Improving the Diets of Children: Understanding the Decision-Making of Parents, Children, and Food Manufacturers

by

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Abstract

The objective of this study is to explore the underlying decision-making that impacts the effectiveness of potential policies that could be implemented by the government in an effort to improve children's diets and subsequent health outcomes. Under investigation are how food choices could be affected by the following types of policies: 1) a price mechanism at the retail level, 2) a label mechanism similar to one that will soon be found on foods high in sugar, sodium and/or saturated fat in Canada, and 3) a policy targeted at food manufacturers. The price and label mechanisms could influence parents' or children's food choices, but likely would not affect all consumers' choices equally. Some might place more importance on price while others on brand preferences and still others on nutrition information. How children with differing levels of cognitive development would respond to price changes and a traffic light style label when purchasing salty snacks is investigated in the first study. Preferences were elicited via a consequential choice experiment, while cognitive development was assessed through several standardized tasks. Heterogeneity in price sensitivity was established, while responsiveness to the traffic light label appeared somewhat homogenous across the survey sample. How parents with varying characteristics would respond to an explicit, text-based warning label on high-sugar breakfast cereals is the focus of the second study, with data being collected via an online survey including a choice experiment along with measures of nutrition knowledge, purchasing behaviour, and demographic characteristics. Heterogeneity in responsiveness to the warning label was identified both among parents with different characteristics such as nutrition

knowledge as well as between brands. In terms of food manufacturers, improving our understanding of their strategic behavior will help to identify what types of policy measures targeted at them could be effective in improving the nutritional quality of their products. The last study in this dissertation examines how breakfast cereal manufacturers choose a combination of price, advertising, and nutritional quality for the products in their portfolio and how these decisions correspond to input prices and consumer awareness of nutrition. There is evidence that firms react both to trends in public nutrition awareness and to each other's actions, and that overall their product portfolios have been improving in terms of nutritional quality over the past two decades.

Preface

This dissertation is an original work by Shannon Allen, while the research projects discussed within were collaborative efforts.

Chapter 2 of this dissertation was part of a larger research project being conducted with Sean Cash at Tufts University, Vic Adamowicz at the University of Alberta, and Anna McAlister at Endicott College. This project received research ethics approval from the University of Alberta Research Ethics Board, Project Name "Children's Response to Information on Foods: Alberta Study", Pro00034195, Oct. 31, 2012.

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Chapter 1: Introduction

1.1 Background

An individual's diet has long-term health implications as both over and under-consumption of various nutrients can lead to an assortment of health problems. In developing nations, health issues are more commonly related to the under-consumption of nutrients; for example, under-consumption of vitamin A can lead to immune system deficiencies and blindness (Stephensen 2001; Sommer 2001), inadequate protein can result in Kwashiorkor (Wu et al 2004), and low iron intake causes anemia and impaired cognitive development (Grantham-McGregor and Ani 2001).

Although micronutrient deficiencies are still present in some population segments of developed countries, more broadly it is the overconsumption of nutrients, specifically sugar, sodium, and saturated fat that is resulting in the most negative health consequences. High sugar consumption is a major factor in developing diabetes as well as hypertension and kidney disease (Johnson et al 2007) and has also been linked to increased risk of cardiovascular disease (Yang et al 2014). Overconsumption of sodium and saturated fat lead to increased risk of cardiovascular disease and stroke (Strazzullo et al 2009; Astrup et al 2010). In addition to these problems, poor dietary choices in general are contributing to the obesity epidemic and a variety of other chronic health issues such as cancer, arthritis, osteoporosis, etc.

The relationship between diet and health is complex, and because it can be decades before the negative impacts of dietary choices are felt by an individual, it may be difficult for people to make what are lifetime utility maximizing choices. Most people, although they aren't aware of it, have myopic discount rates meaning that they value current utility of present consumption, be it of food or other goods, proportionately more than that in the future. As such, many people eat what they enjoy now, putting off their healthy eating plan till the future, and the result is poor health outcomes, be they 5, 10, or 50 years down the road (Wing et al 2001). In addition, most developed countries have some form of health care system or

insurance, meaning that the costs of poor dietary choices and their resulting health problems are borne in part by society, not solely by the individual. Therefore, it is not only in a person's best interest to eat a healthy diet, it is also in society's best interest for them to do so. Unfortunately due to the high palatability of less healthy foods and their relative cheapness compared to healthier choices (Neumark-Sztainer et al 1999; Veling et al 2013; Drewnowski and Darmon 2005; Jones et al 2014), combined with the temporal separation of consumption and consequence, incentives for people to eat healthy are too low to have an economically efficient outcome (Brunello et al 2009; Sassi et al 2009).

Some argue that this inefficiency should be addressed through public policy. Policies designed to do this could take many forms such as financial mechanisms, food manufacturer regulations, or consumer education. Some policies, however, are criticized as being paternalistic if the government restricts the options available to consumers despite being in the best long term interests of the consumer. For example, if it became illegal to put trans-fats in foods (which are known to contribute to cardiovascular disease), some people may complain that their weekly doughnut doesn't taste as good and that they have the right to eat products with trans-fats if they so choose. The virtual elimination of trans-fats in foods is a consumer protectionist policy which has been effective in reducing the risk of coronary heart disease in Denmark (Stender et al 2006). A similar ban on producing foods containing trans fats in Canada was recently implemented in September 2018 (Health Canada 2018).

The debate surrounding consumer sovereignty vs. consumer protection is not a new one. Choice is the core value of consumerism (Gabriel and Lang 2006), so to many parties limiting choice would be detrimental to consumer well being, however Gabriel and Lang (2006) point out that without enough information the freedom to choose is an illusion. In economic terms, most views of consumption assume that utility is non-decreasing in choice. Consumers were once seen as naïve victims of mass marketing in need of government protection, but are now seen as active and knowledgeable (Klompenhouwer and van den Belt 2003). Therefore, proponents of consumer sovereignty would argue that by giving consumers as much information

as possible, they will make utility maximizing decisions. As such, regulations pertaining to food labels are intended to assist the consumer make informed choices through information provision (Klompenhouwer and van den Belt 2003). It should be pointed out, however, that some studies have found that people are overwhelmed when facing too many options and can often resort to heuristics, meaning that they don't choose the utility maximizing option (Scheibehenne et al 2010). Proponents of consumer protection would argue that by eliminating unhealthy or unsafe choices, they are protecting the consumer's well being and making it less likely that the consumer 'chooses wrong' or in other words, does not choose the utility maximizing option. European Union legislation pertaining to food product labels states that "the prime consideration for any rules on the labeling of foodstuffs should be the need to inform and protect the consumer" (EC 2000 recital 6). As pointed out by Klompenhouwer and van den Belt (2003), the objectives of informing and protecting can easily be conflicting. Informing consumers promotes their sovereignty while protecting them can quickly degenerate into paternalism.

When it comes to public policy, however, not all population groups are treated equally. Of particular interest in this research are children, and there are far more policies protecting children than there are adults as they are not expected to be capable of protecting themselves. These policies include everything from specific standards to which toys must be made (for example, the eye of a plush toy must withstand a 9kg load being suspended from it for 5 minutes without detaching) and putting warning labels about fire resistance and proper fitting in sleepwear up to stringent car seat requirements and not selling alcohol or tobacco to minors. Despite this level of child protection, there are no federal policies pertaining to protecting children from poor dietary choices, although the province of Quebec has restricted advertising to children since 1980 (Dhar and Bayliss 2011). Legislation restricting the marketing of unhealthy foods to children, is however, currently being debated and could come into effect in the next year if passed (Weeks 2018). There is increasing evidence that diet-related health problems once assumed to be exclusive to adults such as high blood pressure, type 2 diabetes, sleep breathing disorders, polycystic ovary syndrome, artery hardening, and nonalcoholic fatty liver

disease are being seen more frequently in children (Daniels 2006, Han et al 2010, Franks et al 2010, Mayer-Davis et al 2017). In addition, obese children are more likely to become obese adults and experience obesity-associated health issues (Magarey et al 2003, Patrick and Nicklas 2005). Given that children are consuming unhealthy foods and suffering the negative health consequences, the arguments for consumer sovereignty lose out to those of consumer protection when discussing children's food choices. Children should be protected from poor diets just as they are protected from tobacco use, unsafe toys, and inadequate seatbelts. Also important to consider is that dietary habits and preferences developed in childhood can persist into adulthood, so improving children's diets will likely improve their lifetime dietary choices. Finkelstein et al (2004 pg. 71) argue that "interventions targeted at youth are relatively easy to justify on economic grounds due to the additional protections that this group requires". The focus of this research will be to explore the potential policy tools that could be mandated by the government to improve children's diets and subsequently their long-term health and to determine what would be most effective and equitable.

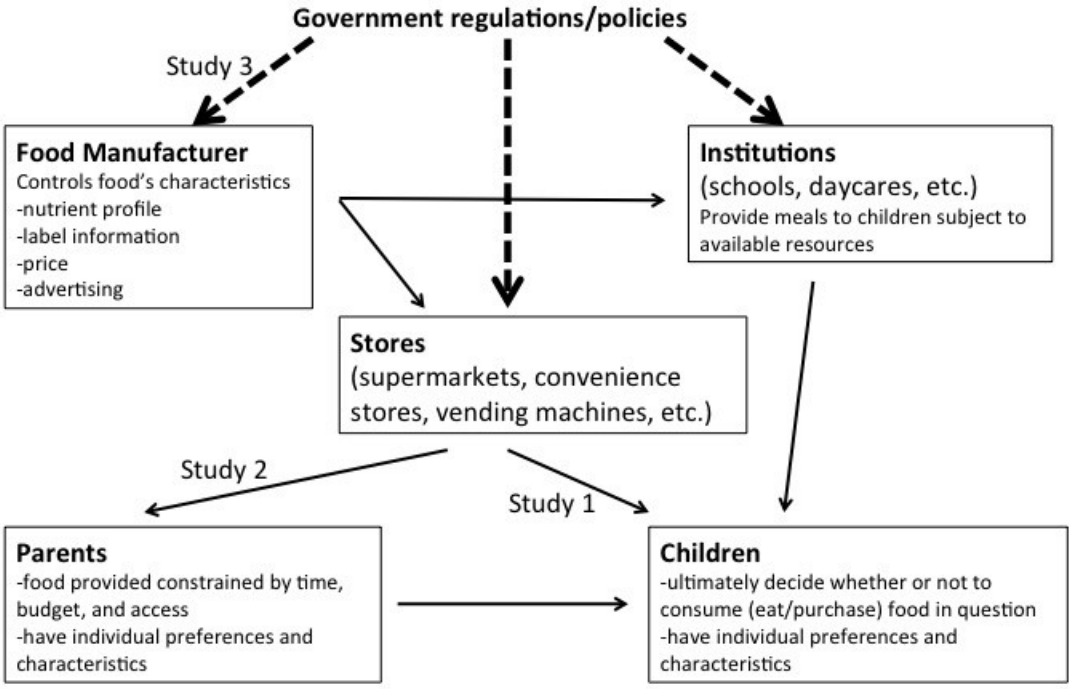
1.2 Factors influencing children's diets

An individual's dietary choices are influenced by the environment in which they are making choices, including culture, food prices, availability of food products, advertising, and many other things, subject to their personal preferences. When it comes to children, food choices are made by a combination of parents, institutions (ie schools or daycares), and children themselves. Parents typically purchase the food that children have available to them at home and are generally preparing meals for the children. Despite this, children do have influence on the foods their parents purchase and prepare, both in the form of 'pester power' (McNeal and Kellogg 2000) and more simply in what they will and won't eat. We will assume that parents are utility maximizing agents with a budget constraint and that they derive some utility from both their child's happiness and expectation of long-term health.

There is also the possibility that children can act as consumers independently from their parents, purchasing food when away from home from stores, vending machines, etc. Institutions, primarily schools and daycares, also shape a child's diet in terms of providing meals, the options they make available at the cafeteria, and products for sale in vending machines. Several studies have found that the school food environment can affect children's food choices because they consume a large proportion of their daily calories there (Fox et al 2001, Burghardt et al 1993, Gleason and Suitor 2001, Oostindjer et al 2017, Leonard 2017). We will assume that children maximize utility subject to a budget constraint and that they derive utility from current consumption but may or may not get utility from expected health in future time periods as it is difficult for children to understand how current choices will affect them in the future (Komlos et al 2004; Smith et al 2005).

In addition, food manufacturers also play a role in children's diets through the formulation of their products, as well as how they price, label, and advertise them. We will assume that food manufacturers are profit-maximizing agents but that their profits are affected not only by prices, input costs, and quantities sold, but also by the quality of their product and advertising strategy. Figure 2 represents the avenues through which children obtain food and identifies which of these avenues the different studies in this dissertation focus on. Policies can be used to modify various elements within the food environment that affect children's decisions. These factors along with policy instruments that could address them will now be discussed.

Figure 1.1: Conceptual framework identifying children's sources of food



1.2.1 Price

It is assumed that most households operate within a budget constraint, and we know that there are a variety of substitutes and complements among food products (ie: Coke and Pepsi, hot dogs and ketchup) so changes in food prices can affect not only the product whose price has changed, but demand for other products as well. Although food as a broad category is a necessity, the existence of substitutes means that individual food products have a downward sloping demand curve and have some degree of price elasticity. In a review of 160 studies examining the price elasticity of demand for various food products, Andreyeva et al (2010) state that the absolute value of price elasticity for nonalcoholic beverages and foods ranged from 0.27 to 0.81.

Unfortunately, there is an inverse relationship between the energy density of food and its cost, meaning that foods higher in calories, fat, and sugar are typically cheaper than products containing whole grains, lean meats, and fruits and

vegetables (Darmon and Drewnowski 2015). Cash and Lacanilao (2007) found that in Canada, the price per calorie is the lowest in the fats/sugar/oils category, followed by grains and then processed sweets, while fish and poultry were the most expensive followed by vegetables. Given this relationship between price and demand, it follows that people are more likely to purchase (or will purchase more of) cheaper goods, so the relative prices of healthy vs. unhealthy foods are likely to play a role in the quality of a child's diet. It should be pointed out, however, that different food categories, while all being price inelastic, have different levels of elasticity (Andreyeva et al 2010), meaning that the same price change in two different types of products could result in different changes in quantities consumed. For example, if granola bars are more price elastic than breakfast cereals, and the same tax is imposed on both products that are high in sugar, consumption of high-sugar granola bars will decrease more than for high-sugar cereals, and some category switching could result. As such, price elasticities, not only absolute prices, should be considered when designing price interventions to improve diets.

Financial considerations are also key for institutions providing food. Many schools participate in school breakfast and lunch programs which must adhere to a given budget and nutrition standards. As such, prices greatly affect what foods they can provide and how many man-hours can be allotted to preparing them, often steering these meals in a less desirable direction nutritionally (Belot and James 2011; Story et al 2009). In addition, many schools also have food for sale a la carte or through vending machines which do not need to meet any standards, are typically of low nutritional value, and provide valuable income for schools (Kaphingst and French 2006; Cisse-Egbuonye et al 2016; Suarez-Balcazar et al 2007). Despite their best intentions, the people responsible have limited resources with which to operate schools so it may be difficult to give up the additional income generated from the sale of unhealthy food.

