99)	2.15 4	2.76 1	2.39 3	2.70 2
Consume PBDMA	Yes (N=508)	2.06 4	2.81 1	2.46 3	2.66 2
	No (N=528)	1.94 4	2.67 2	2.53 3	2.66 2
WTP for ultrafiltered milk	Yes (N=699)	1.91 4	2.77 1	2.57 3	2.75 2
	No (N=333)	2.17 4	2.69 2	2.35 3	2.79 1

only group to rank price first, an indication of the group's price sensitivity. Two income groups ($50,000-$74,999 and $100-$124,999) ranked nutrition ahead of taste. The table also included comparisons of rankings based on lifestyle and consumption choices. In general, the group that

one would characterize as more health-conscious ranked nutrition ahead of taste; those who regularly exercised and used supplements ranked nutrition first while those who did not take supplements followed the total sample ranking and those who did not exercise ranked nutrition third (behind taste and price). As for consumption choices, those who drank dairy milk followed the total sample ranking, while those who do not drink dairy milk ranked nutrition first. The opposite was true for PBDMAs; those who drink PBDMAs ranked nutrition as their most important consideration, while those who do not drink PBDMAs followed the total sample ranking. Finally, those who indicated they would be willing to purchase ultrafiltered milk ranked nutrition as their most important factor while those who would not consider purchasing the ultrafiltered milk followed the total sample ranking. These results should be of interest to the dairy industry as they may provide guidance on how to strategically target different demographic groups based on their rankings of the factors involved in milk purchasing decisions.

5.4 Binary Logistic Regression Results

5.4.1 Binary Logistic Regression Results for Dairy Milk Consumption

The first model looked at the variables that influenced respondents' decision to consume dairy milk. The results of the regression analysis can be found in Table 22. The model was found to be statistically significant, $\chi^2(19) = 113.662$, $p < 0.0005$. The model explained 25.2% of the variation in respondents' decision to consume dairy milk and correctly predicted 90.4% of the cases (identical to the baseline model). The result from the Hosmer and Lemeshow goodness of fit test ($p = 0.356$) indicated the model fit the data well. Including the intercept, there were seven statistically significant variables in this model at the five percent level.

The odds ratios can be used to provide additional context for the significant variables. The use of nutritional supplements and regular exercise both had a positive and statistically

Table 22. Binary logistic regression results for dairy milk

	B (SE)	Odds Ratio	95% CI for Odds Ratio	
			Lower	Upper
Intercept	-4.007*** (0.972)	0.18		
Nutritional supplements	0.623** (0.260)	1.865	1.121	3.102
Regular exercise	0.551** (0.261)	1.735	1.039	2.895
Gender	-1.017*** (0.284)	0.362	0.207	0.632
Age	-0.026*** (0.010)	0.974	0.956	0.993
Children under 18	0.229 (0.289)	1.257	0.714	2.216
Ontario	0.172 (0.285)	1.188	0.679	2.078
Quebec	0.279 (0.396)	1.321	0.609	2.869
Maritimes	0.207 (0.509)	1.230	0.454	3.333
Non-Caucasian	0.812** (0.391)	2.253	1.047	4.847
Some postsecondary	0.489 (0.459)	1.630	0.663	4.009
Certificate or diploma	0.099 (0.352)	1.104	0.554	2.203
Bachelor's degree	0.009 (0.377)	1.009	0.482	2.111
Master's degree or Ph.D.	-0.933* (0.481)	0.393	0.153	1.009
$25,000-$49,999	0.038 (0.401)	1.039	0.473	2.279
$50,000-$74,999	0.229 (0.431)	1.257	0.540	2.925
$75,000-$99,999	-0.144 (0.436)	0.866	0.369	2.034
$100,000-$124,999	0.420 (0.544)	1.522	0.524	4.418
$125,000 and over	0.419 (0.539)	1.521	0.529	4.371
Score for dairy milk	0.132*** (0.017)	1.141	1.105	1.179

******* indicates significance at α=0.01, ** indicates significance at α=0.05, * indicates significance at α=0.10

significant coefficient. The odds ratio for nutritional supplements was 1.865, indicating that those who used nutritional supplements were 1.865 times more likely to consume dairy milk than those who did not use nutritional supplements. Similarly, the odds that a respondent who exercised regularly drank dairy milk were 1.735 times higher than a respondent who did not exercise regularly. Gender and age both had negative, statistically significant coefficients. To interpret the gender odds ratio, it is easier to invert the odds ratio (1/0.362). Thus, a decrease in the gender variable (i.e. being male) led to a 2.76 increase in the odds that a respondent drank dairy milk. A one-unit increase in age resulted in a 2.6% decrease in the odds that the respondent drank dairy milk. The odds that a respondent who was not Caucasian drank dairy milk were 2.253 times higher than for a Caucasian respondent. Finally, respondents' scores for the health perception of dairy milk had a positive and statistically significant coefficient; a one-unit increase in the score resulted in a 1.141 increase in the odds that the respondent drank dairy milk. Cronbach's alpha was computed in SPSS to determine the reliability of the scale to measure dairy milk health perceptions; the resulting value of 0.856 indicated a high level of internal consistency.

5.4.1.1 Testing for Linearity

To test for linearity, interaction terms were included in the binary logistic regression model for each continuous variable. The two continuous variables in the model were age and health perception score, therefore the first interaction term was between age and the log of age while the second interaction term was dairy health perception score and the log of the score. A Bonferroni correction was applied (Tabachnick and Fidell 2014) and the resulting level of acceptable statistical significance was $p < 0.00227$. The binary logistic regression model was ran

with the two new interaction terms and since neither interaction term had a statistically significant result, it was determined that the assumption of linearity of the logit had been met.

5.4.1.2. Testing for Multicollinearity

Table 23 shows the output from the collinearity diagnosis testing in SPSS. Since the tolerance values were all quite high (much higher than the 0.2 value of concern) and the VIF values were all near 1, it was concluded that multicollinearity did not present an issue in this model.

Table 23. Collinearity diagnosis output for dairy milk

Variable	Tolerance	VIF
Nutritional supplements	0.958	1.044
Regular exercise	0.943	1.061
Gender	0.954	1.048
Age (in years)	0.812	1.232
Children under 18	0.917	1.091
Provinces	0.958	1.044
Race	0.859	1.164
Schooling	0.818	1.222
Income	0.827	1.210
Health score for dairy milk	0.913	1.096

5.4.1.3 Testing for Outliers and Influencers

As outlined in section 4.2.4 of the procedures for statistical analysis, no more than 5% of the standardized residuals should fall outside of ±1.96, no more than 1% should fall outside of ±2.58 and any value above 3 should be further investigated. In this dataset, there were 35 standardized residuals outside of the ±1.96 range which equated to 3.88% of the sample and two standardized residuals outside of the ±2.58 range which equated to 0.22% of the sample. One value was above ±3 but after investigation of the specific case entry there was no obvious reason to exclude the data point. In terms of influencers, the values for Cook's distance were all below 1, with the highest value being 0.40218. Therefore, it was concluded that there were no significant influencers in the dataset.