Tax policy has been proposed as a possible instrument for reducing the incidence of diet-related non-communicable diseases. A "fat tax" may discourage people from buying energy dense, nutrient poor products by raising their price relative to healthier substitutes (Brownell and Frieden 2009, Jacobson and Brownell

2000, Marshall 2000). Evidence from fat tax studies focusing on adults implies that using taxes to discourage consumption of less nutritious foods will have limited success (e.g., Faulkner et al 2011, Cash and Lacanilao 2007, Lacanilao and Cash 2011, Kuchler et al 2005, Powell and Chaloupka 2009, Schroeter et al 2008, Wansink et al 2014, Bodker et al 2015). In many situations, the tax only makes the unhealthy product *relatively* more expensive; in absolute terms it is still often cheaper than the healthy product. One of the drawbacks of a fat tax is that it would place a disproportionately high burden on lower income families as they spend a greater proportion of their disposable income on food (Cash et al 2005, Madden 2015). Also, there is no evidence to date on how children would react to a fat tax (ie: whether they are price sensitive) as they are generally not regarded as autonomous consumers.

1.2.2 Nutrition and product label

Some parents may make choices based on nutrient profile of products, by the nutrition level inferred by information provided on the label (ie: a healthy choice symbol), or based on their knowledge about nutrition. Nutrition information can be presented on the back of the food package via the nutrition facts panel (mandatory) or on the front of the package via a health claim (subject to the health claim regulations imposed by Health Canada). Although they are not specific to nutrient content, third party logos can infer a product's healthfulness while a warning or recommendation can communicate that a product may be less healthy. Health Canada is currently undergoing the process of implementing warning labels on foods high in sugar, sodium, and/or saturated fat, but the exact foods or criteria have yet to be announced. This warning label could not only impact the foods that consumers choose to buy, but also manufacturer behaviour. When mandatory disclosure of trans fats became regulated in the US in 2003, many packaged foods were reformulated to eliminate trans fats to maintain consumer demand and maintain product reputation (Unnevehr and Jagmanaite 2008). A study by Tandon et al (2011) found that when menus were labeled with calorie contents, parents chose meals for themselves that had fewer calories but did not purchase lower

calorie meals for their children. Harris et al (2011) found that nutrition related claims on breakfast cereal packaging influenced parents' perceptions of the healthfulness of a product (often erroneously) as well as their willingness to purchase it. Fenko et al (2018) found that consumers paid more attention to a traffic light label than a healthy choice logo but that visual attention to these attributes was a poor predictor of a healthy choice.

Clark et al (2007) note that parents with higher levels of nutrition knowledge feed their children healthier diets. A study by Variyam (2001) found that prevalence of overweight and obesity in children is lower among families where parents have higher nutrition knowledge. Children's nutrition knowledge and fruit intake has also been shown to be positively related to maternal nutrition knowledge (Zarnowiecki et al 2011).

Institutions such as schools and daycares may have policies guiding nutritional aspects of the food they provide. For example, daycares in Alberta must provide 2-3 year olds with at least 4 servings of fruits and vegetables per day (Healthy Alberta 2012). Typically they would purchase products wholesale from a catalogue, so labeling would not be a factor in this decision making process. Food retailers, such as grocery stores, convenience stores, and food service establishments do not have to adhere to any particular nutritional guidelines in the products they sell.

There is no evidence to date whether children (among those who are even old enough to comprehend nutrition labels) care about the information contained on a food label. One aspect of the proposed research will be to assess how children and parents respond to label mechanisms indicating an unhealthy product.

Various types of warning labels on food products have been proposed as a tool to improve the public's diet. Several studies have evaluated the effectiveness of the traffic-light style label in which the healthiest foods have a green light, the least healthy have a red light, and those in between have a yellow light. Sacks et al (2011) and Kelly et al (2009) found that consumers were more likely to choose healthier products when the traffic light label was included on the food package. Balcombe and Fraser (2010) found that consumers avoided products with a red light. Thorndike et al (2014) found that in a hospital cafeteria setting, using traffic light

labels increased the sales of healthier (green label) choices. Freire et al (2017) found that children and adolescents would use traffic light labels infrequently in purchasing decisions. With regards to warning labels more generally, Boncinelli et al (2017) found little effect among college students, while Bollard et al (2016) found that New Zealand youth would be responsive.

Some governments have implemented explicit warning labels on some food products. Most countries in the EU require a warning label on foods containing synthetic dyes stating "may have an adverse effect on activity and attention in children" (Bayer 2010). Denmark was the first to implement mandatory warning labels on energy drinks advising that they are not intended for consumption by children or women who are pregnant or breastfeeding, and the rest of the EU adopted the same labeling policy in 2014 (Meister 2014). Most recently, the California senate passed a bill requiring warning labels on sugar sweetened beverages saying "Drinking beverages with added sugar(s) contributes to obesity, diabetes, and tooth decay" (Zuraw 2014).

Also proposed have been graphic (tobacco-style) warning labels that put unappealing photographs directly on to food packages. This approach has not gained much traction however, due to the fact that while tobacco is unequivocally bad for people, the relationship between food and health is much more complex and less healthy foods can be consumed in moderation by most people without causing health concerns (Yach et al 2003).

Educational warning labels have also been suggested by consumer groups to help put the consumption of junk food into a more easily understood context. An example of this would be a statement such as "to burn the calories contained in this product, you would need to climb 6 flights of stairs". This type of label has received less attention than others due to its lack of generalizability to products and/or individuals.

1.2.3 Advertising

Food products are very heavily advertised. In the US alone, the food industry spent about $3.8 billion on advertising in 2013, with McDonalds spending $976

million and Kraft Foods spending $376.2 million (Statista 2014). Globally, advertising on food reached $516.47 billion in 2013 (Statista 2014). A 2008 report estimated that food and beverage manufacturers spend around $2 billion annually marketing their products to children (Kovacic and 2008). Legislation prohibiting the advertising of unhealthy foods to children is currently under review in Canada and could pass in the next year (Weeks 2018).

Despite the evidence that both parents and children are exposed to high levels of food advertising, it is not clear how this advertising is affecting our diets and subsequent levels of obesity. Several studies have found that it is predominantly energy dense, nutrient poor food products that are being advertised (Folkvord et al 2016, Boyland and Whalen 2015, Sonntag et al 2015). In a study examining children's exposure to television and advertising in Australia, Dixon et al (2007) found that increased television viewing led to higher self-reported consumption of junk food by children. Halford et al (2004) found that increased exposure to television adverts resulted in increased consumption of the advertised foods in children aged 9-11 while Lobstein and Dibb (2005) found a positive association between the amount of nutrient-poor energy-dense food advertising and the proportion of children who were overweight. A study by Veerman et al (2009) estimated that by decreasing the exposure of 6-12 year olds in the US to zero food advertising, the prevalence of obesity would be decreased by approximately 2.5 percentage points.

Given that the evidence suggests some kind of link between food advertising and children's consumption of nutritionally-poor foods, banning the advertising of unhealthy foods to children has been proposed. Currently in Canada, Advertising Standards Canada has a code specific to advertising to children in an ethical and appropriate fashion (ASC 2014), but this is a self-regulatory approach and thus is not enforceable by the government. As mentioned, the federal government is currently looking into banning the advertising of junk food to children in Canada. Quebec, however, has had a ban on advertising targeting children since 1980, and fast food consumption has been found to be significantly lower in Quebec (Dhar and Bayliss 2011). While there are many potential explanations for the differences in

fast food consumption between Quebec and the rest of Canada, this link shouldn't be ignored.

1.2.4 Regulation of Food Manufacturers

There are various factors influencing the nutrient content of foods, such as the availability and cost of ingredients, the firm's objective function and marketing strategy, perceived market demand for nutritious foods, the actions of competing firms, and the regulatory environment in which the firm is operating. Understanding how these components affect the nutritional profile of children's food products is important to know because even minor changes in them could have significant impacts on children's health outcomes.

From a consumer policy perspective, rather than adopting policies aimed at influencing children or parents' food choices, the government could choose to go straight to the source and place mandatory nutrition standards on food produced primarily for children. This could include placing upper limits on the amount of sugar or sodium permitted in a typical serving of a product or a lower limit for vitamins or fibre. For example a standard sized granola bar could be limited to contain no more than 6 grams of sugar and at least 4 grams of fibre. The benefit of this type of approach is that all consumers of the regulated products would be better off nutritionally. The drawback is that it infringes upon the consumer's freedom of choice and could impose additional costs on firms. New York City imposed a policy to protect consumers by requiring that restaurants eliminate the trans-fat content of their foods by 2008 (Angell et al 2009). Argentina has recently passed legislation to limit the allowable amount of trans-fats in foods (Rubinstein et al 2015). A ban on trans fats in Canada and the US was just implemented in 2018 (Health Canada 2018, FDA 2018).

Some types of regulations, such as labeling regulations do not limit consumer choice but rather provide more information to the consumer so that they can make better choices. In Canada and the US, a regulation mandating that nutrition facts panels on food packaging include the amount of trans-fat came into effect in 2005. This labeling regulation resulted in the large-scale reformulation of products to

reduce or eliminate the trans-fat content of foods (Ratnayake et al 2008). Some regions have mandated that restaurants include nutrition information on menus which has resulted in a decrease in the content of sodium, saturated fat, and calories, although the amounts still exceed recommended levels (Bruemmer et al 2012).

Policies could also be targeted at the other factors that play a role in determining the nutritional profile of foods, such as adjusting the input prices faced by firms or placing restrictions on advertising.

1.2.5 Limiting access to junk food

Another proposed policy to improve children's diets is the banning of unhealthy foods from schools, be they from cafeterias or vending machines. In 2005, New Brunswick was the first of 6 provinces to ban junk food in Canadian schools, the most recent being Ontario in 2011, and this ban has resulted in small but significant declines in students' BMI (Leonard 2017). In 2007, the state of California implemented a policy banning the sale of junk foods (candy bars, soda, etc) from vending machines in schools and implemented salad bars as part of lunch cafeteria fare (Suarez-Balcazar et al 2007). A 2012 report found that since this policy had taken effect, average daily caloric intake had decreased by 158 calories, as had the consumption of fat and sugar (O'Connor 2012). Despite these promising results, this type of policy has not become common in the rest of North America due in part to concerns about the financial repercussions of such actions and partly due to the additional manpower and knowhow it requires to substitute junk food with perishable healthier options.

1.3 Problem statement

People's food choices can have negative externalities on society due to the financial burden they impose on the health care system, as well as on their own lifetime utility in the form of long-term health issues. This makes diet-related policies a priority for many governments. Given that children merit higher levels of protection as consumers than adults do, policies to improve the diets of children and

protect them from high levels of sugar, sodium, and excess calories are being advocated by many parties. Financial instruments, especially taxes, are the more popular instruments due in part to some degree of empirical evidence, but also because they do not infringe on consumer sovereignty and because they can potentially generate revenue (Faulkner et al 2011). Label mechanisms have also garnered support because they inform consumers rather than restricting their choices (Swinburn and Egger 2002), and will soon be found on Canadian grocery store shelves.

Children's food choices are influenced by various factors within the food environment. In many situations, their choices are limited to what is provided to them by their parents or what is available to them at school, but some children may have access to supermarkets, convenience stores, vending machines, or food service establishments. When choosing what to eat, a child or their parent likely subconsciously narrows down all of the available options to a subset of familiar foods predetermined by previous exposure, familial influences, known preferences, and knowledge about healthy eating. Children's choices from within this subset may be affected by food prices, the advertising they've been exposed to, or information found on food packaging. If they are affected by these factors, the suggested price and label policies could be effective in helping them make better choices. If they are not, some type of manufacturer regulation would likely be the most effective policy in improving children's diets. In order to take this approach, we need to better understand how various factors affect firms' decision making as the nutrient profiles of foods could be affected by prices of ingredients, market structure, public awareness of nutrition issues, advertising and/or product line diversification. These factors need to be explored before regulating manufacturers could be recommended.

Poor dietary choices are creating externalities. Affecting dietary changes could help to mitigate these externalities, but before this can be done, we need a better understanding of how different factors influence decision-making (of both consumers and manufacturers). The effectiveness and equity of the aforementioned

policies will be estimated empirically to help inform potential policies that could address the diets of children.

1.4 Study objectives

The objective of this study is to inform potential policies that could be implemented by the government in an effort to improve children's diets and subsequent health outcomes. The policies that will be investigated are 1) a tax mechanism, 2) a traffic-light or warning label, and 3) a regulation on food manufacturers. The tax and warning label mechanisms address factors that could influence parents' or children's food choices while the regulation of food manufacturers would address the manufacturer's strategic decisions in order to improve the nutritional profile of foods targeted at children and bypass the consumer choice aspect completely.

1.5 Description of papers

The first paper of this dissertation will address children's willingness to pay for food with different price and label characteristics when purchasing the food directly for themselves. How their preferences are affected by their age, gender, and cognitive abilities will be assessed. This will be achieved through the use of a choice experiment conducted with children aged 8-12 along with a questionnaire pertaining to food purchasing behaviours and various tasks assessing cognitive abilities. The policy instruments tested are a tax and a traffic light style label, which will be applied in some scenarios to less healthy products. Given our assumption that they are maximizing utility subject to a budget constraint, the children will choose their utility maximizing bundle (making trade-offs between price, brand preference, and label information) in several scenarios and this will allow us to determine their sensitivity to price and label mechanisms.

The second paper of this dissertation will examine parents' willingness to pay for foods based on the product's price and presence of an explicit text based warning label. Rather than assuming the parent will choose only one product,

however, we will construct an experiment where the parent can choose multiple products in varying amounts as if they are making purchases for a month. This will allow for the reduction rather than elimination of purchases of products with a warning label which could be more realistic. If the parent is deriving utility from both the child's happiness and the child's expected long-term health, they will want to choose products that they know the child likes and more often that are healthy (ie: no warning label). However, they may need to make trade-offs between these objectives when they are not aligned, all while adhering to their budget constraint, keeping in mind that it doesn't matter how healthy a product is if the child won't eat it. Positive dietary changes could be affected if parents prefer to purchase healthier products without warning labels and their child is willing to consume them. If the parents do not respond to the warning label, this mechanism will not be effective. This paper will explore how parents would respond to a warning label (in terms of frequency of choice) and how this response might differ based on individual-specific characteristics such as nutrition knowledge.

The third paper of this dissertation will assess whether or not there is any merit to regulating the manufacturers of children's food. This will be done by examining the firms' decision-making via the outcome of nutrient profiles of their products and how they've adjusted over time in response to nutrition trends in the media, recommendations by third-parties, and regulations from the government (such as mandatory trans-fat labeling). If the nutrient profiles of products have adapted and improved without direct government mandates, be it to adjust to consumer demand for healthier products or to appear like a socially responsible corporation, a manufacturer regulation would likely be unnecessary or inefficient. However, if products are getting nutritionally worse or increasingly segmented (a super healthy kind for nutrition-conscious consumers with a sugar-packed variety for kids), this could be grounds for putting mandatory nutrient standards in place. In addition to the nutrition aspect of these products, prices and advertising will also be considered, as lower prices and/or higher advertising of less healthy products could be encouraging their consumption.

1.6 Contribution of study

This study will endeavor to improve the understanding of how extrinsic food characteristics, namely price and labeling mechanisms, affect children's and parents' food choices, thus hoping to inform policy designed to improve the diets of children. If behaviour can be modified through the provision of information via food labeling or through a price mechanism, a policy utilizing one of these approaches to improve children's diets without infringing on consumer sovereignty could be recommended. This research will also give some insight into the possible effects that the upcoming warning label will have on the purchases of Canadian consumers. Firm behaviour will also be examined to determine how various factors such as input prices, public health focus, and the regulatory environment affect the nutrition profile of their products. If desirable outcomes cannot be achieved through the modification of extrinsic food characteristics, policies affecting firm decision making and thus impacting intrinsic food characteristics, namely their nutrition profiles, could be the more effective approach to improving children's diets.