5.4.2 Binary Logistic Regression Results for PBDMAs Consumption

The results from the regression analysis for the decision to consume PBDMAs are presented in Table 24. The model was found to be statistically significant, $\chi^2(19) = 258.359$, $p < 0.0005$. The model explained 33.1% of the variance in respondents' decision to consume PBDMAs and correctly predicted 72.4% of the cases (an increase of 21.7% from the baseline model). The result from the Hosmer and Lemeshow goodness of fit test was not significant ($p = 0.562$) indicating that the model fit the data well. Including the intercept, there were eight statistically significant variables in this model at the five percent level. Respondents who used nutritional supplements, as well as respondents who exercised regularly both had positive, statistically significant coefficients. Looking at the odds ratio, those who used nutritional supplements were 2.039 times more likely to drink PBDMAs than those who didn't use nutritional supplements. Likewise, the odds that respondents who indicated that they exercised regularly drank PBDMAs were 2.065 times higher than for those who did not exercise regularly. Age had a negative statistically significant coefficient; a one-unit increase in age resulted in a 3.9% decrease in the odds that the respondent drank PBDMAs. Being non-Caucasian had a positive, statistically significant coefficient; respondents who were not Caucasian were 1.868 times more likely to drink PBDMAs than Caucasian respondents. Two categories of schooling also had positive, statistically significant coefficients. Respondents who had a certificate or diploma were 1.845 times more likely to drink plant-based dairy milk alternatives than those who did not, while those who had a Bachelor's degree were 2.035 times more likely to drink PBDMAs. Finally, respondents' scores for the health perception of PBDMAs had a positive and statistically significant coefficient; a one-unit increase in the score resulted in a 1.087 increase in the odds that the respondent drinks PBDMAs. Cronbach's alpha was computed in SPSS to determine

Table 24. Binary logistic regression results for PBDMAs

	B (SE)	Odds Ratio	95% CI for Odds Ratio	
			Lower	Upper
Intercept	-4.381*** (0.713)	0.013		
Nutritional supplements	0.713*** (0.161)	2.039	1.489	2.794
Regular exercise	0.725*** (0.162)	2.065	1.503	2.839
Gender	0.298* (0.160)	1.347	0.985	1.844
Age	-0.040*** (0.006)	0.961	0.950	0.972
Children under 18	0.290* (0.168)	1.337	0.961	1.858
Ontario	-0.086 (0.181)	0.917	0.644	1.308
Quebec	-0.231 (0.244)	0.793	0.492	1.279
Maritimes	-0.591* (0.305)	0.554	0.305	1.006
Non-Caucasian	0.625*** (0.202)	1.868	1.258	2.776
Some postsecondary	0.478* (0.270)	1.612	0.949	2.738
Certificate or diploma	0.613*** (0.230)	1.845	1.176	2.896
Bachelor's degree	0.710*** (0.239)	2.035	1.274	3.249
Master's degree or Ph.D.	0.550* (0.331)	1.734	0.907	3.316
$25,000-$49,999	0.000 (0.270)	1.000	0.589	1.696
$50,000-$74,999	-0.269 (0.272)	0.764	0.448	1.303
$75,000-$99,999	0.174 (0.284)	1.190	0.682	2.076
$100,000-$124,999	0.625 (0.330)	1.304	0.683	2.489
$125,000 and over	0.287 (0.327)	1.332	0.702	2.529
Score for PBDMAs	0.084*** (0.012)	1.087	1.063	1.113

******* indicates significance at α=0.01, * indicates significance at α=0.10

the reliability of the scale to measure PBDMAs health perceptions. The resulting value of 0.820 indicated a high level of internal consistency.

5.4.2.1 Testing for Linearity

To test for linearity, interaction terms were included in the binary logistic regression model for each continuous variable. The two continuous variables in the model were age and health perception score, therefore the first interaction term was between age and the log of age while the second interaction term was between PBDMAs health score and the log of the score. A Bonferroni correction was applied and the resulting level of acceptable statistical significance was $p < 0.00227$. The binary logistic regression model was ran with the two new interaction terms and since neither interaction term had a statistically significant result, it was determined that the assumption of linearity of the logit had been met.

5.4.2.2. Testing for Multicollinearity

Table 25 shows the output from the collinearity diagnosis testing in SPSS. Since the tolerance values were all quite high and the VIF values were all near 1, it could be concluded that multicollinearity did not present an issue in this model.

Table 25. Collinearity diagnosis output for PBDMAs

Variable	Tolerance	VIF
Nutritional supplements	0.941	1.062
Regular exercise	0.930	1.076
Gender	0.956	1.046
Age (in years)	0.877	1.140
Children under 18	0.924	1.083
Provinces	0.963	1.038
Race	0.861	1.162
Schooling	0.823	1.216
Income	0.831	1.204
Health score for PBDMAs	0.958	1.044

5.4.2.3 Testing for Outliers and Influencers

In this dataset, there were 16 standardized residuals outside of the ±1.96 range which equated to 1.7% of the sample and 1 standardized residual outside of the ±2.58 range which equated to 0.1% of the sample. In this case, the values for Cook's distance were all well below 1, with the highest value being 0.16149. Therefore, it was concluded that there were no significant outliers or influencers in the dataset.

5.4.3 Binary Logistic Regression Results for Willingness to Purchase Ultrafiltered Milk

The output from the binary logistic regression model for respondents' willingness to purchase ultrafiltered milk is summarized in Table 26. The model was found to be statistically significant, $\chi^2(20) = 127.958$, $p < 0.0005$. The model explained 18.2% of the variance in respondents' willingness to purchase ultrafiltered milk and correctly predicted 72.7% of the cases (an increase of 4.8% from the baseline model). The result from the Hosmer and Lemeshow goodness of fit test was not significant ($p = 0.648$) indicating that the model fit the data well. There were six predictor variables that were statistically significant at the five percent level, half of them had positive effects on the logit of the outcome while the other half had negative effects. Once again, the use of nutritional supplements and regular exercise both had positive, statistically significant coefficients. The use of nutritional supplements led to an increase of 1.795 in the odds of indicating willingness-to-purchase ultrafiltered dairy milk over those who did not use nutritional supplements. Similarly, those who exercised regularly were 1.406 times more likely to indicate willingness-to-purchase ultrafiltered dairy milk over those who did not exercise regularly. Non-Caucasians were 1.553 times more likely than Caucasians to indicate willingness-to-purchase. The odds of indicating willingness-to-purchase for respondents with an income of $25,000 to $49,999 were decreased by 42.3%. As for consumption type, the odds of indicating willingness-

Table 26. Binary logistic regression results for willingness-to-purchase ultrafiltered dairy milk

	B (SE)	Odds Ratio	95% CI for Odds Ratio	
			Lower	Upper
Intercept	0.736* (0.418)			
Nutritional supplements	0.585*** (0.158)	1.795	1.315	2.448
Regular exercise	0.341** (0.159)	1.406	1.028	1.921
Gender	-0.125 (0.161)	0.883	0.644	1.209
Age	-0.003 (0.006)			
Children under 18	0.076 (0.175)	1.078	0.766	1.519
Ontario	0.216 (0.181)	1.241	0.871	1.768
Quebec	0.020 (0.233)	1.021	0.647	1.611
Maritimes	0.389 (0.299)	1.476	0.822	2.652
Non-Caucasian	0.440** (0.222)	1.553	1.005	2.400
Some postsecondary	-0.007 (0.252)	0.993	0.606	1.629
Certificate or diploma	0.188 (0.217)	1.207	0.788	1.846
Bachelor's degree	0.231 (0.235)	1.260	0.796	1.995
Master's degree or Ph.D.	0.287 (0.335)	1.333	0.691	2.570
$25,000-$49,999	-0.551** (0.254)	0.577	0.351	0.948
$50,000-$74,999	-0.001 (0.266)	0.999	0.593	1.683
$75,000-$99,999	-0.116 (0.280)	0.891	0.515	1.541
$100,000-$124,999	-0.029 (0.333)	0.972	0.506	1.866
$125,000 and over	0.159 (0.338)	1.173	0.604	2.275
Drink just dairy milk	-0.644*** (0.178)	0.525	0.370	0.745
Doesn't drink dairy milk	-1.825*** (0.272)	0.161	0.095	0.274

******* indicates significance at α=0.01, ** indicates significance at α=0.05, * indicates significance at α=0.10

to-purchase for respondents who drank dairy milk exclusively were decreased by 47.5%, while the odds for those who did not drink dairy milk at all were decreased by 83.9%. This indicates that the group with the most likely odds of purchasing ultrafiltered dairy milk are those who currently consume both dairy milk and PBDMAs. The results from this regression analysis could guide the dairy industry's targeting strategies for the promotion of ultrafiltered dairy milk should it become available in Canada.

5.4.3.1 Testing for Linearity

To test for linearity, interaction terms were included in the binary logistic regression model for each continuous variable. The only continuous variable in the model was age, therefore the sole interaction term was between age and the log of age. A Bonferroni correction was applied and the resulting level of acceptable statistical significance was $p < 0.00227$. The binary logistic regression model was ran with the new interaction term and since the interaction term did not have a statistically significant result, it was determined that the assumption of linearity of the logit had been met.

5.4.3.2. Testing for Multicollinearity

Table 27 shows the output from the collinearity diagnosis testing in SPSS. Since the tolerance

Table 27. Collinearity diagnosis output for ultrafiltered dairy milk

Variable	Tolerance	VIF
Nutritional supplements	0.934	1.070
Regular exercise	0.923	1.083
Gender	0.955	1.047
Age (in years)	0.863	1.159
Children under 18	0.916	1.092
Provinces	0.965	1.036
Race	0.842	1.187
Schooling	0.818	1.223
Income	0.826	1.211
Consumer type	0.870	1.150

values were all quite high and the VIF values were all near 1, it could be concluded that multicollinearity did not present an issue in this model.

5.4.3.3 Testing for Outliers and Influencers

There were 16 standardized residuals outside of the ±1.96 range which equated to 1.7% of the sample and no standardized residuals outside of the ±2.58 range. Looking at the residual statistics for influencers, the values for Cook's distance were all well below 1, with the highest value being 0.16797. Therefore, it could be concluded that there were no significant influencers in the dataset.

5.5 Survey Feedback

At the end of the survey, respondents were given the chance to provide feedback. Approximately 15% of respondents left comments that either related to the format of the survey or the research topic (please see Appendix B for a full list of the comments provided). Some used the additional comment space to provide justification for a particular answer given, while others used the space to elaborate on their personal opinions regarding dairy milk, PBDMAs, the dairy industry, etc.

The majority of the feedback regarding the format of the survey was positive; many commented that the survey was both quick to fill out and easy to understand. A few respondents left comments that they had difficulty answering the health claim perception questions for PBDMAs due to a lack of familiarity or knowledge about these products, or due to the fact that the beverage categories were too broad. This feedback was useful as it provided a starting point to guide future research-this will be further discussed in the following chapter.

The feedback regarding the survey topic, the health value of dairy milk and PBDMAs, was more divided. Strong opinions were expressed in favour of and against both dairy milk and

PBDMAs. However, many expressed their appreciation for the opportunity to share their opinion on the topic indicating that the topic was one of interest to the general population.

Finally, respondents commented on the topic of ultrafiltered dairy milk; they expressed excitement about the beverage's health benefits, offered suggestions to ensure the beverage's success in the marketplace or requested more information about the beverage. This was encouraging as it offered supplementary evidence of the market potential for ultrafiltered dairy milk in Canada beyond the quantitative results previously presented.

Chapter 6: Summary, Conclusions, Limitations and Suggestions for Future Research

The purpose of this study was to compare consumer perceptions of dairy milk and PBDMAs, as well as to determine which factors affected the decision to consume either dairy milk or PBDMAs. A secondary goal was to assess the market potential for a new type of dairy product, ultrafiltered dairy milk, in Canada. To accomplish this, an online survey was designed to collect data on a sample of respondents' level of agreement or disagreement with various health claims related to the consumption of both dairy milk and PBDMAs, as well as a series of questions assessing respondents' consumption habits.

6.1 Summary of Findings

Survey results indicated that 90.4% of respondents consumed dairy milk, while approximately half (49%) of respondents consumed PBDMAs. These results were similar to a comparative study of American consumers (Mintel 2016). Looking at the data from a different perspective revealed that 90% of those who consumed PBDMAs also consumed dairy milk thus providing evidence that the choice to consume PBDMAs is mostly based on preferences rather than necessity as the percentage of respondents who consumed both dairy milk and PBDMAs should've been quite low if the majority of those consuming PBDMAs were doing so out of necessity (i.e. due to milk protein allergies). The most popular variety of dairy milk was 2% milk (51.5%), while the most popular variety of PBDMAs was almond milk (56.7%). Dairy milk consumers drank dairy milk much more frequently on a weekly basis than PBDMAs consumers.