By eliciting a better understanding of children's and parents' decision making with respect to food and how the aforementioned policies can affect their choices, as well as exploring the potential of firm level policies, this study will help to determine the most effective approaches in improving children's diets. More specifically, this study will contribute the literature by providing evidence as to how children react to traffic light style labels and price changes when purchasing food for themselves, how parents react to a warning label and price changes when purchasing food for their family, and what factors influence food manufacturers to produce healthier products.

Chapter 2: Children's response to price and label interventions

2.1 Introduction

As discussed in the introductory chapter, there are many factors influencing children's food choices. Although parents and institutions are largely responsible for providing children with food, it is the children themselves who ultimately choose whether or not to consume it. In some situations, however, we need to consider that children could be purchasing food independently. Many kids have a vending machine or cafeteria in their school or at a recreational facility where they can buy food. Some may have a grocery store, corner store, or fast food restaurant within easy walking distance of home or school. These kids may receive an allowance from their parents that they might use to purchase food or their parents might give them money specifically to buy food with if they are unable to send a lunch or snack to school or extracurricular activities with their child. Given that our overall objective is to evaluate the effectiveness of potential policy tools to improve children's diets, it is critical that we consider children's autonomous food purchasing decisions and their responses to these policies.

When considering the effectiveness of various policy mechanisms, researchers typically assume they're dealing with an adult who behaves as a rational economic agent. Rarely are children studied as consumers. Can we apply the same assumptions to them as we do to adults? Do kids even care about prices? How do they differ as consumers from their grown-up counterparts? And how does their level of cognitive development affect these similarities or differences? This study attempts to provide some insight into how children behave as consumers while addressing the overall objective.

The economic objective of this paper is to explore how children respond to two of the proposed policy instruments: price and label mechanisms. What we really want to know is if a child decided to buy a snack at a vending machine or in a convenience store, whether their choice would be affected by a price or something they saw on the label, such as the impending warning label soon to be implemented by Health Canada. If it was, we could use this information to help increase the

likelihood that children will buy the healthier options. To address this, a simulated purchase environment where a child is choosing a pre-packaged salty snack is created with legitimate, recognizable brands. In order to determine whether the children exhibit any sensitivity to price changes or a traffic light style warning label, prices will be varied and the traffic light label will be applied to the products higher in saturated fat and calories on some occasions. Given that children develop at different rates and that they have a wide range of cognitive abilities, it is also of interest to consider whether the policies would elicit an equitably distributed change or if only some segments of the child population would be affected. Therefore, measures of cognitive development (such as IQ and vocabulary) in addition to age and gender will be used to explain variation in responses to pricing and label interventions.

Following this introduction is a literature review exploring the use of price and label mechanisms to influence food choice as well as considering children as consumers. Next the methods and data collection are discussed, then the analysis and finally the conclusion.

2.2 Literature Review

2.2.1 Taxes

Most commonly referred to as a 'fat tax', the name implies that the tax is applied to foods high in fat, which is not necessarily the case; more broadly the instrument should be called a health related food tax. Food taxes have been proposed as a policy instrument to improve diets in many countries for the past decade and beyond. Countries such as Norway, Samoa, Australia, Fiji, Finland, Hungary, Denmark, and France have implemented various taxes on unhealthy foods with the focus being largely on soft drinks and foods high in sugar (Mytton et al 2012). While the US does not have a national tax applied to sugary drinks, many cities, starting with Berkeley, California in 2015 followed by Philadelphia, Pennsylvania and many others (some still to be implemented in 2018) have applied a soda tax to reduce the consumption of sugary beverages (Boseley 2017). As such,

there has been a fair amount of research dedicated to determining how effective health related food taxes are or could be.

A study examining the effectiveness of the soda tax in Berkeley (Falbe et al 2015) showed a 26% decrease in the city's soda consumption. A similar study in Brazil also found that a soda tax did in fact reduce consumption (Claro et al 2012) as it did in Mexico (Colchero et al 2017). However, it should be pointed out that Debnam (2017) found heterogeneity in consumer response to the soda tax in Berkeley, with those in the high-consuming households being less responsive to price changes. Cawley and Frisvold (2017) found that across all brands and sizes of SSBs, 43.1% of the Berkeley tax was passed on to consumers, and that this level increased as the distance to the closest store exempt from the tax increased. Therefore the policy is not affecting consumer prices to the extent it was expected. It has also been reported that when a soda tax was briefly imposed in Cook County, Illinois, many people drove to nearby Indiana to stock up on SSBs (The Economist 2017). It should also be noted that just because consumers decrease their soda consumption, it doesn't necessarily mean that they're substituting it with a healthier option. It is important to keep in mind that findings on beverage consumption are not necessarily transferable to food decisions; sugary drinks are not a necessity, and water is a widely available and much cheaper substitute when sugary drinks get more expensive. There is not, however, a similar substitute for food products, so the price elasticity of food is lower than for beverages. As such, the transferability of these results on the effectiveness of a tax on 'junk' food is not clear.

The Danish tax on saturated fats provided an opportunity to see how effective a fat tax would be; a study by Smed et al (2016) using scanner data found that the tax resulted in a 4% reduction in saturated fat intake. In addition, they found that vegetable consumption increased, as did salt intake for most population groups. Mexico also imposed a tax on high energy density nonessential foods which resulted in a 10.2% decline in the amount of taxed foods low income households purchased; middle income households purchased 5.8% less of the taxed foods while high income households did not change their purchases (Batis et al 2016). Taillie et al (2017) found that the purchases of taxed foods in Mexico declined with the greatest

change being among families who were the most frequent purchasers of the taxed products before the tax was introduced.

An ex-post study assessing how a fat tax affects nutrients purchased by households in France found that the effects were small and ambiguous (Allais et al 2010). Using the 2005-2006 UK Expenditure and Food Survey to construct demand equations, Tiffin and Arnoult (2011) estimated that although a tax could reduce consumption of saturated fat, it was insufficient in reducing it enough to improve health outcomes. They did find, however, that a subsidy could increase average fruit and vegetable consumption to the recommended levels. When examining scanner data for dairy product consumption in the US, Chouinard et al (2005) estimated that a fat tax on dairy products would not reduce fat consumption significantly. Mytton et al (2007), using data from the National Food Survey in Great Britain, found that taxing primary sources of saturated fat would not improve health outcomes due to substitution behaviours, but that taxing unhealthy foods would have modest improvements in health outcomes largely due to reductions in sodium consumption. Regardless of effectiveness, the main criticism of food taxes is that they place a much larger burden on lower income households (Allais et al 2010; Madden 2015).

All of this research focused on adults; none was found pertaining to children's responses to food taxes. One study by Just and Price (2013) did find that by providing a financial reward (the opposite of a tax), elementary school aged children increased their fruit and vegetable consumption, more so if they were in low-income neighborhoods. It is possible that children will react differently to taxes than adults do, perhaps due to their limited disposable income, less developed financial competency, or that they are more likely purchasing extraneous snacks. This portion of the research will explore how children respond to financial mechanisms imposed on snack foods.

2.2.2 Graphic labeling mechanisms

Various types of label mechanisms beyond just the nutrition facts panel have been proposed to help consumers make healthier choices. Many of these initiatives

have been led by third parties who offer endorsements such as the Health Check symbol in Canada, the Pick the Tick logo in New Zealand and Australia, and a Healthy Choice symbol in Singapore to healthier products in exchange for a licensing fee. What should be pointed out about these programs is that most simply point out 'healthier' products, they don't tell a consumer when something they're choosing is unhealthy. The traffic light food labeling system, which was developed by the Food Standards Agency (a department of the Government of the United Kingdom) has been widely used in the UK on a voluntary basis, uses red, green, and amber signals for the amounts of sugar, salt, and fat in a product, making it easier for consumers to discern the more or less healthy choices with a glance at the front of the package.

A study examining vending machine purchases found that when items were colour coded, purchases of the 'red' items (least healthy) decreased by around 5% (Garson and Engelhard 2007). In a study examining explicit vs. subtle health messages in snack choices, Wagner et al (2015) found that subtle messages indicating a healthy choice (such as a heart with checkmark symbol) were more effective in encouraging healthy snack choices than explicit messages (such as the words "A Healthy Choice"). They theorize that explicitly labelling a food as healthy may imply that the food tastes bad or lead to reactance. In traffic-light style label research, Sacks et al (2010) and Kelly et al (2009) found that consumers were more likely to choose healthier products when the traffic light label was included on the food package, and Balcombe and Fraser (2010) found that consumers avoided products with a red light. More recently, Boncinelli et al (2017) found that among college students, a high-calorie warning label had little effect on respondents' choices. In a study examining preferences for SSBs among New Zealand youth (aged 13-24), Bollard et al (2016) found that all the interventions they considered (warning label, tax, and plain packaging) significantly reduced respondents' purchase probability of SSBs.

Very little research pertaining to children's responses to a graphic labeling mechanism or nutrient information on food packaging was published until quite recently. One study evaluated consumer perception of the traffic light label in Ecuador, and found that although some consumers used the label to help them

choose food products, children and adolescents reported using them infrequently (Freire et al 2017). Another found that American adolescents (aged 12-18) were less likely to purchase SSBs when a warning label was present (VanEpps and Roberto 2016). Children's responsiveness to traffic light labels will be investigated in this study because knowing whether children's choices will be affected by some type of warning about the inappropriate nutritional content of a food is an important aspect of designing policies to improve children's diets.

2.2.3 Children as consumers

A survey conducted in 1998 found that American children get about $9 billion annually in pocket money and gifts; because of their wealth, children aged 8-12 are a significant market (Gunter and Furnham 1998). It was estimated that in 2002, American 4-12 year olds spent $30 billon (Schor 2004). A large proportion of children's disposable income is spent on food. A 2012 study conducted in Ontario, Canada, found that 65% of grade 7 and 8 students surveyed reported purchasing food at either fast food outlets or convenience stores (He et al 2012). Dennisuk et al (2011) found that 10-14 year olds surveyed in Baltimore, USA, on average purchased food at corner stores twice per week and that chips, candy, and soda were the most commonly purchased items. In Australia, Finch et al (2006) found that less healthy foods and high sugar drinks were the most commonly purchased products at school canteens by children in grades 1 through 6. A study of junior-senior high schools in Minnesota found that the availability of less healthy snacks and drinks in schools was associated with a small but significant increase in BMIs (Nanney et al 2016). Given this evidence that many children have a disposable income and often use it to purchase unhealthy food, examining how they would react to the proposed policy measures is merited. If we can gain a better understanding of what affects children's food purchasing decisions, we can assist in the development of policies to help children choose healthier foods, thus improving their diets and lowering the incidence of chronic diseases in the future.

2.2.4 Children's ability levels

Several studies have examined children's cognitive capabilities, patience, and honesty in order to better understand what influences their economic behaviour. According to the literature, as children enter the phase of late childhood to early adolescence, they begin to make choices about how to spend their money and allocate their time (Lundberg et al 2009). From the age of eight to sixteen, children rapidly develop the skills to weigh options and make rational choices (Keating 1990).

Using mathematical scores as a proxy for cognitive ability, Harbaugh et al (2001) found that children with higher cognitive levels made more rational economic choices up to age 12, at which point they behaved consistently with college students. Another study by Harbaugh et al (2003) found that bargaining behaviour among children changes with age and height, but not by gender. Bettinger and Slonim (2007) found that in general, children's choices exhibit hyperbolic discounting and that more specifically, girls, older children, and kids with higher mathematical scores are more patient.

2.3 Objective and Research Question

The overall objective of this dissertation is to evaluate potential policy tools to improve children's diets; the focus of this study is to determine how children would respond to price and label mechanisms and how this response might differ based on age, gender, and cognitive abilities. If, for example, children with higher cognitive abilities were more responsive to price interventions, that would mean that a tax policy would have greater impacts in some groups of children than others. Therefore it is important to consider not only the overall effectiveness of the different mechanisms but also how the child-specific characteristics play a role.

2.4 Methods

In order to address the research question, an incentive-compatible choice experiment involving real snack foods and money was conducted with children aged 8-12. This was done in order to emulate real-world purchases and thus elicit realistic responses. The attributes of the purchase experiment were brand, price, and a traffic light label. There were four types of pre-packaged salty snacks used, they had four price levels in order to be able to identify price sensitivity, and there was a traffic light label which could appear on two of the higher fat products. In addition to the choice experiment, children participated in several tasks used to evaluate their level of IQ, verbal mental age, and executive functioning. Participants also filled out a questionnaire giving their age, gender, allowance, and food purchasing habits. It was decided to utilize the child's age in months rather than grade as it could provide a more precise measure and the use of both would lead to multicollinearity. More detail about data collection can be found in section 2.4.2.

This combination of cognitive assessment data and a choice experiment is uncommon in and of itself, but no other studies have been found that collected both types of data with children. This gives us an opportunity to see how a child's level of cognitive development affects their responsiveness to a price and/or label mechanism.

2.4.1 Theoretical Model

This choice experiment and cognitive task data will allow us to identify children's sensitivity to price and label mechanisms and how it varies with cognitive ability. The theory behind choice experiments is the random utility model (RUM) (Verbeek 2008 pg.220-223). Random utility theory is used to elicit non-market valuations for attributes which cannot be purchased independently of each other. It builds on Lancaster's (1966) theory which considers goods to be bundles of attributes rather than homogeneous. The main assumption of the RUM is that each respondent will select the option from the set of alternatives that gives them the most utility. In this scenario, we assume that the child will choose the type of snack, possibly with a traffic light label, at the associated price that gives them the greatest

utility. The attributes of which the chosen alternative is comprised determines the utility derived from the given option. This utility can be expressed as:

$$U_j = U(X_j) \quad (1)$$

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

$$V_{nj} = V(X_j, A_n) \quad (2)$$

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

$$U_{nj} = V(X_j, A_n) + \varepsilon_{nj} \quad (3)$$

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

$$U_{nj} = \beta'_n V_{nj} + \varepsilon_{nj} \quad (4)$$

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

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

$$P_{jn} = \frac{\exp(\mu V_{jn})}{\sum_{k \epsilon C_n} \exp(\mu V_{kn})} \quad (5)$$

where P_{jn} is the probability of choosing j on occasion n, μ is a scale factor (assumed to be 1), and V is indirect utility.[1]

2.4.2 Data collection

After receiving permission from the YMCA childcare program head for the Edmonton, Alberta area, numerous YMCA afterschool childcare centres around the city were contacted in an effort to recruit participants. The centers interested in

[1] Using a scaled MNL model was attempted in order to allow for heterogeneity but the sample size was insufficient to generate significant estimates.

taking part in the study were given information sheets to send home with the children, then the children who wanted to participate were given consent forms to have signed by their parents. Once consent forms were returned to the centre, dates to conduct the research at the facility were coordinated. Initially, 60 children aged 8-12 were participating in the study, but 2 of them completed only a portion of the tasks and were unavailable to finish at a later date. Each child completed a short questionnaire pertaining to allowance received and snack food purchases (see Appendix 2A), participated in a purchase experiment, and did several tasks used to evaluate various aspects of their cognitive development. As recommended by a developmental psychologist, the tasks used to evaluate cognitive measures in the participating children were the Peabody Picture Vocabulary Test (PPVT) which assesses the child's verbal mental age, the Stanford Binet Intelligence Scales (non-verbal) which is a standardized test used to evaluate the child's IQ, the Sort task which assesses organization and categorization skills by asking the child to sort shapes with their hands that they are unable to see, the Tower of London task which assesses planning and anticipation by asking the child to move pieces on a game to match a picture, the Circle Trace task which measures impulse control by asking the child to trace over a circle printed on letter sized paper as slowly as possible, and finally the Stroop test which assesses impulse control and working memory by having them read words and name colours on a page as quicly as possible. The Sort task, Tower of London task, Circle Trace task, and Stroop test all evaluate different components of executive functioning and are therefore combined to generate an overall measure of executive functioning. The developmental variables included in the analysis are therefore IQ (from the Stanford Binet task), verbal mental age (from the Peabody Picture Vocabulary Test), and executive functioning.

In order to evaluate whether the surveyed children were autonomous consumers of food, the questionnaire asked them whether they got a weekly allowance, and if so, how much was it and did they ever use it to purchase food, as well as whether their parents ever gave them money specifically to purchase food with. They were also asked to check any foods on a list that they purchase independently from their parents.

The purchase experiment was designed to elicit children's preferences for various snack foods with different prices and the occasional inclusion of a traffic light style label indicating that the snack wasn't a healthy choice. A 96 choice set efficient design based on a fractional factorial design and some parameter estimates was generated using Ngene. These choice sets were broken down into 8 blocks of 12. Each participant was randomly assigned a block of 12 choice sets, each of which gave the child 2 snack options (individual-sized bags of salty snacks) in addition to a 'neither' option (A, B, or none). Each child was given $2.00 in Canadian coins to keep or use in the task, and real packaged snacks were used in the experiment. Upon completion of the 12 choice sets, one was drawn at random and the transaction actually carried out with the snacks and prices in question. This process was explained to the children prior to beginning the purchase experiment, and they were permitted to ask as many questions about the process as they liked until they felt that they understood how it worked. The fact that the children were aware that one of their choices would be binding makes them more likely to make choices which reflect their true purchasing behavior. Any of the 4 price levels ($0.75, $1.00, $1.25, and $1.75) could be associated with any of the 4 brands, but the traffic light labels were only ever applied to the Original Lay's Potato Chips and the Cheetos Cheese Puffs as they are higher in fat and calories than the other two options (Baked Lay's Chips and Rold Gold Pretzels).

The label mechanism incorporates a red traffic light image as well as the statement "Health Canada recommends eating foods like this less often because they are high in calories, fat or sodium". This label mechanism was pre-tested by a pilot sample of 10 children to ensure that it was easy to understand and conveyed the correct message. The general feedback from the participating children was that it was easy to understand, so no modifications were made to it. The traffic light label is displayed in Figure 2.1 below and the children's comments about it are shown in Table 2.1.

Figure 2.1: Traffic Light label mechanism used in choice experiment

Table 2.1: Children's comments about the traffic light label

would only affect someone's choice if they were health conscious
easy to understand *****
I might be less likely to purchase something with this label ****
good to know because you could get a disease if you don't eat healthy
wouldn't affect my decision because I don't eat these types of snacks very often
won't affect choices of most kids **
the red dot is weird
it should be more specific (It says high in calories, fat, OR sodium – which one is it?)
if I see it, it might make me read the nutrition label for more info
good idea because companies are interested in profits, not in people's health

(indicates how many children made the same comment)*

Table 2.2: Descriptive statistics of sample(n=58)

Variable	**Mean**	**Standard Deviation**
Age	9.91 years	1.1399
Gender	69.7% female	
IQ	72.8%	0.1326
Vocabulary	81.1%	0.1099
Executive Functioning	64.9%	0.1106

Table 2.3: Number of times each product was shown and chosen both with and without the warning label

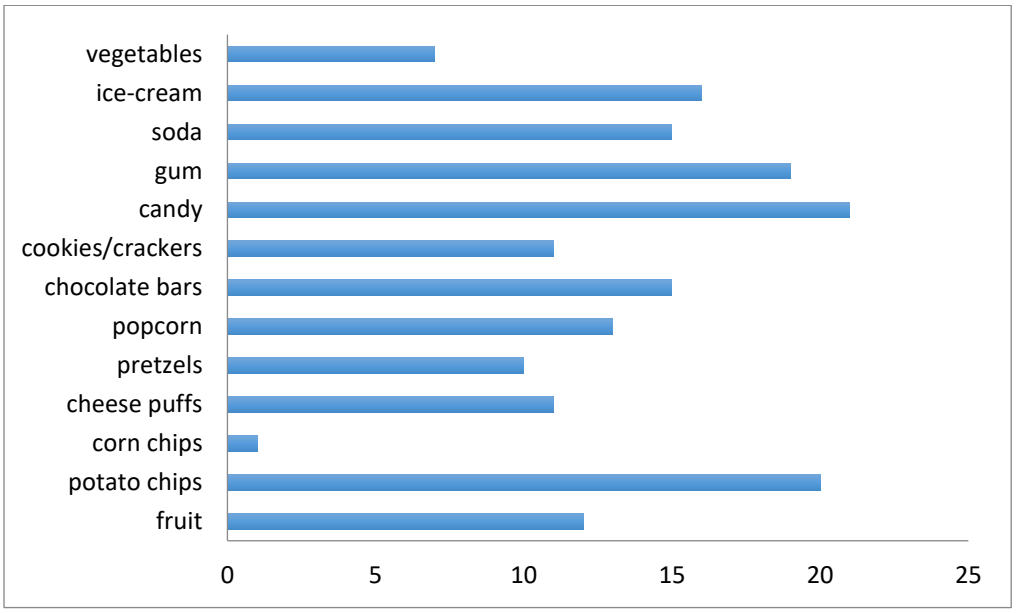
	No Warning Label		Warning Label	
	# shown	# chosen	# shown	# chosen
Baked Lay's Chips	257	43	0	0
Lay's Potato Chips	260	99	85	21
Cheeto's Puffs	272	72	82	18
Rold Gold Pretzels	256	65	0	0

These data were collected between November 2012 and August 2013 by the author and three other research assistants. Interviews were conducted in two sessions in order to maintain the focus of the children as it typically took 90-120 minutes to complete all of the tasks. One session was comprised of just the Stanford Binet test which could take as long as one hour; all other tasks, including the choice experiment, were conducted in another session. Two children were not available for a second interview and were therefore omitted from analysis.

2.5 Analysis

The first step in the analysis is to examine the descriptive statistics to assess the disposable incomes and food purchasing behaviours of the children in the study. Based on answers to the questionnaire, we found that within our sample, 44% of children receive a weekly allowance. Of those who do receive an allowance, the average weekly amount is $6.46, and 69% of kids say that they sometimes spend this money on food purchases. 80% of the children in this sample said that their parents sometimes give them money with which to purchase food. Given these numbers, it is entirely appropriate to think of children in this age range as autonomous consumers when it comes to purchasing food and thus they should be considered when developing policies. When asked about the types of foods purchased autonomously, the children reported predominantly choosing energy-dense nutrient-poor foods, with candy and potato chips being the most common.

Figure 2.2 The number of children (out of 58) who reported purchasing the following types of food independently



2.5.1 Estimations

To analyze the choice experiment data, the basic multinomial logit model is first run with only the brands (omitting the pretzels for normalization), price, warning label, and a 'neither' option (the alternative specific constant).

Table 2.4: Results from the basic multinomial logit regression.

	Coefficient	Standard Error
Price	-0.946***	0.166
Baked Lay's	-0.422***	0.129
Lay's Classic	0.409***	0.100
Cheetos	0.048	0.105
Warning label	-0.201*	0.104
None	-0.468**	0.200
LLF	-659.102	
AIC	2.034	
BIC	2.075	

***, **, and * indicate statistical significance at 1%, 5%, and 10% respectively
Rold Gold pretzels are the omitted brand category.

This basic model indicates that children prefer products with lower prices, and when holding prices constant prefer Lay's classic potato chips to Rold Gold pretzels (omitted as the base case), yet prefer Rold Gold pretzels to Baked Lay's chips. These results also show that children would avoid products with a traffic light warning label. Based on these values, we can determine what children are willing to pay for the various attributes by dividing the coefficient for the attribute in question by the negative of the price coefficient. In this sample, children are on average willing to pay $0.45 less for Baked Lay's chips (relative to pretzels), $0.43 to get Lay's Classic chips (relative to pretzels), and $0.21 less for a product with a warning label on it.

Next, in order to determine the effects of the development measures with respect to changes in price and the inclusion of a warning label, interaction variables are included in the model. The child-specific cognitive characteristics as well as age and gender are first interacted with price, generating the following results:

Table 2.5: Results from the multinomial logit regression with price interactions.

	Coefficient	Standard Error
Price	0.164	0.757
Baked Lay's	-0.453***	0.130
Lay's Classic	0.436***	0.102
Cheetos	0.046	0.107
Warning label	-0.216**	0.107
None	-0.738***	0.208
Price*Executive Functioning	-2.635***	0.840
Price*Verbal Mental Age	-1.280	1.147
Price*IQ	1.862**	0.810
Price*female	1.128***	0.175
Price*age	-0.070	0.101
LLF	-609.614	
AIC	1.970	
BIC	2.048	

***, **, and * indicate statistical significance at 1%, 5%, and 10% respectively

Table 2.6: Results from the multinomial logit regression with warning label interactions.

	Coefficient	Standard Error
Price	-0.946***	0.168
Baked Lay's	-0.432***	0.130
Lay's Classic	0.418***	0.101
Cheetos	0.052	0.107
Warning label	-0.010	0.955
None	-0.544***	0.202
Warning Label*Executive Functioning	-1.207	1.144
Warning Label*Verbal Mental Age	-2.010	1.609
Warning Label*IQ	1.335	1.073
Warning Label*female	0.216	0.219
Warning Label*age	0.110	0.139
LLF	-638.090	
AIC	1.298	
BIC	1.359	

***, **, and * indicate statistical significance at 1%, 5%, and 10% respectively

In addition to providing the same inferences as the basic model, these results also indicate that children with higher executive functioning scores are more price sensitive and children with higher IQs are less price sensitive. It also shows that boys are also more price sensitive than girls in our sample.

The same child-specific characteristics were also interacted with the warning label, but the lack of statistically significant interaction coefficients in this model showed that children with differing cognitive abilities, age, or gender do not respond differently to a red traffic light label (see Table 2.5). Having said that, because there is heterogeneity in price response, different groups do have differing WTP's for different product attributes.

2.5.2 WTP calculations

Using the estimates from Table 2.4, price coefficients were calculated for children with different characteristics and these were subsequently used to calculate their WTP for the different brands and for the traffic light warning label. Price coefficients are shown in Table 2.6 while WTP values are shown in Table 2.7.

For this purpose we classify a low score as the 25th percentile and a high score as the 75th percentile.

Table 2.7: Price coefficient (β_p) for children with different gender, executive functioning (EF), and IQ characteristics.

	β_p	Standard Error
Female, low EF, high IQ	-0.41**	(0.201)
Female, high EF, low IQ	-0.96***	(0.181)
Male, low EF, high IQ	-1.54***	(0.242)
Male, high EF, low IQ	-2.08***	(0.252)

Table 2.8 Price discount required when traffic light label present to make people as well off as they were without it and WTP for different brands (relative to Rold Gold Pretzels) in $CAD for kids with different characteristics.

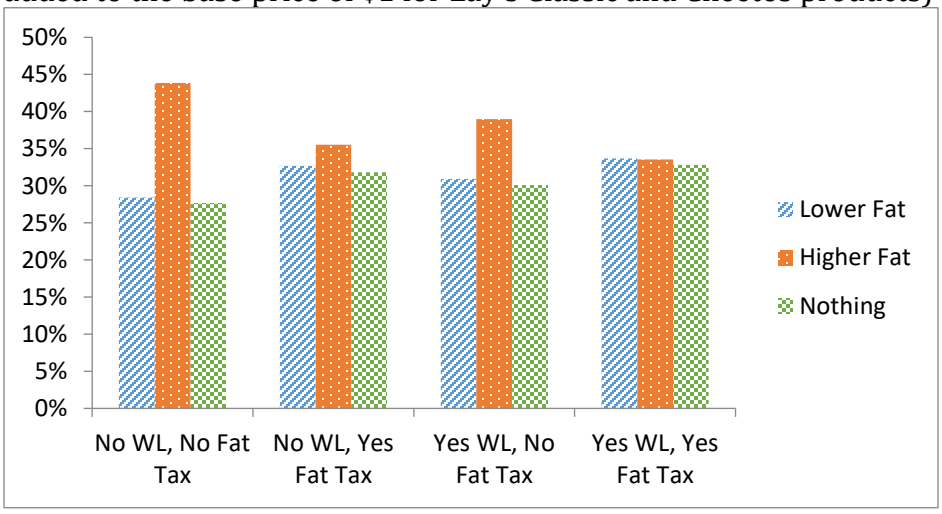
	traffic light label	WTP Baked Lays	WTP Lays	WTP Cheetos
Female, low EF, high IQ	0.52	-1.096*	1.056*	0.11
	(0.367)	(0.620)	(0.565)	(0.265)
Female, high EF, low IQ	0.23*	-0.47***	0.46***	0.05
	(0.121)	(0.162)	(0.135)	(0.113)
Male, low EF, high IQ	0.14*	-0.29***	0.28***	0.03
	(0.073)	(0.096)	(0.078)	(0.070)
Male, high EF, low IQ	0.10*	-0.22***	0.21***	0.02
	(0.053)	(0.067)	(0.054)	(0.052)

Tables 2.6 and 2.7 illustrate how individual characterisitics influence price sensitivity and subsequently WTP for different product attributes. Girls with low EF and high IQ have the lowest price sensitivity and thus the highest WTP to get their desired brand. Girls with high EF and low IQ have the next lowest price sensitivity along with second highest WTP values. Boys with high EF and low IQ are the most price sensitive and have the lowest WTP values for all attributes, while boys with low EF and hight IQ are the second most price sensitive and have the second lowest WTP values.

2.5.3 Simulation

Among the most commonly discussed obesity-combatting policies are price and label mechanisms. As this chapter explored both, we will examine how a warning label and/or tax (in various combinations) could impact purchase probability of higher and lower fat salty snacks. Using the basic model estimates to simulate the purchase probability of the lower and higher fat products in scenarios applying a warning label or fat tax (Figure 2.3), we can see that a $0.25 tax would be more effective in reducing the purchase of higher fat products than a warning label, although a warning label is still effective. Obviously a tax can be applied at various levels whereas the warning label is either applied or not, so the level at which a tax should be applied bears some consideration. It should also be noted that when either or both policies are applied, the likeliness of children to choose nothing increases; if the snack would simply be extra unnecessary calories, that's not a bad thing, but in some cases the child's autonomous purchases could represent a significant portion of their daily calorie requirement, so discouraging purchases could be a negative. However, if these policy instruments encourage them to choose healthier items from a different food category not carrying warning labels or fat taxes (such as fresh fruits), the overall outcome would be positive.

Figure 2.3: Purchase probability simulation using estimates from Table 2.3 with and without the traffic light warning label (WL), and with and without a fat tax ($0.25 added to the base price of $1 for Lay's Classic and Cheetos products)



2.6 Discussion

The overall objective of this dissertation is to explore mechanisms to improve children's diets. One important component of this is to help children make healthier food choices for themselves when they are not with a parent or guardian. The goal of this paper was to explore whether food price interventions and traffic light style labels might be effective in encouraging children to choose healthier snack foods when making autonomous purchasing decisions, and whether this effectiveness would differ based on the individual level of cognitive development.