In terms of comparing consumer perceptions of the health claims for dairy milk and PBDMAs, significant differences in perception were found for 15 of the 16 claims. In general, respondents were more likely to agree with the claims for dairy milk than for PBDMAs which

could be attributed to the fact that dairy milk has been a staple product in diets for many years, while PBDMAs are a relatively new beverage category and thus it is reasonable to assume that consumers are not as familiar with these products in general. Respondents were more likely to agree that dairy milk, rather than PBDMAs, is a good source of calcium and protein, is naturally sourced, promotes heart health, aids in developing strong bones, is healthy for kids and is an essential component of a healthy diet. Thus, it does appear as though respondents held an overall favorable view of dairy milk and were aware of the nutritional benefits that dairy milk can provide. However, respondents were also more likely to agree that dairy milk has high levels of fat and cholesterol, a high calorie content and causes weight gain while agreeing more that PBDMAs help with weight loss efforts. This should be of interest to the dairy industry, as consumers who are concerned with weight control could be choosing PBDMAs over dairy milk based on these perceptions. One suggestion for the dairy industry, resulting from these findings, would be to promote the consumption of skim milk for weight control; the results from this study found that it was one of the least consumed varieties of dairy milk, yet it has the lowest levels of fat and calories among dairy milk varieties.

The binary logistic models revealed that the factors that influenced consumption decisions for dairy milk and PBDMAs were quite similar and included the use of nutritional supplements, regular exercise, age, race and health perceptions. Health perceptions were found to have a positive and statistically significant effect on the odds of consuming both beverages, suggesting it was worthwhile to study consumers' health perceptions as they do play a role in consumption choices. In addition, gender was found to influence the decision to consume dairy milk, with females less likely to consume dairy milk than males and certain levels of schooling (certificate/diploma and a bachelor's degree) influenced the decision to consume PBDMAs.

These results should be of interest to the dairy industry as they provide information on which factors may be worthwhile focusing on when developing strategies to increase dairy milk consumption.

Over two thirds of respondents (67.7%) stated that they would consider purchasing ultrafiltered dairy milk over their current milk selection, signaling that there is market interest for this type of product and providing evidence to support the suggestion by McCarthy et al (2017) that innovation in the lactose-free sector could aid in increasing dairy milk consumption. Of those who currently only consume PBDMAs, nearly 40% indicated that they would be willing to purchase ultrafiltered dairy milk, which indicates that this could be a market opportunity for the dairy industry to recapture a segment of plant-based dairy milk alternative consumers. The average premium respondents indicated they would be willing to pay for the ultrafiltered dairy milk was 15.47%. The feasibility of introducing ultrafiltered dairy milk in Canada would require further investigation as ultrafiltered dairy milk is currently sold in the US for double the price of regular milk.

6.2 Limitations and Suggestions for Future Research

While the sample of respondents did represent the Canadian population generally well, there were certain demographics that were not properly represented as detailed in section 4.3. For instance, the 65 years and plus age group was underrepresented which is most likely attributed to the choice of survey method. Recall that one of the limitations of the online survey, as discussed in the third chapter, is the coverage error which results from certain demographic groups, such as older age groups, being less likely to have access to the internet or having the technological know-how to sign up for an online panel and access and complete online surveys. Therefore, it was not surprising that the oldest age category was underrepresented in the survey. A suggestion

for future research would be to design a mixed-mode survey, meaning that respondents could choose the method by which they would like to fill out the survey, either by mail or online. This could lead to a more representative sampling. Another group that was underrepresented in the survey was Quebec residents. This could be due to the fact that the survey could only be distributed in English and therefore, respondents from Quebec were more likely than other provinces to decline answering due to a language barrier. Future studies should consider using a survey platform that would offer the survey in both official languages to obtain a more representative sample.

Most respondents left positive feedback at the end of the survey and many indicated that they found the questions clear and the survey format easy to understand and answer. However, a few respondents indicated that they had difficulty answering the Likert scale questions because the beverage categories being evaluated were too general; for instance, one respondent commented “the alternative milk questions are too broad […] because of the wide variety of alternative dairy products. For example, I have a fairly positive opinion of almond milk, but a scathing opinion regarding soy milk” (Appendix B). Future research should consider defining specific PBDMAs for comparison. As almond milk is the most popular plant-based dairy milk alternative, it would be the most sensible choice. Alternatively, an idea for future research would be to compare consumer perceptions of different types of PBDMAs exclusively.

Some respondents also indicated that they had difficulty answering the Likert scale questions for PBDMAs due to a lack of familiarity with the product. For instance, one respondent commented “I know very little about plant-based dairy alternatives, as I have never had any reason to try them. […] As a result, most of my answers about those products are based on "I really have no idea"” (Appendix B). While the exclusion of an “I don’t know” option was

done intentionally to motivate respondents to truly consider the statements in every question, a future study may consider designing a survey where half the respondents are presented with an "I don't know" option and half are presented with the standard five-point Likert scale. It would be interesting to see whether responses are affected by the inclusion of the "I don't know" option.

Many respondents left comments at the end of the survey regarding the ultrafiltered dairy milk and expressed excitement to try this new product. However, some respondents indicated that they did not know enough to make an informed decision as to whether they would purchase ultrafiltered dairy milk. Thus, to improve on the current study, future research should consider providing more information to the respondents regarding ultrafiltered dairy milk such as a breakdown of the nutritional content versus conventional dairy milk, a more detailed overview of the manufacturing process and/or external links for additional resources. Additionally, while this study did find that consumers were interested in ultrafiltered dairy milk and were willing to pay a premium for the new milk type, these results could still be influenced by the hypothetical bias. Thus, future studies may want to consider more robust methods of determining willingness-to-pay.

When comparing the results of this study to those of the Mintel study (2016), there were some discrepancies that could warrant additional investigating. For instance, while the Mintel study found that American consumers were more likely to agree that PBDMAs were healthy for kids and were consumed for heart health, the results from this study indicated that Canadian consumers were more likely to agree that dairy milk was healthy for kids and promoted heart health. This could be attributed to numerous factors such as differences in the survey instruments that were utilized in each study or in the sample populations that were chosen. Further research

should consider a cross-country study, similar to Jones et al (2008), to determine whether differences in perception exist between Americans and Canadians and the resulting implications.