In order to address this, we conducted choice experiments, cognitive assessment tasks, and food questionnaires with children aged 8 to 12. This data set, although not overly large, is considerably unique and thorough in the sense that it combines various facets of cognitive development (verbal mental age, IQ, and executive functioning) with information about decision-making. This study, therefore, provides novel insight into how cognitive development affects food choices and price sensitivity. The results suggest that both taxes and traffic light warning labels could be effective tools in encouraging children to purchase healthier snacks, but that the effect of taxes would likely not be uniform across children with different cognitive abilities, while labels appear to have a more homogeneous effect (assuming prices are held constant). It should also be noted that taxes could be applied at various levels, giving policy makers more flexibility, whereas the traffic light warning label is either present or not.

Although making less healthy foods more expensive could encourage children to make better food choices, this approach would need to be balanced against the overall affordability of food offerings available to children as their autonomous snack purchases may play a non-trivial role in meeting their basic caloric intake needs. Therefore this could be an effective policy tool in situations where healthy options are available at a low price, for example in a school cafeteria. In situations where it is infeasible to make healthy options available at an affordable price, potentially in a vending machine, utilizing a label mechanism would be a good

approach since kids could still afford to eat but the information on the label might encourage them to either choose something different which might be marginally healthier or to plan ahead in future situations and bring healthier snacks with them from home. Either mechanism could help to improve the food choices children make for themselves. This study has provided evidence as to how children would respond to two types of diet-improving policy instruments; policy makers can use this information to determine which would better suit their individual situation in order to promote healthy choices among their young constituents.

Chapter 3: Parental response to label interventions

3.1 Introduction

The policy tools proposed to improve children's diets affect various avenues through which children obtain food. The previous chapter examined children's food purchases direct from retailers. The general finding was that they would respond to both price and label mechanisms, but that price sensitivity varied between children based on gender and cognitive development while the effect of the warning label was more homogeneous. This chapter shifts the focus from children's choices to parents' choices. Parents not only purchase and prepare food for their children, but they also influence long term dietary preferences and habits that could play a role in their child's health throughout their life. Utilizing similar types of mechanisms as the previous study (price and label – although this label is purely text-based and more explicit), this chapter examines how parents would respond to different measures and how these responses differ by individual characteristics. More specifically the policy instrument being investigated in this study is a text-based explicit warning label being placed on the front of the boxes of breakfast cereals high in sugar. This is particularly relevant right now because Health Canada is currently working on the implementation of some type of front-of-package warning label to be applied to products high in sugar, sodium, and/or saturated fat, (current designs being considered can be viewed at link provided in Young 2018) but there is limited evidence pertaining to how consumers will react to this type of mechanism on food products.

It is possible that a warning label indicating that a product is inappropriate for regular consumption by children due to poor nutritional content will affect a parent's willingness to purchase it due to the disutility caused by the label. Some parents might still be willing to purchase a product carrying a label if it were discounted, or some might just purchase it less frequently. The economic objective of this paper is to determine whether this is the case and if so, assess how this reaction varies by individual characteristics such as nutrition knowledge or income level. If only certain segments of the parent population react to the warning label or

are still willing to purchase products carrying it when discounted, the label could prove to be an inequitable regulation.

The analysis for this study will be done in a similar fashion to that of the previous study for ease of comparison. First a basic multinomial logit regression with brands of cereal chosen as the dependent variable is estimated, followed by regressions containing individual interaction and brand interaction variables. Next, WTP for the different product attributes is calculated for parents with different characteristics and for different brands. Finally, a simulation of purchase probabilities for the higher and lower sugar products under the different mechanisms is conducted. This study also included the participation of 30 children of the respondents so that within family comparisons could be done.

Following this introduction a literature review focusing primarily on warning labels and choice experiments, then survey design and data collection are discussed. This is followed by the analysis and results section, then finally the discussion.

3.2 Literature review

3.2.1.What makes an effective warning label?

Warning labels serve two main purposes. "The first goal is to inform people so they appreciate potential hazards. The second goal is to change behavior, that is, to redirect people away from performing unsafe acts that they might otherwise perform." (Wogalter and Laughery 1996 p.33) For a warning to be successful, it must first be noticed and understood, then it should coincide with the person's existing attitudes or at least be persuasive enough to make the person change their opinion, and lastly should motivate the person to comply (Wogalter and Laughery 1996).

In a meta-analysis of text-based warning label effectiveness on a variety of consumer products, Argo and Main (2004) find that consumer attention to warning labels is moderated by vividness-enhancing characteristics, the location on the package, and familiarity of product, but not by type of product. Of great relevance to this study, they also find that product familiarity and compliance cost affect whether

or not people comply with the warning. Frantz and Rhoades (1993) found that the placement of a warning was significant with large variation in subjects who noticed and complied with warnings based on where it was located. Bzostek and Wogalter (1999) found that the presence of an icon and colour reduced the time it took people to notice product warnings and that they found warnings presented in red to be more noticeable. In a study examining how warning label style affected perceived urgency, Adams and Edworthy (1995) found that font size, amount of white space around the warning, and border width around the warning all had an increasing linear impact on perceived urgency with text size having the largest impact followed by border width. They also found that a warning in black text had to be twice as large as red text to achieve the same level of perceived urgency. Laughery et al (1993) found that consumers noticed warnings printed horizontally faster than warnings printed vertically but that the amount of clutter on the label increased the time it took people to notice a warning. They also found that warnings on the front of the package were more noticeable as were warnings printed in colour and those with a border. Braun and Silver (1995) found that consumers were more likely to wear protective gloves when using household chemicals that had a warning printed in red than in green or black. In a recent meta-analysis, Purmehdi et al (2017) found that labels addressing the safe use of a product had stronger effects in changing behavior than did a label targeting cessation or moderation.

3.2.2 Warning labels on products intended for adults

With products intended for use by adults, warnings usually pertain to the hazards of misuse or improper handling of products such as cleaning chemicals, electrical appliances, or prescription medicine. In contrast, alcohol and tobacco are required to have warnings stating the dangers of consuming the product as intended. Many studies have been conducted evaluating the effectiveness of warning labels on tobacco products, especially since Canada imposed mandatory graphic warnings on cigarettes in 2000 (Hammond et al 2004). Canadian laws

require that warning labels on cigarettes are on the front of the package and occupy 30% of its area (Givel 2007).

In a study evaluating the effectiveness of text vs. graphic warning labels among adolescents, Sabbane et al (2009) found that Canadian teens were most discouraged from smoking by the graphic labels but that these were the least effective among American teens. Thrasher et al (2007) found that graphic warning labels elicited negative price premiums for cigarettes among Mexican adults when compared to text only warnings. O'Hegarty et al (2006) found that graphic warning labels on cigarette packages were a stronger deterrent than text-only warnings among smoking and formerly smoking young American adults. Nan et al (2015) also found that graphic warning labels were perceived as stronger in argument strength and generally more effective than their text-only counterparts.

3.2.3 Warning labels on products intended for children

When it comes to products intended for use by children, warning labels are intended to make parents aware of the dangers associated with the product when a child puts it in their mouth, pokes themself with it, hits another child with it, leaves it close to a heat source, plays with the packaging instead of the toy, or a variety of other things children do all the time. In Canada, the Canada Consumer Product Safety Act regulates the warnings that are required on children's products. Virtually every product intended for use by children or babies requires a warning label, including cribs, playpens, sleepwear, shampoos, toys, high chairs, etc. According to Kulak and Stein (2016), there are two essential components of safety labeling in children's products. The first, which is mandatory, is safety labeling for hazards such as balloons or small parts that could present a choking risk. The second is age-labeling, which describes the age of child for which the product is intended, and this is largely discretionary. In addition to helping protect the consumer, these warning labels are motivated in part to protect the product manufacturer from potential lawsuits arising from injuries or deaths involving their product.

3.2.4 Food packaging

There are several regulations imposed on food packaging requirements by Health Canada which were last updated in 2007, including the mandatory nutrition facts panel (which must include trans-fat content) the ingredient list, product name and quantity, expiry date, etc., along with optional nutrition claims. Health Canada also makes the rules about health and nutrient claims as well as what foods must carry a nutrition facts panel and which are exempt. Health Canada is currently evaluating 4 potential warning labels to determine which one will be used on packaged foods in Canada. The chosen warning label will be applied to foods that have more than 15% of the recommended daily value of sugar, sodium, or saturated fat – 30% is the threshold if it's a pre-packaged meal or main dish (Health Canada 2018).

In 2007, 16 food companies formed the Canadian Children's Food and Beverage Advertising Initiative to implement voluntary advertising standards to support healthy eating practices (Dietitians of Canada 2010). Although this is a positive development in that firms are voluntarily establishing industry guidelines intended to protect children, these standards are only voluntary, and food packaging is not considered advertising and thus is not subject to these rules. As such, licensed characters such as Dora the Explorer, Sponge Bob Square Pants, Disney Princesses, and the Simpsons can be found on many food products targeted to children, and many of these products are high in sodium and/or sugar.

Globally, infant formulas must adhere to the international code of marketing of breast-milk substitutes set forth by the WHO in 1981 to ensure that mothers are not discouraged from breastfeeding (WHO 2015). But again this only pertains to advertising, not to product packaging. In 2013, South Africa implemented regulation R991 which prohibits the use of images of babies or any humans on the packaging of infant formulas (SA Dept of Health 2013).

Similar to warning labels on non-food products, a warning label on less healthy foods would not only inform the consumer about the potential risks of consuming a product but could protect producers from liability. Text based explicit warning labels are now being used for various food products in several countries.

Most countries in the EU require a warning label on foods containing synthetic dyes (Perry 2010), and although Denmark was the first to implement mandatory warning labels on energy drinks, the rest of the EU adopted the same labeling policy in 2014 (Meister 2014). In 2014, the California senate introduced a bill requiring warning labels on sugar-sweetened beverages (Zuraw 2014), but the bill died in the Senate Appropriations Committee in 2018 (Racker 2018). Chile and Ecuador both require warning labels on certain food products that exceed a certain level of several nutrients including sodium (Campbell et al 2014). Since the 1980's, Finland has required products containing more than a given level of salt to carry a high salt warning, and this has resulted in many food companies reformulating their products to lower their sodium content and subsequently avoid the warning label (Pietinen et al 2008). In 2015 the New York City Health Department proposed that chain restaurants be required to put a warning label on menu items containing more than 2300mg of sodium (Grynbaum 2015). Health Canada will soon be implementing a warning label on food products that are high in sugar, sodium, and/or saturated fat (Health Canada 2018), but how this will affect consumer's food choices is yet unknown, which makes the current research project particularly timely.

3.2.5 Previous studies on effectiveness of warning labels

In general, research on warnings is hampered by the fact that direct observation of behaviour is difficult because the events in question are infrequent and sporadic, there are ethical concerns with allowing potentially hazardous behaviour to proceed, and because laboratory experiments which allow for complete control of the situation may not be generalizable to real world settings (Wogalter and Laughery 1996). As such, there is limited evidence as to the effectiveness of warning labels, most of which are currently concerned with either alcohol or tobacco consumption. In a 1998 review of empirical research, Stewart and Martin (1994) found that warning labels are not so much persuasive as they are informative to consumers, that consumers only selectively heed them, and that they lose effectiveness with frequent use (both in terms of how many times they see a warning on the same product and how often they see warning labels in general). In

a review of policies designed to reduce the harm caused by alcohol consumption, Anderson et al (2009) found that warning labels only reduced the amount of alcohol people intended to consume, but not how much they actually consumed. As mentioned in the previous section, graphic warning labels on cigarette packages have had some success in decreasing consumption (Sabbane et al 2009; Thrasher et al 2007; O'Hegarty et al 2006).

Most of the evidence found pertaining to the effectiveness of explicit, text-based warning labels on food packaging was published somewhat recently. Lacanilao et al (2011) found that a warning label on snack foods (a text-based, explicit warning generated specifically for the study) had heterogeneous effects among consumers, specifically that the consumers policy makers would be hoping to target are less responsive to the mechanism in question. In a study examining how warning labels (such as "consumption of this product could lead to heart disease") vs. nutrient content labels (such as "one serving of this product contains 25% of the daily recommended amount of saturated fat") affected food choices, Bushman (1998) found that nutrient content labels were more effective when dealing with credible and familiar risks such as fat content. With respect to sugar sweetened beverages, Roberto et al (2016) found that significantly fewer parents would purchase them for their children when they displayed a warning label. VanEpps and Roberto (2016) also found that American adolescents were less likely to purchase sugar sweetened beverages when a warning label was present. Arrua et al (2017) found that both a traffic light label and a standardized Chilean warning label were effective in affecting children's choices of cookies and juice. In a study of Brazilian adults, Khandpur et al (2018) found that a warning label was more effective than a traffic light label in assisting people to identify the healthier product and improving their understanding of excess nutrient content.

Also of interest are colour-coding and traffic-light style labels, but these could be seen as recommendations or guidelines, rather than warnings. Three recent studies comparing warning labels and traffic light style labels were found. In a study comparing Brazilian consumer understanding and purchase intentions between foods with warning labels and traffic light style labels, Khandpur et al

(2018) found that the warning labels were more effective in helping people correctly identify the healthier product. Also comparing warning labels to traffic light style labels, Arrua et al (2017) found that the two label mechanisms performed equally well in enabling respondents to identify the healthiest product, both being an improvement over no label mechanism. Similarly, Machin et al (2018) found no significant difference in the healthfulness of choices between Chilean respondents who saw traffic light style labels versus warning labels. It should be noted that these studies focused on how these label mechanisms enabled consumers to identify the healthier products; they did not explore how they would affect the probability that people would purchase products with or without them. It is possible that an explicit warning label could increase awareness and perceived seriousness among consumers that over-consumption of a given product or nutrient could be harmful to their (or their children's) health. This study endeavors to better understand how implementing a warning label on the front of food packaging will affect its likelihood of being purchased via a choice experiment, the background of which is discussed next.

3.2.6 Choice Experiment Design

One of the commonly used methods for eliciting consumer preferences for product attributes (including label attributes such as warning labels and third party certification logos) is to conduct a choice experiment, which is a type of stated preference experiment. Many discrete choice experiments have been utilized in a food product context. Balcombe et al (2009) used choice experiments to determine consumer responses to the traffic light system on a basket of food products. Choice experiments were used by Gracia et al (2009) to explore if consumers placed a higher value on nutrition facts panels or nutrient claims. Mueller and Umberger (2010) used choice experiments to determine consumer valuation of the "Pick the Tick" health certification logo on both beef steaks and seafood. Also using a choice experiment, Goddard et al (2012) elicited consumer WTP for the "Health Check™" certification logo on turkey sandwiches.

Stated preference experiments are very useful in determining consumer preferences for goods which are not available in the market. Revealed preference data, when available for market goods, should be more accurate than stated preference data, as it reveals actual purchases rather than hypothetical choices. Given that there are currently no warning labels for food in Canada (although this may soon change), revealed preference data is nonexistent. It should be noted that there are currently breakfast cereals in Canada bearing the Whole Grain logo. Because of the nature of choice experiments, they provide a thorough description of tradeoffs respondents are willing to make between various product attributes, such as price and nutritional quality, thereby revealing whether or not individuals are sensitive to attribute levels or even to the attributes themselves; the attributes present and their levels can both be adjusted to meet the researcher's objective (Adamowicz et al 1995, Dhar and Simonson 2003). A weakness of choice experiments is that due to their lack of consequentiality, respondents may inaccurately represent their sensitivity to the various attributes and the subsequent estimations may not translate to the real market due to the differing number of options available, prices, or attributes (Dhar and Simonson 2003, Adamowicz et al 1995). In addition, when answering a survey, participants often have strategic incentives to answer in a certain way that may not reflect their true preferences (Carson and Groves 2007). For example, if an individual is aware that the government is considering imposing a warning label on foods and they're completing a choice experiment that includes warning labels on foods, they may over-represent their sensitivity to the warning if they think the government should impose them or under-represent their sensitivity if they oppose the idea.