6.3 Conclusion

The findings from this study should be of interest to the dairy industry because they indicate that differences in perception do exist between dairy milk and PBDMAs and these health perceptions have an influence on the decision of whether to consume both dairy milk and PBDMAs. Therefore, the dairy industry may want to address any negative health perceptions consumers might have regarding dairy milk, especially in terms of the usefulness of dairy milk for weight control. Additionally, the study did find that there is a market interest for ultrafiltered dairy milk and by making this product available, there is potential for the dairy industry to recapture a portion of plant-based dairy milk alternative consumers.

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Appendices

Appendix A: Survey Instrument

Comparing Consumer Perceptions of the Health Value of Plant-Based Dairy Milk Alternatives and Dairy Milk

You have been invited to participate in a survey entitled "Comparing Consumer Perceptions of the Health Value of Plant-Based Dairy Milk Alternatives and Dairy Milk." This study is being conducted and self-funded by Janelle Préjet from the University of Manitoba as part of the Master's thesis.

Please read through the information below before providing your consent to participate in the study.

The purpose of this study is to compare how consumers perceive the health value of dairy milk and plant-based dairy milk alternatives. Participants will be provided with a series of statements regarding various health benefits and concerns associated with dairy milk and plant-based dairy milk alternatives and asked to indicate their level of agreement or disagreement with each statement. While plant-based dairy milk alternatives have grown in popularity in recent years, to date little research has explored how consumers perceive the health benefits and concerns of plant-based dairy milk alternatives compared to those of dairy milk. Therefore, the information collected in this study may benefit the dairy industry by providing a better understanding of how consumers perceive these beverages and what influences their purchasing decisions in order to improve their products and marketing strategies. The survey should only take 10 to 15 minutes of your time to complete. There is no compensation for responding and no known risks to participants beyond those encountered in everyday life.

All reasonable measures to protect both your identity and responses have been taken. Secure Sockets Layer (SSL) encryption has been turned on to create a secure connection for information being transmitted over the web and the data collected will be stored in a password protected database. The data collected are anonymous and do not contain any personal identifiers, meaning that there is no risk of identification to participants. All data will be pooled and reported in summary form only. Findings from this research will be presented in the final written thesis as well as a public seminar as is required for the thesis defense. It is also the intent of the researcher to publish the findings from this study in a peer-reviewed journal in the field of agricultural economics.

Your participation in this study is voluntary. You may choose to decline answering any question and you are free to withdraw your participation from this study at any time. Should you choose to withdraw before completing the questionnaire, you may simply exit the survey and your responses will not be stored. However, please note that once the survey is submitted, your answers can no longer be erased as they are anonymous.

If you have any questions regarding the survey or would like to obtain a copy of the results of this research (which should be available by January 2018), I can be reached by phone at or by email at . Alternatively, you may contact the research advisor on this project, Dr. Jared Carlberg, at or . This study has been reviewed and approved by the Joint-Faculty Research Ethics Board at the University of Manitoba and any questions or concerns regarding your rights as a research participant can be directed to the Human Ethics Coordinator at or .

If you would like to download a copy of this consent form to save for your records, please click here.

By clicking on "Begin Survey", you acknowledge that you have read and understood the above terms and wish to participate in this study.

Please read through the following for additional information and instructions for filling out the survey

The goal of this survey is to compare consumers' perceptions relating to the health value of dairy milk and plant-based dairy milk alternatives. The first section of the survey attempts to gain insight into your consumption habits and your perception of the health value of dairy milk, while the second section of the survey attempts to gain insight into your consumption habits and your perception of the health value of plant-based dairy milk alternatives. In these two sections, you will be asked to indicate to what extent you agree or disagree with various statements regarding the health benefits and concerns associated with either dairy milk or plant-based dairy milk alternatives consumption. Please select a single response that corresponds to how strongly you agree or disagree with each statement. *Please keep in mind that there are no right or*

wrong answers, we are simply seeking respondents' opinions on the topic.

The third section of the survey attempts to ascertain whether there would be market potential for a new type of ultrafiltered milk product in Canada. Following a brief description of this new product, the first question asks whether you would consider purchasing this ultrafiltered milk. If so, a follow up question asks how much you would be willing to pay for the ultrafiltered milk . *Past research has found that in a situation where respondents are not actually making a purchasing decision, they tend to overestimate or underestimate what they would be willing to pay for the product.* With that in mind, please consider carefully how much you would realistically be willing to pay for ultrafiltered milk.

The final section of the survey asks a series of demographic questions. This information will be used solely to compare the responses of different demographic groups and determine if there are any response patterns based on factors such as gender, age, income level, etc.

Are you 18 years of age or older and living in Canada?

- ○ Yes
- ○ No

Do you drink dairy milk? (Note: dairy milk in this study refers to any type of milk that comes directly from a cow, such as whole milk, 2%, 1%, skim milk, etc.)

- ○ Yes
- ○ No

What type of dairy milk do you drink most often?

- ○ Skim milk (0%)
- ○ 1% milk
- ○ 2% milk
- ○ Whole milk (3.25%)
- ○ Lactose-free milk
- ○ Other (please specify) [ ]

How often do you drink dairy milk?

- ○ Less than once a week
- ○ 1-3 times a week
- ○ 4-6 times a week
- ○ 7-13 times a week (once or twice a day)
- ○ 14-20 times a week (two or three times a day)
- ○ 21 or more times a week (three or more times a day)

Please indicate to what extent you agree or disagree with the following statements regarding dairy (cow's) milk consumption.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Dairy milk is a good source of calcium.	○	○	○	○	○
Dairy milk has a high sugar content.	○	○	○	○	○
Dairy milk is a good source of protein.	○	○	○	○	○
Dairy milk has high levels of fat.	○	○	○	○	○
Dairy milk is a naturally sourced product.	○	○	○	○	○
Dairy milk has high levels of cholesterol.	○	○	○	○	○
Drinking dairy milk helps with weight loss efforts.	○	○	○	○	○
Dairy milk has a high calorie content.	○	○	○	○	○

Please indicate to what extent you agree or disagree with the following statements regarding dairy (cow's) milk consumption.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Drinking dairy milk promotes heart health.	○	○	○	○	○
Drinking dairy milk causes gastro-intestinal problems.	○	○	○	○	○
Drinking dairy milk aids in developing strong bones.	○	○	○	○	○
Drinking dairy milk causes weight gain.	○	○	○	○	○
Dairy milk is healthy for kids.	○	○	○	○	○
Drinking dairy milk increases the risk of developing heart disease.	○	○	○	○	○
Dairy milk is an essential component of a healthy diet.	○	○	○	○	○
Drinking dairy milk causes allergic reactions (such as rashes, asthma, etc.)	○	○	○	○	○

Do you drink plant-based dairy milk alternatives? (Note: plant-based dairy milk alternatives in this study refers to any milk substitute beverage derived from a plant such as almond milk, soy milk, coconut milk, rice milk, etc.)