One of the challenges in designing a choice experiment is balancing the ability of respondents to trade off attributes with statistical efficiency (Johnston et al 2017). Standard consumer theory assumes that individuals are able to fully process information, that they are perfectly aware of their preferences, and that they consistently use this information to make choices between alternatives (Grafton et al 2004). This is rarely the case in reality, especially when a product is unfamiliar or when an overwhelming amount of information is given (Ohler et al 2000). Thus

some consideration in determining how many choice scenarios each individual is given, the number of alternatives per scenario, and the number and levels of attributes needs to take into account the limited amount of information a person can process. If choice sets are too complex, meaningful results will be hard to obtain.

One of the most important things to determine is the number and levels of attributes (Janssen and Bridges 2017). In a study examining attribute non-attendance (when participants simply ignore certain attributes) Hensher et al (2012) find that the range and levels of attributes may be such that to some respondents, certain levels of an attribute may simply not matter, until a given threshold is reached at which point the attribute is deemed relevant. In an effort to decrease the cognitive burden on participants, de Bekker-Grob et al (2012) found that in the health economics field, the mean number of attributes included in choice experiments has decreased from 7 to 5. With regards to price levels, according to Haab and McConnell (2002), the optimal levels should be close to the true mean WTP. Given that WTP is generally unknown (or else the experiment would be redundant), it must be estimated based on current prices and evidence. Hanley et al (2005) found that range of the price vector in a choice experiment did not significantly impact the estimated coefficients or WTP measures. Johnston et al (2017) point out that investigators should choose price levels with consideration for range and spacing, making sure that the amounts seem realistic to respondents. Another issue is that of how many alternatives should be included in a choice set. Deshazo and Fermo (2002) found that giving respondents more alternatives to choose from initially decreased the variance, but once a certain number of alternatives were reached, the increased complexity increased the overall variance.

Once the choice sets along with their attributes and levels have been determined, the researcher still needs to decide how many choice sets each respondent should answer. Most studies have respondents answer one to sixteen choice sets, with the average being around eight (Bech et al 2011; Deshazo and Fermo 2002). In a review of choice experiments used in health economics, de Bekker-Grob et al (2012) found that the mean number of choice sets shown to each participant has increased from 12 to 14.

Attribute levels are usually presented to respondents in a table, but in many real-world food-purchasing situations, consumers have to discern a product's attributes by reading the packaging. Green and Srinivasan (1990) note that using pictorial materials rather than paragraph descriptions make the task more engaging for the respondent and provide a less ambiguous, easier way of conveying information, allowing a greater number of attributes to be used without causing statistical issues. Graphically represented choice sets are becoming very popular as they more realistically portray what a consumer would be looking at purchasing in an actual shopping scenario. Cherchi and Hensher (2015) note that the use of images can be used to improve realism in stated preference experiments so long as they are controlled to only allow for variation in the attributes of interest.

3.3 Objectives and Research Question

The overall objective of this dissertation is to evaluate the effectiveness of potential government mandated policies to improve children's diets, positively impacting their long-term health and reducing the financial burden of diet-related diseases on health care. This paper specifically aims to determine how parents of 8-12 year old children would respond to an explicit text-based warning label, similar to that proposed by Health Canada, on high sugar breakfast cereals. The main objective is to determine how effective a warning label might be in reducing the consumption of high sugar products as well as to see how the response to a warning label differs between parents by individual specific characteristics such as income or nutrition knowledge or by brand. As such, the parental willingness to pay for products with and without warning labels are what will be measured using choice experiments for breakfast cereals to determine whether a warning label is a strong enough incentive to choose a less preferred but healthier brand. If parents prefer products without warning labels and either switch away from products with warning labels or choose them less frequently, positive dietary outcomes could be elicited by mandating warning labels on products high in over-consumed nutrients.

3.4 Data

In order to address this objective, surveys were conducted primarily online with parents as well as in person for a sub-sample, and included questions pertaining to current consumption patterns, who makes food decisions, nutrition knowledge, and a choice experiment where the main attribute of interest was the presence of an explicit text-based warning label. Ten of the most highly purchased cereal products by adults aged 25-49 in Canada (as identified by the Print Measurement Bureau from 2009-2015) were used in the choice experiments to ensure familiar products were under consideration. In order to keep it from being obvious to participants what our attribute of interest is, we also included the "Whole Grain Council" logo as a label attribute in addition to the proposed warning label. It is of interest to see how consumers respond to this whole grain logo since Mancino and Buzby (2005) found that most Americans were not consuming the recommended level of whole grains, and it is likely this is also true for Canadians. Price was also varied so that sensitivity to price as well as relative importance of warning label to price could be assessed. It is possible that some families would want to primarily avoid products with warning labels, but for those with lower incomes, price could be the most important determinant in their choices.

It is important to consider that multiple breakfast cereals are often purchased at the same time, sometimes because the consumer desires variety, they are purchasing it for different members of the household, or just so they have a large enough quantity to last until the subsequent shopping trip. As such, a traditional discrete choice experiment where the participant chooses only one from a subset of choices may be inappropriate to examine breakfast cereal choices. In addition, changing the product attributes might change the relative proportions of cereals they choose rather than influencing them to switch from one type to another for all of their purchases. One example in the breakfast cereal context could be that if a mother is unaware of the high amount of sugar in cereal *x*, she purchases it for her children to eat every morning, but if a warning label alerts her to the high amount of sugar, she may substitute to a healthier product for the weekdays but still allow her

children to eat product *x* on weekends or for snacks. As such, rather than asking participants to choose either product A or B, participants will be shown a condensed grocery aisle which is composed of ten of the most frequently consumed cereals, then asked to imagine that they are purchasing all of the cereal for their household for one month, and to choose the quantity of each to purchase. The resulting data has non-negative integer values for each cereal along with the product specific attributes associated with these frequency choices.

This type of choice data is called 'frequency' data and can be modeled using the traditional random utility framework but rather than the dependent variable being limited to 0 or 1, it can take any nonnegative integer value (Greene 2007). Frequency choice analysis is often used in research examining recreation site choices where data on number of visits to sites is available.

3.4.1 Questionnaire Design

The objectives of this study are to determine the effectiveness of warning labels on less healthy food products and how it differs between parents by individual specific characteristics such as nutrition knowledge and income and whether it is consistent from one brand to another. The choice experiment portion of the survey elicited information about sensitivity to warning labels and is discussed in the subsequent section. The parent and child surveys can be found in Appendices 3A and 3B respectively.

The nutrition knowledge questions are a subset of the General Nutrition Knowledge Questionnaire for Adults developed by Parmenter and Wardle (1999) which was demonstrated as a reliable and valid measure of nutrition knowledge among adults in the UK. Within this scale are 4 subscales (dietary recommendations, sources of nutrients, choosing everyday foods, and diet-disease relationships) all of which demonstrated test-retest reliability over 0.7 and a Cronbach's alpha between 0.7-0.97 for internal consistency. For this survey, we used the dietary recommendations and sources of nutrients subscales, as did Carrillo et al (2012). A score of 1 was assigned to each correct response and a score of 0 assigned to each incorrect response to generate a total nutrition knowledge

score, a method employed by several other studies (Cooke and Papadaki 2014; Carrillo et al 2012; Cannoosamy et al 2014; Drichoutis et al 2005). Some changes were made to make the foods used in the questionnaire more culturally appropriate for Canadians, for example switching blood sausage to salami. In total we used 14 questions, several of which had multiple parts, to address knowledge about salt, sugar, fat, protein, and fibre, the sources of these nutrients, the consequences of over- or under-consuming them, and foods that according to nutritionists should be eaten more or less often. Questions asked and descriptive statistics of responses are discussed further in section 3.4.4.2.

The questionnaire also had questions about whether the respondent's child received an allowance, whether they were ever given money with which to purchase food, and the foods typically purchased autonomously by the child. Grocery shopping habits and the child's input on grocery purchases were addressed, as were typical breakfast cereal purchases for the household. General behaviours including the average amount of physical activity and screen time the child had per week and their propensity to try new foods were elicited. The parent's use of labels (such as nutrition facts on food packaging and warnings on toys) was explored. Finally, the decision making dynamics between the parents and children were addressed by asking which party (or possibly both) make the choices in various meal scenarios, incorporating different meals, locations, and days of the week.

A parallel questionnaire was also designed to be completed by the children of a subset (n=30) of the participants. It contained similar questions but was shorter and written at a lower reading level. This was done in order to compare how children and parents in the same family would respond to some of the purchasing behaviour questions as well as to the warning label in the choice experiment.

3.4.2 Choice Experiment Design

As described in the previous section, a binary discrete choice experiment is likely not the most realistic representation of breakfast cereal purchasing decisions, and as such a multiple discrete continuous choice experiment was constructed where respondents could purchase positive quantities of multiple products. This

frequency rather than binary approach was also used by Kuperis et al (1999) to model milk purchasing decisions. We preselected participants who purchase breakfast cereals and provided them 10 popular products to choose from in 4 different choice sets. They could choose 0-10 boxes of each type of cereal, or none at all, and although the attributes varied by choice set, the brands available did not. Given that our objective is to determine the effectiveness of a text-based warning label on a food package, using an image of the product package with a warning label on it is likely a better representation of reality than a table listing attributes, so that is what was done. For an example of a choice set, please see Figure 3.1. Enlarged images of the warning label and whole grain logo are shown in Figures 3.2 and 3.3 respectively.

Our primary attribute of interest was the warning label (binary) but as previously stated we also included price, which had 4 levels to capture responsiveness, and a Whole Grain Council stamp (binary). Half of the respondents were given an information treatment prior to completing the choice experiment in which they were shown an image of the two label attributes and given a brief explanation of what they meant (see Figure 3.4 for exact wording). This was done to evaluate how consumers responded differently when the label attributes were familiar to them and had been brought to their attention. The information given is shown in Figure 3.4. While only 4 of the products currently carry the Whole Grain Council stamp, any of them could have them in the choice experiment; this was explained to participants.

Figure 3.1: Example of a choice set used in the purchase experiment

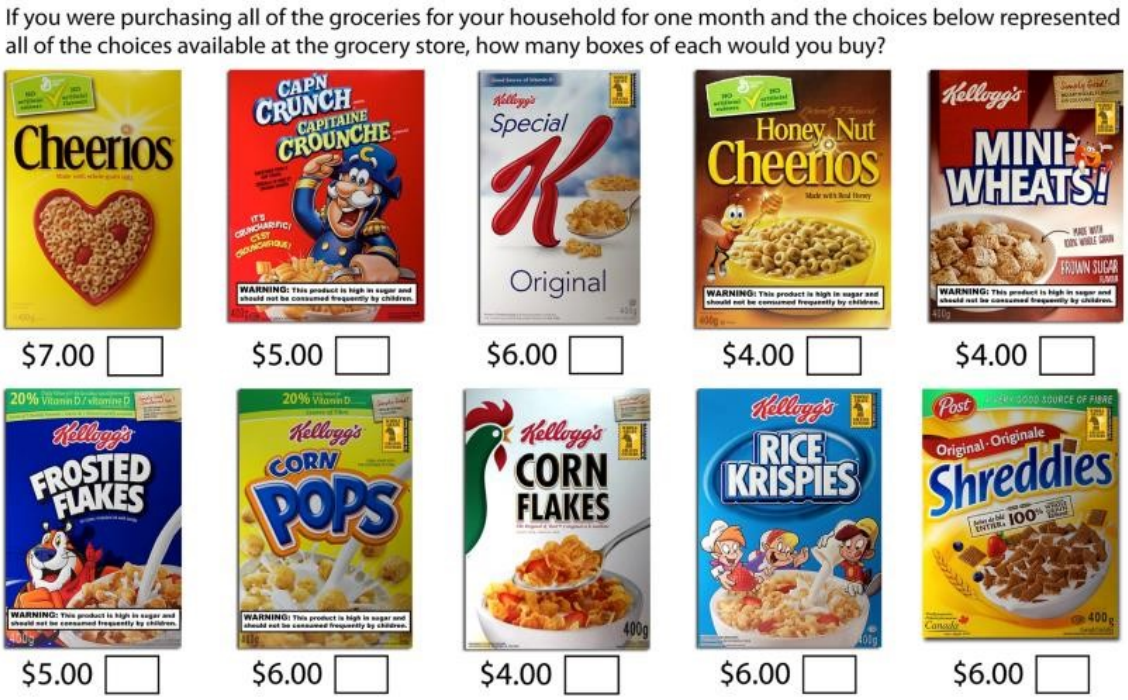


Figure 3.2 Enlarged image of the warning label used in purchase experiment

Figure 3.3 Enlarged image of whole grain stamp used in purchase experiment

Figure 3.4 Information given along with labels prior to respondents completing the choice experiment for those receiving the information treatment

Whole Grain Stamp: The following Whole Grain Stamp was created by the Whole Grains Council to indicate that the product bearing it contains at least 8 grams of whole grains per serving. In this survey, we are occasionally applying the Whole Grain Stamp to any breakfast cereal, although in reality they may not all qualify for it.

Warning Label: The World Health Organization has stated that breakfast cereals containing more than 15 grams of sugar in a 100 gram portion should not be marketed to children. In this survey, we are occasionally applying the following high-sugar warning label to breakfast cereals that contain 20 grams or more of sugar in a 100 gram portion.

Since we were showing respondents a grocery aisle with 10 options, which is much more to consider than the typical 2 or 3 used in most discrete choice experiments, only 4 choice sets were given. This number was determined by pilot testing the choice experiment; most respondents stopped paying attention around the fourth to sixth choice set, either not completing the rest or simply choosing 1 for everything. The full experimental design (an efficient design generated in Ngene) used for the main data collection, along with the estimates used to generate it, is shown in Appendix 3C. There were 16 choice sets in total broken down into 4 blocks of 4, 2 of which received the information treatment. Details about the attributes and levels are shown in Table 3.1.

Table 3.1 Attribute levels in choice experiment

Attribute	Levels	Restrictions
Price	$4, $5, $6, $7	None – any price could appear on any product.
Warning label	On/off	Could only appear on products that are over 20% sugar (by weight).
Whole grain logo	On/off	None – could appear on any product even if the product doesn't currently qualify for it. At the time the experiment was conducted, 4 of the included products were qualified to (and did) carry it.

Information treatment (Exact wording shown in Figure 3.4)	On/off	Half of the main sample received information about the labels before doing the choice experiment, the other half did not.

The Print Measurement Bureau (PMB) has data on household use of many different grocery products, including breakfast cereals. They have this data available for all of Canada, major cities, and regions. To determine which breakfast cereals to use in our choice experiment, the PMB data was used to identify the most frequently used breakfast cereals in Canada in the spring of 2015 by 25-49 year olds (the most likely age group to have children aged 8-12), shown in Table 3.2. By using familiar rather than unidentified brands in the choice experiment, we hope to get a more realistic idea of whether or not consumers will switch away from a currently preferred product when it suddenly has a warning label on it. (Participants were asked to indicate which cereals they typically purchase to identify baseline preferences.) To identify which cereals would require a warning label, the sugar content was assessed. In 2015 the WHO released recommendations for foods that should not be marketed to children, and their nutrient profile states that breakfast cereals containing more than 15 grams of sugar in a 100 gram portion should fall under this restriction (WHO 2015). In order to leave some margin between those that can be marketed to children and those that would require a warning label, we imposed a warning label on products containing more than 20 grams of sugar in a 100 gram portion for the purposes of this study. Going forward, we describe cereals that are greater than 20% sugar (by weight) as high sugar cereals and those that contain less than 20% sugar as low sugar cereals. The quantity of cereal was standardized in the graphics presented to all be 400g per box, and in the instructions respondents were told that all the boxes contained the same amount of cereal.

Table 3.2 Breakfast cereal products most frequently purchased in 2015 (in decreasing order) by adults aged 25-49 in Canada.

	grams of sugar in 100g portion	warning label required?
General Mills - Cheerios	**3.7**	**N**
General Mills - Honey Nut Cheerios	**31**	**Y**
Kellogg's - Rice Krispies	**10.7**	**N**
Kellogg's - Corn Flakes	**10.3**	**N**
Kellogg's - Mini Wheats-White/Brown Frosted	**20.4**	**Y**
Kellogg's - Froot Loops	44.4	Y
Kellogg's - Frosted Flakes	**38.7**	**Y**
Kellogg's - Corn Pops	**37.5**	**Y**
General Mills - Multi-Grain Cheerios	20	N
Quaker - Cap'n Crunch	**44**	**Y**
Post - Honeycomb	33.3	Y
General Mills - Apple Cinnamon Cheerios	33.3	Y
Kellogg's - Two Scoops Raisin Bran*	27.3	Y
Post - Shreddies (Regular)	**16.4**	**N**
Kellogg's - Special K Original	**12.5**	**N**
Kellogg's - Special K Vanilla Almond	27.6	Y
Kellogg's - Vector	20	N
Post - Alpha Bits	20	N
Kellogg's - All-Bran - Bran Buds	25	Y

Bolded items in Table 3.2 are the products included in the stated preference experiment. These were chosen to represent the four main cereal manufacturers and to get an equal number of products that would and wouldn't require a warning label.

3.4.3 Data collection

Questionnaires are shown in Appendices 3A and 3B. Details about the experimental design are given in Appendix 3C. Data were collected in 3 distinct phases. First, an online pilot was conducted via a third party contractor, Fluid Surveys, of 54 English-speaking adults living in Canada who had children in the home between the ages of 8-12. The choice experiment was based on a fractional factorial design generated in Ngene of 44 choice sets split into 4 blocks of 11. Warning labels were omitted from the first 4 choice sets in each block then applied to all high sugar products in subsequent 7 choice sets. Analysis of the choice

experiment data indicated that respondents were not noticing (or reacting to) the warning label or whole grain logo and were given too many choice sets. Follow up questions in the pilot phase asking respondents what label attributes they noticed in the choice experiment images showed that about 80% of respondents hadn't noticed the warning labels at all. Additionally, after around 4 - 6 choice sets respondents either stopped answering the choice sets or simply chose 1 of each product. With these findings, it was decided to make the size of the warning label and whole grain logos larger relative to the size of the cereal boxes, as well as to limit the number of choice sets each respondent received to 4. The coefficient estimates from the pilot were used as priors to generate an efficient experimental design in Ngene for subsequent rounds of data collection (shown in Table 3C.1).

The second round of data collection was conducted in person at the Saville Community Sports Centre on the University of Alberta South Campus. Thirty families were recruited to participate, each having one parent complete the survey as well as at least one child aged 8-12 complete the child's version (both versions included the choice experiment). The parent portion will be discussed descriptively in this section. An efficient design of 4 blocks of 4 choice sets was generated in Ngene which omitted warning labels from the first choice sets. One of these blocks of choice sets was given to each respondent. Warning labels were applied to all high sugar products in choice sets 2-4. Price and whole grain logo were determined by experimental design. Estimates from this round of data collection were combined with those from the pilot round to update the prior estimates in generating another efficient design of 16 choice sets in Ngene for the third round of data collection (shown in Table 3C.1 in Appendix 3C).

The third round of data collection was conducted online through Survey Gizmo with 550 English-speaking Canadian parents of children aged 8-12. Survey Gizmo maintains a panel of adults across Canada, which is what our sample was drawn from. It should be noted that while the survey was only offered in English, panel members from Quebec weren't prevented from participating. Qualifying questions were included at the beginning of the survey to ensure that respondents had children in the correct age range. The sample was split into 2 groups, one of

which received an information treatment before the choice experiment, showing and explaining the warning label (Figure 3.2) and whole grain logo (Figure 3.3). The other group did not receive any information about the logos at any point in the survey. A description of which choice sets were contained in each block and which blocks received the information treatment are given in Table 3C.2 in Appendix 3C. In the experimental design of 4 blocks of 4 choice sets, warning labels were allowed to appear in any choice set on any of the 5 high sugar products. The presence of a whole grain logo and the price level were again determined by the experimental design. Only main effects were considered in the experimental design; no interactions were included. A summary of how many times each brand was shown in a choice set with the various combinations of attributes is shown in Table 3C.3, Appendix 3C. The full experimental design is shown in Table 3C.4. Unless otherwise noted, the main sample is what is used for subsequent analysis.

3.4.4 Descriptive Statistics

For the full questionnaire given to parents (including information treatment, full wording of questions, and response options), please see Appendix 3A. The questionnaire given to the children for the in-person subsample is in Appendix 3B. Table 3.3 describes the different samples based on how participants responded to items in the questionnaire.

All samples had an average age of around 39 years old and had more women than men, especially the in-person sample which was 84% women. Most families had 2 adults and 2 - 3 children in the household. The in-person group had a slightly higher average education level although all were between three (college or technical diploma) and four (undergraduate degree). The household income level was much higher for the in-person group at $155,926 than for the pilot and main samples. Compared to the Canadian census, our sample had more two parent and multiple children households and higher income and education levels. Approximately half of families in our sample give their children an allowance, the most being 66% in the no information treatment of the main sample, with the average amount being much higher in the pilot sample at $11.90/week. Between 32% and 63% of parents say

that their children purchase food autonomously while 78% to 94% say their children have input on grocery store purchases.

Parents from the in-person group had the average highest nutrition knowledge scores with 76%; the pilot and main groups had scores of 61% and 62%. When we asked parents whether or not they read nutrition facts panels (in all 3 groups) and warning labels in the main groups, they were given the options 'never' (1), 'sometimes' (2), and 'always' (3). In all samples, the average fell between 'sometimes' and 'always'. In the pilot and in-person surveys, parents were only given 'yes' and 'no' options for whether or not they read warning labels on their children's toys; slightly more than half said yes. The in-person group had slightly more independent children when it came to meal choices, scoring an average of 0.63 where a lower score indicates the child makes more meal choices and a higher number indicates the parent makes more meal choices.

Respondents were asked whether the children in their family ever purchased food when not with a parent or guardian. For those who answered 'yes', they were subsequently asked what types of foods the children typically purchased. Parents were most likely to report that their children bought pop, candy, and chips when making autonomous purchases. Children from the in-person group also answered this question, and reported buying a combination of healthy and unhealthy snacks. Based on this, it looks like either the kids are biasing their responses towards more healthy choices or they're making better choices than their parents give them credit for.

3.4.4.1 Demographic characteristics

Table 3.3 Descriptive comparison of data from all stages of collection

	Pilot n=54		In-Person n=30		Main - No info n=275		Main - Info n=275		2016 Canadian Census
	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.	Mean
Demographics									
Age	39.24	6.58	Parent: 39.41 Child: 9.34	4.38	40.10	7.67	39.73	7.14	41.0
Female	53.70%	-	Parent:	-	60.51%	-	61.59%	-	50.89%

			83.87% Child: 60.00%						
# adults in household	1.91	0.45	2.04	0.62	2.13	0.68	2.07	0.66	1.72
# children in household	1.88	0.72	2.26	0.68	2.30	1.15	2.26	1.09	1.79
Education	3.39	1	3.78	0.71	3.54	0.98	3.34	0.99	2.39
Income	$81,815	$42,778	$155,926	$55,976	$90,859	$46,303	$83,906	$49,257	$76,171
Child's behaviours									
Gets allowance	53.70%	-	48.39%	-	65.58%*	-	42.39%*	-	
Weekly allowance ($)	$11.90	$7.60	$3.80	$2.70	$4.30	$5.54	$3.92	$3.83	
Purchases food	40.74%	-	32.26%	-	63.04%*	-	37.68%*	-	
Input on groceries	79.63%	-	93.55%	-	81.16%	-	77.90%	-	
Parent's behaviours									
Reads warning labels	57.41%	-	55.17%	-	2.15	0.66	2.24	0.59	
Reads nutrition facts panels	2.76	0.87	2.53	0.57	2.26	0.56	2.23	0.62	
Nutrition Knowledge	61.44%	16.31 %	76.40%	10.54 %	61.56%	19.14 %	62.51%	18.40 %	
Who chooses child's meal	0.70	0.78	0.63	0.76	0.70	0.45	0.67	0.40	

* Indicates a statistically significant difference (at a 1% level) between the info and no info treatment groups in the main sample.

3.4.4.2 Nutrition knowledge

Questions used to assess respondents' level of nutrition knowledge, based on the questionnaire developed by Parmenter and Wardle (1999), are shown along with the percentage of respondents who answered correctly in Table 3.4. In general, the majority of people could correctly answer the questions about the sources of various nutrients while they struggled more with the agree/disagree type questions.

The average score of our sample was 62% correct answers, very similar to the 61% in Carrillo et al's (2012) study which used the same constructs. Among respondents who didn't study for a nutrition-related degree, the average nutrition score was 64% in the study by Cannoosamy et al (2014). Participants in Cooke and

Papadaki's (2014) study had an average nutrition score of 65% while the average in the study by Drichoutis et al (2015) was 58%.

Table 3.4 Summary of nutrition knowledge questions and scores

Question	Proportion of correct responses
Do you think health experts recommend that people should be eating more, the same amount, or less of these foods?	
Vegetables	74.1%
Sugary foods	75.0%
Meat	53.8%
Starch foods	34.6%
Fatty foods	69.6%
High fibre foods	67.2%
Fruit	71.6%
Salty foods	67.8%
Do you think these are high or low in sugar?	
Peanuts	69.0%
Unflavoured yogurt	73.6%
Ice cream	87.5%
Orange juice	71.6%
Ketchup	69.9%
Do you think these are high or low in fat?	
Pasta (without sauce)	58.2%
Baked beans	60.7%
Salami	74.1%
Honey	67.0%
Hard boiled eggs	62.5%
Nuts	52.4%
Cottage cheese	36.6%
Polyunsaturated margarine	61.2%
Do you think these are high or low in salt?	
Sausages	81.5%
Pasta (without sauce)	65.2%
Red meat	58.9%
Frozen vegetables	71.9%
Cheese	57.2%
Canned soup	81.0%
Do you think these are high or low in protein?	
Chicken	85.0%
Cheese	63.9%

Fruit	69.0%
Baked beans	71.2%
Butter	63.9%
Cream	58.3%
Do you think these are high or low in fibre/roughage?	
Shreddies cereal	71.2%
Bananas	56.3%
Eggs	65.8%
Red meat	64.7%
Broccoli	72.8%
Nuts	54.3%
Fish	61.4%
Baked potato with skin	51.3%
Chicken	59.8%
Baked beans	59.6%
Do you think these fatty foods are high or low in saturated fat?	
Salmon	64.5%
Cream	71.7%
Olive oil	55.8%
Red meat	51.6%
Sunflower margarine	35.7%
Chocolate	58.3%
What do nutrition experts say kids should try to eat less of? Protein, calcium, sugar, fibre, not sure.	85.3%
Some foods contain a lot of fat but no cholesterol. Agree, disagree, not sure.	53.8%
A glass of unsweetened fruit juice counts as a helping of fruit. Agree, disagree, not sure.	54.3%
Brown sugar is a healthy alternative to white sugar. Agree, disagree, not sure.	36.6%
There is more protein in a glass of whole milk than a glass of skimmed milk. Agree, disagree, not sure.	31.5%
A type of oil which contains mostly monounsaturated fat is a. coconut oil, b. sunflower oil, c. olive oil, d. palm oil, e. not sure.	22.1%
Which one of the following has the most calories per 100g? a. sugar, b. starchy foods, c. fibre, d. fat, e. protein, f. not sure.	19.6%
Which of the following issues are related to sugar consumption? a. obesity, b. dental caries, c. diabetes, d. all of the above, e. not sure.	77.5%
Average Score	62.0%

3.4.4.3 Purchasing behaviour

One of the questions in the survey asked parents to indicate how many boxes of different kinds of cereals they typically purchased in one month. These amounts were aggregated into the high and low sugar categories then segmented into individuals with above and below average levels of nutrition knowledge. While on average the lower nutrition knowledge group reported buying more of both types of cereal, about 52% of their purchases were higher sugar cereals whereas the higher nutrition knowledge group purchased about 49% higher sugar cereals.

If we look descriptively at the choice data, grouped by what people say they typically purchase, there are strong differences by group, shown in Table 3.5. It should be noted that in the questionnaire people were asked how many boxes they typically purchased of each cereal in one month, which is the same time frame as the choice experiment, but people answered 4 choice sets so their total number of boxes selected reflects hypothetical purchases for 4 months. The people who said that they do not typically purchase any of the products included in our choice experiment selected around 5.6 boxes of low sugar cereals and between 1-2 boxes of high sugar cereals. Unsurprisingly, people who reported only buying high sugar cereals had higher selections of high sugar cereals, around 4.7-6 boxes compared to 3-4 boxes of low sugar cereal. People who reported typically buying the low sugar cereals in real life chose around 11-13 boxes of low sugar cereal in the choice experiment as opposed to about 2 boxes of high sugar cereal. People who reported typically buying a mix of low and high sugar cereals chose more low sugar cereal than high sugar cereal in the choice experiment. Perhaps most worth noting is how the information treatment appeared to affect choosing high sugar cereals. Without the information treatment, only the people who reported buying both high and low sugar cereals chose fewer high sugar cereals (0.57 and 0.14 fewer boxes on average) with a warning label than without in the choice experiment. Conversely, all groups who received the information treatment chose fewer boxes of high sugar cereals with warning labels than without (0.17-1.07 fewer boxes on average).

Table 3.5 Average total number of each type of cereal chosen in the choice experiment grouped by typical purchases (main sample)

In the questionnaire, what people said they typically purchased from the cereals included in the choice experiment	In choice experiment, average total number of each type of cereal 'purchased' over 4 choice sets					
	No information treatment			With information treatment		
	high sugar, no WL	high sugar, yes WL	low sugar	high sugar, no WL	high sugar, yes WL	low sugar
None (n=45)	1.32	1.40	5.68	1.90	1.55	5.55
Only high sugar cereals (n=73)	4.67	4.92	3.06	5.95	5.68	4.08
Only low sugar cereals (n=133)	2.00	2.00	10.97	2.33	2.16	13.31
Both high and low sugar, totalling 1-4 boxes/month (n=144)	5.28	4.71	9.28	4.05	3.77	7.36
Both high and low sugar, totalling 5+ boxes/month (n=157)	7.48	7.34	17.49	8.01	6.94	19.84

Note that in the questionnaire people answered per month, while the choice experiment contained 4 choice sets per respondent, representing a month each.

Comparing children's hypothetical purchases with those of their parents, it was found that children chose larger amounts overall but there was a significant correlation of 0.85 between child and parent purchase amounts. In terms of brand selection, kids and parents from the same family chose to purchase the same brands 26% of the time and chose to avoid the same brands 39% of the time. If we look at the proportion of high sugar cereals that respondents hypothetically purchased in the choice experiment (shown in Table 3.6), it appears that children were more responsive to the warning label as more children than parents adjusted their choices when it was present.

Table 3.6: Breakdown of high sugar breakfast cereals chosen in choice experiment by children and parents.