○ Yes

○ No

What type of plant-based dairy milk alternative do you drink most often?

○ Almond milk

○ Cashew milk

○ Coconut milk

○ Hemp milk

○ Oat milk

○ Rice milk

○ Soy milk

○ Other/Blend (please specify) _____

How often do you drink plant-based dairy milk alternatives?

- ○ Less than once a week
- ○ 1-3 times a week
- ○ 4-6 times a week
- ○ 7-13 times a week (once or twice a day)
- ○ 14-20 times a week (two or three times a day)
- ○ 21 or more times a week (three or more times a day)

Please indicate the reason(s) why you consume plant-based dairy milk alternatives: (check all that apply)

- ☐ Lactose intolerance
- ☐ Milk allergies
- ☐ Follow a vegan diet
- ☐ Environmental concerns related to dairy production
- ☐ Animal welfare concerns related to dairy production
- ☐ Health concerns related to dairy milk consumption
- ☐ Calorie content
- ☐ Shelf life
- ☐ Taste preference
- ☐ Availability
- ☐ Price
- ☐ Other ____

Please indicate to what extent you agree or disagree with the following statements regarding plant-based dairy milk alternatives consumption.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Plant-based dairy milk alternatives are a good source of calcium.	○	○	○	○	○
Plant-based dairy milk alternatives have a high sugar content.	○	○	○	○	○
Plant-based dairy milk alternatives are a good source of protein.	○	○	○	○	○
Plant-based dairy milk alternatives have high levels of fat.	○	○	○	○	○
Plant-based dairy milk alternatives are a naturally sourced product.	○	○	○	○	○
Plant-based dairy milk alternatives have high levels of cholesterol.	○	○	○	○	○
Drinking plant-based dairy milk alternatives helps with weight loss efforts.	○	○	○	○	○
Plant-based dairy milk alternatives have a high calorie content.	○	○	○	○	○

Please indicate to what extent you agree or disagree with the following statements regarding plant-based dairy milk alternatives consumption.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Drinking plant-based dairy milk alternatives promotes heart health.	○	○	○	○	○
Drinking plant-based dairy milk alternatives causes gastro-intestinal problems.	○	○	○	○	○
Drinking plant-based dairy milk alternatives aids in developing strong bones.	○	○	○	○	○
Drinking plant-based dairy milk alternatives causes weight gain.	○	○	○	○	○
Plant-based dairy milk alternatives are healthy for kids.	○	○	○	○	○
Drinking plant-based dairy milk alternatives increases the risk of developing heart disease.	○	○	○	○	○
Plant-based dairy milk alternatives are an essential component of a healthy diet.	○	○	○	○	○
Drinking plant-based dairy milk alternatives causes allergic reactions (such as rashes, asthma, etc.)	○	○	○	○	○

A new type of dairy milk has recently been released in the market. It is an "ultrafiltered" fluid dairy milk made by recombining the components that make up dairy milk in different ratios. The result is a milk beverage that contains 50% more protein, 30% more calcium, 50% less sugar than regular milk and is also lactose-free. Would you consider purchasing this ultrafiltered dairy milk instead of your current milk (dairy or plant-based) selection?

○ Yes

○ No

In what quantity do you normally purchase milk (dairy or plant-based)?

○ One litre

○ Two litres

○ Four litres

○ Other (please specify) _____

How much do you usually pay for that quantity of milk (dairy or plant-based)? For reference, prices for milk at a local grocery store in Winnipeg this week were $1.60 for a 1L carton, $3.20 for a 2L carton and $4.59 for a 4L jug. If you are unsure how much you usually pay, please write in your best estimate using the reference pricing.

Given your answer to the previous question, what is the maximum price you would be willing to pay for the same quantity of ultrafiltered milk?

By clicking and dragging the boxes, please arrange the following factors in terms of their impact on your milk purchasing decision with 1 being the most important factor and 4 being the least important factor.

Availability/Convenience	
Nutrition	
Price	
Taste	

Do you take any nutritional supplements (such as vitamins, minerals, amino acids, natural or herbal supplements, etc.)?

- ○ Yes
- ○ No

Do you exercise regularly (an average of three times a week or more)?

- ○ Yes
- ○ No

Please indicate your gender:

- ○ Female
- ○ Male
- ○ Other
- ○ Prefer not to say

What year were you born?

Do you have any children under the age of 18?

- ○ Yes
- ○ No
- ○ Prefer not to say

Please indicate which province you reside in:

- ○ Alberta
- ○ British Columbia
- ○ Manitoba
- ○ New Brunswick
- ○ Newfoundland and Labrador
- ○ Nova Scotia
- ○ Ontario
- ○ Prince Edward Island
- ○ Quebec
- ○ Saskatchewan
- ○ Prefer not to say
- ○ Other (please specify):

Please indicate your race/ethnicity:

- ○ Aboriginal/Indigenous
- ○ Asian
- ○ Black
- ○ Caucasian
- ○ Latin American/South American
- ○ Prefer not to say
- ○ Multiple ethnicity/Other (please specify): _____

Please indicate the highest level of schooling you have completed:

- ○ Primary school
- ○ Some high school
- ○ Completed high school or GED
- ○ Some postsecondary (university or college), but not complete
- ○ Completed postsecondary certificate or diploma from a trade school, college or university
- ○ Completed Bachelor's degree from a university
- ○ Completed Master's degree or Ph.D. from a university
- ○ Prefer not to say

Please indicate your annual household income (combined income of all people living in your household):

- ○ Under $25,000
- ○ $25,000 - $49,999
- ○ $50,000 - $74,999
- ○ $75,000 - $99,999
- ○ $100,000 - $124,999
- ○ $125,000 - $149,999
- ○ $150,000 and over
- ○ Prefer not to say

If you have any additional comments/feedback you would like to provide, please use the space below.

Appendix B: Additional Survey Comments

1. I'm actually excited if this is a real product coming to the market. Don't know how much more I could pay for milk BUT the idea of greater protein AND calcium will be a huge hit, especially with aging females.
2. Will you be giving out free samples of these alternate milks?
3. Something new in survey.
4. This was great.
5. I loved this survey, informed me very much about a product I use on the daily.
6. I love milk but it does give me gas so a great tasting lactose free 2% flavored milk would be awesome.
7. I know very little about plant-based dairy alternatives, as I have never had any reason to try them. Nobody in our household is lactose-intolerant or vegan, so no incentive. As a result, most of my answers about those products are based on "I really have no idea" beyond the assumption that nut-based products are probably quite fat-dense, as opposed to dairy milk which has different fat (and calorie) quantities depending on which product you select.
8. Interesting survey.
9. Thank you for this survey. I learned something to consider about the kind of milk you said.I enjoyed!
10. Sometimes buy milk in U.S. . same great taste but half the price.....
11. This is an informative survey.
12. Quick and easy survey.
13. It was a nice survey. I enjoyed it.
14. Going to try the new plant based milk in my grocery store.
15. When I was sick, it turned out to be diagnosed Celiac Disease, for 2 years the only thing I could keep down regularly was milk. It saved my life.
16. It is a perfect survey.
17. This was very interesting.
18. Upon reflection - the ultrafiltered milk product is tweaking a desire to learn more - time for google.
19. Maybe say for the type of plant-based milk you drink most often, do you think it has lots of calcium/protein/fat etc. To evaluate those things for ALL types of non-dairy milk is impossible generally speaking because it really depends on the variety.
20. Interesting survey.
21. Good survey. Easy to answer, not too long, and straightforward.
22. I avoid all dairy products because they are pro-tumor. Also I avoid all dairy substitutes because I don't believe in substitutes.
23. Great topic!
24. Your survey is poorly worded as to definitions - you need to say whether dairy milk includes half & half and dairy cream or does not include these.
25. Don't mess with mother nature.
26. The alternative milk questions are too broad, jeopardizing accuracy of results, because of the wide variety of alternative dairy products. For example, I have a fairly positive opinion of almond milk, but a scathing opinion regarding soy milk.

27. I am looking forward for the unfiltered dairy milk. Animal dairy milk protein is important and plant based does not replace it.
28. Once this ultra pasteurized milk is on the market, it is vital for taste tasting. For an example, I once tried lactose-free milk and I disliked the taste. Having stated that, the other benefits listed will allow me to try this new milk. I don't mind paying extra, however, the taste is paramount regardless of lower calories and higher protein.
29. Thank you for letting me share my opinion.
30. No comments. It's great to see surveys about dairy products.
31. I don't think I know enough about ultrafiltered milk to answer questions on it. I thought it was only used in the cheesemaking process, not for home consumption.
32. Plant-based milk products general don't taste so good. I would consume that more often if it tasted better.
33. Informative helpful and interesting survey. Good job.
34. A good survey.
35. Good milk made right is good for us.
36. Dairy milk is very nutritious and helpful for the bones.
37. Interesting survey. Thanks.
38. Very interesting topic for a survey, I enjoyed it.
39. While this new filtered milk idea sounds interesting, we prefer our food to be as simple and natural as possible. As such I can't realistically see buying a milk that's had so much altered about it.
40. Interesting survey.
41. One daughter only uses almond or coconut milk. She switched from cow's milk because she heard that it would be better for her skin/acne to go off dairy products. For me, taste is the most important factor.
42. Well done survey. I enjoyed it coming from a health care professional background.
43. I am very anxious to obtain some of this ultra filtered milk. If it tastes very similar to regular milk and price is somewhat similar, I would definitely change over.
44. I like this product for me. But for my mother who is on fixed income, she really needs a low costing milk option.
    I do worry she won't get enough calcium and dairy because of rising milk prices.
45. I am open to non-dairy alternatives, however I am just as happy to drink milk. I prefer skim or lactose free milk as higher fat foods and drinks tend to make me tummy sick. Lactose free milk also tends to have a longer best before date.
46. Good survey, no issues at all. Very clear questions. Thank you!
47. I feel milk is a very important part of our diet and have always used it on a daily basis. I try to inform all of my friends how important milk is for the building of a strong body
48. Would like to hear more about new milk product.
49. This was a very interesting survey. It was a great idea to compare peoples' perceptions of dairy milk vs. plant-based milk. Hopefully, these results will continue to help to develop the milk industry.
50. I love organic milk and would absolutely try the ultrafiltered one if it's organic!
51. Real milk is always the best option.
52. I detest cow's milk. It's only good for coffee, whipped cream, butter and ice cream. I dislike the taste and feel of it in my mouth. I don't like the plant-based options either.
53. Like to hear more about new milk product.

54. Great survey.
55. LOOK FORWARD TO TRYING IT.
56. Love milk but prefer local milk products.
57. Milk is great.
58. EXCITED TO TRY IT.
59. Le lait c'est bon!
60. I would like to be able to purchase RAW milk, I feel it would be better than having it damaged by processing, give people the choice, if they are allowed to choose to smoke, why can they not be allowed to drink raw milk?
61. Nice and easy little survey.
62. Husband is Diabetes he drink Silk Almond Unsweetened . We purchased it on sale. I do not like the taste. Prefer the real milk.
63. Food for thought. I prefer dairy over plant based so interested to see the alternative which is lower fat and sugar for my 3 sons who are all 18 and under.
64. Interesting survey.
65. I have tried a milk alternative before and maybe it is just habit and taste but I believe I will never drink anything but 2%.
66. Relevant to those who are lactose intolerant.
67. I'm not against milk. I'm against the processes it's filtered through. All the real nutrients are pasteurized away. Fresh farm milk from plant fed, free range cows is great. Put that back on our tables. Thanks.
68. Received information about other milk products in market.
69. I find Sweetened milk terrible. a high protein milk is a good idea.
70. Seems unnecessary to me to over process a food item like milk when it is already a good food option.
71. Milk is good for health.
72. Well designed and easy to respond to survey. Also piqued my interest in this new product as well.
73. I enjoy doing this survey.
74. While I much prefer dairy milk to soy milk I have developed a lactose intolerance in the past months which has caused me to drastically reduce the amount of dairy I consume, to the extent that I think at some point I'll have to stop consuming it entirely, and so I would welcome any new kind of lactose free milk but the truth is it'll likely sell for like 3 bucks a 1l or whatever which is useless to me. I can get a liter of soy milk for a dollar fifty. At anything 2$ or above for a liter, which there is no way this isn't, I would not consider any dairy milk over dairy alternatives.
75. I would really not support that ultrafiltered milk.
76. Great survey thanks.
77. I really enjoyed this survey.
78. Simple enjoyable survey.
79. An underlying question on this survey was Plant vs Dairy and it could influence answers.... not sure if his was the intent. I thought that it was not.
80. I enjoy milk and the benefits it provides.
81. The new milk product sounds very interesting!
82. Good survey, the new milk product sounds interesting.
83. Will be interested in seeing such a product.

84. Nice little survey. Good questions.
85. Nothing special, plant based milk are good for them who has any health issue with dairy products...otherwise own choice...but me like my milk with my tea...
86. I think if I own a company I would have people have a taste of all to see what people like most and have them fill out a card and put into a box to take count on what people think of the milks.
87. Dairy milk prices are too high. Recently I started looking at alternatives like Almond milk - but this is recent (past year or so). Often not available at my local stores but I would probably start to drink more if it were. Not sure if all my allergies are made worse by dairy milk.
88. I prefer cow's milk any day.
89. I love dairy!!
90. Interesting study.
91. Quick and easy great survey.
92. Looking for a better non-milk alternative.
93. Great survey.
94. I am anxious to try this new milk.
95. The dairy industry is unsustainable, extremely cruel & the products it provides aren't even health-promoting! Ditch dairy!!!
96. I regularly make my own yogurt and would buy the new milk mentioned for it, even though I don't drink milk.
97. I would be interested in a product that does NOT have soy in it.
98. I like this survey.
99. Interesting topic. I thought that there might be a little more depth.
100. This is simple and clear survey...a good one.
101. I am most interested in the environmental impact/animal rights when it comes to milk production.
102. This was a really fun survey!
103. This is a wonderful new product concept, particularly the lower sugar content.
104. Great survey. Easy to complete as well as providing the number of answered and unanswered questions at the bottom of the page.
105. Good survey, folks!
106. Good survey.
107. I like real cows milk best.
108. Interesting info. when will this new milk be available for purchase?
109. Very interesting and well presented.
110. Milk is disgusting. if it wasn't for coffee and tim hortons.
111. Milk is good but in moderation.
112. Very nice survey!
113. Think the less processed food is the better. Very untrusting of what we eat as a country. Too much processing going on. The more natural the better for our health in anything.
114. I follow the Keto way of eating, which is low carb, high fat, moderate protein. labels matter to me, along with macros. I currently purchase large quantities of whipping cream instead of milk due to the high fat, low carb make-up. I prefer 35% fat or more for whipping cream. Providing additional options for whipping cream with high fat would be extremely useful to those of us that follow keto.

115. Please make this product a reasonable price. In our house we treat milk as an extravagance and spare it along and we're just a family of two. My heart goes out to families with children who are trying to raise healthy children on todays prices.
116. I absolutely love these "Food & Beverage Related" surveys. Loved the Survey! Loved the format too!
117. Very interesting and informative survey.
118. No additional comments other than it was an interesting survey.
119. That was good survey easy to understand and easy to give opinion. Amazing survey short and effective. Best of luck.
120. A very good survey with questions directed at the product.
121. Nothing, great survey.
122. Very interested in trying this product if it comes to Canada.
123. I have tried almond silk beverage and did not care for it. Have not tried any others and do not know much about them. I mostly drink milk in my tea (I drink a lot of orange pekoe tea) and am fussy about flavour. Good survey!
124. Great survey. Thanks.
125. I only drink cow milk.
126. With all due respect, this was not a well written survey. A lot of my answers had to be neutral because you did not differentiate between the fat content in dairy milk. You also classed all plant based milks together. I do not consider soy a healthy plant based milk but I do use almond and cashew milk. You are also assuming that we would chose a "milk" for calcium and protein whereas we would not. We get our calcium and protein from other foods. This is not why we purchase plant based milks. You also gave 4 items to order regarding the ultrafiltered milk yet none of those items applied to me. You left out a whole host of other reasons one may not purchase this new milk. For me personally, I could never drink it as I am allergic to all dairy products, even lactose free. It is not an enjoyable experience, what happens to me if I consume dairy. One of my family members can consume lactose free products so I do buy her LF yogurt and sour cream but she would not want to drink LF dairy milk. It seems that your bias is toward the dairy industry and when you have a bias your survey data can become skewed.
127. I feel if people truly understood what the animals go through to produce something that is completely unnecessary and unnatural for human consumption less people would ingest it and education on these topics are important, as a society we are willing to put any in our body's just because, knowing the long term effects and horrors that truly are a product of the dairy industry is enlightening. So thank you for the survey and happy to contribute in anyway possible. Cheers
128. Great survey topic.
129. Dairy is okay as a treat if you don't have inflammation or reactions but is unnatural to drink baby cow food and its acidity leaches calcium leading to higher levels of osteoporosis in countries that drink it. Dairy alternative milk is also okay as a treat but store bought doesn't have enough nutrients left in it to be a health food. I will be happy when Canada makes dairy not a food group.
130. This was a very user friendly survey and to the point. Congrats.
131. I would do more surveys of this type.

132. A key deciding factor for me would be concerning animal conditions and nutrition delivery system.
133. Interesting survey.
134. I slanted some of my answers in a certain way to weight them according to the little |I might know about celiac and other issues that might be important to avoid in the case of some plant based products.
135. There is nothing like a nice cold glass of milk, whether it is with a meal or just by itself. I love milk.
136. Grew up on cow's milk right out of the cow!
137. I believe dairy milk comes from a cow. Plant-Based Diary Milk is a DRINK and not milk.
138. Interesting survey thank you.
139. Interesting survey.
140. Most of the dairy milk alternatives - plant based, like Soy will curdle in coffee. They have a very small container that you can buy about 400 ml creamer in Soy and it is very expensive for the amount. I have always looked for the 2 liter soy, almond, and coconut that I can use BOTH for drinking and for in coffee. They don't make it. Also, the almond and coconut versions in coffee is very thin and weak. Just not creamy. Starbucks offers soy creamer in a large pitcher that one can add it to the coffee, on the side board with their sweeteners etc.
141. This is an interesting survey, and I'm glad of the chance to be apart of it, and give my opinions.
142. I found this survey interesting and thought provoking. I hope that this new idea for milk will come to market. Good luck and thank you for the opportunity.
143. Love drinking milk.
144. I love milk, it's my favourite drink.
145. I think new milk will flop. They used to say Greek yogurt is healthier because it has more protein. I find it less tasty as does my family and more expensive than regular yogurt. It's more important to not feel manipulated by companies' fads and stick to sound, simple doctor generated advice. Leave sugar for birthdays only, I have been told, even without a diagnosis requiring avoiding sugar. Exercise is most important than diet for women. Food intake has no scientific impact on cancer. Only keep fat content down. Simple. Done. Don't assume we cannot get our own information.
146. We are the only species that drinks another species milk....
147. This is survey has me very intrigued. If the price is right, and the nutritional claims are true, I would be very interested in this product.
148. Great survey.
149. Good survey.
150. Always looking for health benefits.
151. Great survey.
152. It wasn't included in the study, but I regularly consume goat's milk. Before discovering its availability, I was a more regular consumer of plant-based milks. I was surprised alternative animal milks were not included in this study.
153. Easy to understand thank you for allowing me this survey.

154. I tried almond milk in the past but I didn't like the fact I had to shake the container every time I wanted to poor a glass and I was disappointed to learn they were not much almond content in the container.
155. Very easy and comprehensive survey.