	Parents	Children
% high sugar cereals without warning label	43%	49%
% high sugar cereals with warning label	47%	42%
# of respondents who chose fewer high sugar cereals when warning labels were added	3	14

The choice experiment data were examined descriptively to identify trends in the data before analysis was conducted and it was found that approximately 25% of the sample made the exact same breakfast cereal choices in each of the 4 choice sets despite varying prices and label attributes. Analysis was thus conducted using two samples; all of the respondents from the main round of data collection (henceforth referred to as the whole sample – WS) and the respondents from the main round of data collection whose answers did not stay exactly the same for all four choice experiments (henceforth referred to as the reduced sample – RS).

3.5 Analysis and Results

3.5.1 Empirical Model

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

$$U_j = U(X_j)$$

where X is the vector of attributes in an alternative. Alternative j will be chosen if $U_j > U_i$ for all $j \neq i$. The researcher will have information about the attributes (X) and some information about the respondent's (i) characteristics (A_i). The researcher

will not, however, have complete knowledge of the individual's decision-making process. The systematic utility (V_j) will be expressed as:

$$V_{ij} = V(X_j, A_i)$$

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

$$U_{ij} = V(X_j, A_i) + \varepsilon_{ij}$$

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

$$U_{ij} = \beta'_i V_{ij} + \varepsilon_{ij}$$

where β_i is a vector of parameters and V_{ij} is the systematic portion of the individual's utility function. E_{ij} is the error term.

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

$$P(j|y_i) = \frac{\exp(\propto_{ji} + \theta'_i z_i + \phi'_i f_{ji} + \beta'_{ji} x_{ji})}{\sum_{j=1}^{J} \exp(\propto_{ji} + \theta'_i z_i + \phi'_i f_{ji} + \beta'_{ji} x_{ji})}$$

Where $U(j,i) = \propto_{ji} + \theta'_j z_i + \phi'_j f_{ji} + \beta'_{ji} x_{ji}$, $j=1,\ldots,J_i$ alternatives in individual i's choice set,

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

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

ϕ_j is a vector of nonrandom (fixed) coefficients,

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

v_i enters β_{ji},

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

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

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

The basic model can be shown as the following equation, where U_{ij} is the utility individual *i* derives from choice *j*, B_p is the price parameter, B_w is the warning label parameter, B_g is the whole grain stamp parameter, B_j is the parameter for brand *j*, and ε_{ij} is the error term.

$U_{ij} = B_p$*price$_j$ + B_w*warning label + B_{wi}*warning label*info dummy + B_g*whole grain stamp + B_{gi}*whole grain stamp*info dummy + B_j*brand *j* dummy + ε_{ij}

A traditional discrete choice experiment would have the respondent choosing one of the alternatives, generating a binary dependent variable. In this study, they were able to select positive amounts of multiple products from the set of alternatives, generating non-negative integer frequency values for the dependent variable. This type of data can be analyzed using the multinomial logit code in Nlogit simply by including a 'frequency' specification.

Several different specifications of the model were estimated to gain a better understanding of the variation of preferences within our data set. In all models, Cheerios is the brand omitted, thus all brand coefficients are relative to Cheerios. The basic model henceforth refers to the model containing only the brands, price, and label attributes, with the information treatment dummy interacted with warning label and whole grain. The individual interacted model refers to a model where the attributes (price, warning label, and whole grain) are interacted with individual specific characteristics determined by log likelihood tests. The purpose of the individual interacted model is to determine how individuals with different characteristics might respond differently to the label attributes. While the individual interacted model allows for heterogeneity among individuals, it assumes constant effects of the label attributes on the different brands. Thus a third model was included, the brand interacted model, which has interactions between the label attributes and the individual brands. This model allows for heterogeneity in the effects of label attributes between brands. The individual and brand interacted MNL models will be used to calculate WTP for cereals with different label attributes. The basic model will be used for a simulation of purchase probability. Unless stated

otherwise, discussion is based on estimates for the reduced sample, although whole sample estimates are included for the purpose of comparison. A summary of the models estimated is provided in Table 3.7.

Table 3.7 Estimations to be conducted with both WS and RS

Models	Explanatory Variables Included	Interactions Included
Basic MNL, RPL	Brands, WL, WG, Price, Info	WL*Info
		WG*Info
Individual interacted MNL, RPL	Brands, WL, WG, Price, Info, Age, Gender, Education, NK	WL*Age, gender, education, NK, info
		WG*Age, gender, education, NK, info
Brand interacted MNL (restricted and unrestricted), RPL	Brands, WL, WG, Price, Info	WG* all brands
		WL* high sugar brands
		Info* all brands

(MNL=multinomial logit, RPL=random parameters logit, WL=warning label, WG=whole grain logo, Info=information treatment, NK=nutrition knowledge)

3.5.2 Estimations

The first stage of the analysis was to check for ordering effects - these were evaluated using a pooled likelihood ratio test to determine whether people's choices in later choice sets were influenced by what they saw in the preceding choice sets. No evidence of this was found. Test values can be found in Table 3D.1 in Appendix 3D. The next step was to run the basic MNL and RPL regressions. The results from the two models are similar but only the MNL estimates will be discussed and are shown in table 3.8; RPL estimates can be found in Table 3D.2 in Appendix 3D. Although the analysis focuses on the main sample, models that could be run with the child portion of our in-person sample are shown as well for the purpose of comparison. It should be noted that the child sample did not receive an information treatment.

When examining the basic MNL regression, we can see that the price coefficient is negative and significant, indicating that our sample is price sensitive. The warning label coefficient is negative but insignificant, while the warning

label/information interaction is negative and significant, indicating that people prefer products without the warning label when they've received information about the label. The whole grain logo coefficient is positive and significant, while the whole grain/information interaction is insignificant, indicating that people prefer products that carry it but that giving them information about it doesn't affect their preference. The coefficients for price, warning label, and whole grain for the child sample all have the same sign as for the main sample but without statistical significance. All significant brand coefficients are negative, indicating that Cheerios (which were omitted) is the preferred brand. This supports the data obtained through the PMB indicating that Cheerios is the most preferred brand of breakfast cereal in Canada. The estimates shown for the basic model shown in Table 3.8 (reduced sample) were used to simulate the purchase probability of each brand and then rank them from highest to lowest purchase probability to compare them with PMB data in terms of popularity of brands. These results are shown in Table 3.9. In both the simulated ranking as well as the PMB ranking, Cheerios were the most popular followed by Honey Nut Cheerios. Rice Krispies and Shreddies ranked somewhat inconsistently between the two measures, but otherwise most brands had similar rankings in the two.

Table 3.8 Basic MNL estimations for main sample

	Reduced Sample		Whole Sample		Children – In person sample	
	Coefficient	St. Error	Coefficient	St. Error	Coefficient	St. Error
Price	-0.171***	(0.010)	-0.160***	(0.008)	-0.045	(0.032)
Warning Label	-0.042	(0.043)	-0.03	(0.036)	-0.163	(0.138)
Whole Grain	0.106***	(0.032)	0.072***	(0.027)	0.053	(0.073)
Warning Label * Info	-0.112**	(0.054)	-0.129***	(0.046)	-	-
Whole Grain * Info	-0.057	(0.045)	-0.008	(0.039)	-	-
Cap'n Crunch	-0.660***	(0.055)	-0.638***	(0.047)	-0.595***	(0.175)
Special K	-0.200***	(0.046)	-0.170***	(0.039)	-0.614***	(0.140)
Honey Nut Cheerios	-0.046	(0.047)	-0.011	(0.040)	-0.112	(0.161)
Mini Wheats	-0.193***	(0.048)	-0.230***	(0.042)	-0.137	(0.162)
Frosted Flakes	-0.319***	(0.051)	-0.291***	(0.043)	-0.305*	(0.159)
Corn Pops	-0.464***	(0.052)	-0.540***	(0.046)	-0.319	(0.163)
Corn Flakes	-0.228***	(0.046)	-0.179***	(0.039)	-0.465***	(0.133)

Rice Krispies	-0.120***	(0.044)	-0.113***	(0.038)	0.146	(0.113)
Shreddies	-0.314***	(0.047)	-0.366***	(0.041)	-0.291**	(0.126)
LLF	-18974.73		-25684.802		-2470.007	
AIC/N	24.282		24.429		35.712	

***, **, and * indicate statistical significance at 1%, 5%, and 10% respectively

Table 3.9 Comparison of breakfast cereal popularity ranking between PMB data and purchase probability simulation based on basic MNL model estimates.

Brand	Rankings by PMB data	Rankings by simulation
Cheerios	1	1
Honey Nut Cheerios	2	2
Rice Krispies	3	6
Corn Flakes	4	5
Mini Wheats	5	4
Frosted Flakes	6	7
Corn Pops	7	10
Cap'n Crunch	8	9
Shreddies	9	3
Special K	10	8

The next step in the analysis was to run the MNL and RPL with individual-specific characteristics interacted with product attributes. Initially, the variables interacted with the product attributes were information treatment (info), education level, age, income, gender, and nutrition knowledge (NK). The log likelihood tests, however, indicated that income did not add significantly to the model and was thus subsequently omitted. The test values can be found in table 3D.3 in Appendix D. MNL results are shown in Table 3.8 and are discussed here; RPL results are shown in Table 3D.4.

In this individual interacted model (Table 3.10), the price coefficient became positive (in the basic model it was negative) but older individuals, females, and people with higher levels of nutrition knowledge were more price sensitive. The warning label coefficient also became positive when the interactions were added (it was negative but insignificant in the basic model) but people who had received the information treatment and who had higher levels of nutrition knowledge were more likely to avoid a product bearing it. The whole grain coefficient was positive and

insignificant, but the positive significant interaction between whole grain and nutrition knowledge indicated that people with higher levels of nutrition knowledge were more likely to choose a product carrying a whole grain logo. The only significant interaction when a similar model was run with the child sample was for age and price, which had a negative coefficient, indicating that older children were more price sensitive. The significant brand coefficients remained negative, consistently indicating that Cheerios and Honey Nut Cheerios are jointly preferred to other brands in our sample.

Table 3.10 Individual interacted MNL estimations

	Reduced Sample		Whole Sample	
	Coefficient	St. Error	Coefficient	St. Error
Price	0.172**	(0.078)	0.218***	(0.066)
Price*Info	-0.001	(0.020)	-0.012	(0.017)
Price*Education	0.018*	(0.011)	0.004	(0.009)
Price*Age	-0.002*	(0.001)	-0.002**	(0.001)
Price*Female	-0.056***	(0.021)	-0.056***	(0.017)
Price*NK	-0.467***	(0.056)	-0.438***	(0.048)
Warning Label	1.362***	(0.211)	1.117***	(0.177)
WL*Info	-0.130**	(0.054)	-0.156***	(0.047)
WL*Education	-0.117***	(0.030)	-0.100***	(0.024)
WL*Age	-0.013***	(0.004)	-0.009***	(0.003)
WL*Female	-0.202***	(0.056)	-0.127***	(0.047)
WL*NK	-0.639***	(0.148)	-0.634***	(0.127)
Whole Grain	0.25	(0.172)	0.182	(0.146)
WG*Info	-0.069	(0.045)	-0.024	(0.039)
WG*Education	-0.028	(0.025)	-0.033*	(0.020)
WG*Age	-0.003	(0.003)	-0.003	(0.002)
WG*Female	-0.055	(0.046)	-0.056	(0.039)
WG*NK	0.197	(0.123)	0.278***	(0.106)
Cap'n Crunch	-0.657***	(0.055)	-0.636***	(0.047)
Special K	-0.201***	(0.046)	-0.171***	(0.039)
Honey Nut Cheerios	-0.052	(0.047)	-0.016	(0.040)
Mini Wheats	-0.204***	(0.049)	-0.239***	(0.042)
Frosted Flakes	-0.313***	(0.051)	-0.286***	(0.043)
Corn Pops	-0.465***	(0.052)	-0.540***	(0.046)
Corn Flakes	-0.232***	(0.046)	-0.179***	(0.039)

Rice Krispies	-0.121***	(0.044)	-0.112***	(0.038)
Shreddies	-0.322***	(0.047)	-0.373***	(0.041)
LLF	-18896.26		-25597.67	
AIC/N	24.199		24.358	

Abbreviations: NK=Nutrition Knowledge, WL=Warning Label, WG=Whole Grain
***, **, and * indicate statistical significance at 1%, 5%, and 10% respectively

The next stage of the analysis was to run the model with interactions between the brands and the label mechanisms to identify any potential product heterogeneity. Cheerios was once again omitted but all the other brands were interacted with the whole grain logo dummy. The warning label was only interacted with the five higher sugar cereals it appeared on in the choice experiment. This model was run in two ways, first where the brand/attribute interaction coefficients were forced to be the same for each brand (restricted) and second where the brand/attribute interaction coefficients were allowed to vary by brand (unrestricted). For example, in the restricted model, the Cap'n Crunch/Warning label interaction coefficient is forced to be the same as the Frosted Flakes/Warning label interaction coefficient. In the unrestricted model, these interaction coefficients have no restrictions imposed on them and can thus have different values. Most studies and policies assume that a given type of label mechanism will have the same effect on different brands of the same products, but this is a testable hypothesis for the breakfast cereals in our study. Therefore the model was run in both its restricted and unrestricted formats and a log likelihood test is performed to determine the validity of the restrictions. The test (which can be found in Table 3D.5 in Appendix 3D) shows that the unrestricted model is a significant improvement over the restricted one so there is merit in exploring how the same policy mechanism could affect some brands differently. The full estimation results for the restricted and unrestricted brand interaction models are shown in Tables 3.11 and 3.12 respectively. RPL results are shown in Table 3D.6.

In the restricted model, the price coefficient is negative and significant for both samples but while the warning label/brand interaction coefficient is negative for both samples, it is only significant for the whole sample, not the reduced sample.

The whole grain/brand coefficient is positive and significant for both samples, and the brand coefficients are mostly significant, with the exception of Frosted Flakes and Corn Pops, but vary in sign. This is not a concern though, the variations in sign are due to the fact that the brands are interacted with the label attributes.

Table 3.11 Restricted brand interacted MNL estimates

	Reduced Sample		Whole Sample	
	Coefficient	St. Error	Coefficient	St. Error
Price	-0.170***	(0.010)	-0.160***	(0.009)
Brand * Warning Label	-0.078	(0.058)	-0.084*	(0.049)
Brand * Whole Grain	0.147***	(0.047)	0.100**	(0.040)
Brand * Info	-0.221***	(0.051)	-0.150***	(0.044)
Cap'n Crunch	-0.325***	(0.070)	-0.259***	(0.060)
Special K	0.152***	(0.059)	0.221***	(0.050)
Honey Nut Cheerios	0.319***	(0.047)	0.366***	(0.041)
Mini Wheats	0.218***	(0.048)	0.307***	(0.041)
Frosted Flakes	0.017	(0.067)	0.090	(0.057)
Corn Pops	0.075	(0.049)	0.095**	(0.043)
Corn Flakes	-0.201***	(0.053)	-0.222***	(0.047)
Rice Krispies	0.088*	(0.049)	0.187***	(0.043)
Shreddies	0.193***	(0.048)	0.253***	(0.042)
LLF	-18974.42		-25691.12	
AIC/N	24.281		24.434	

When looking at the unrestricted model, the price coefficient remained negative and significant in this estimation. Of interest are the interactions between brands and the warning label and whole grain logos; only the statistically significant coefficients are discussed. All of the significant brands interacted with the information treatment coefficients were negative. For Cap'n Crunch, the whole grain interaction is positive, indicating that our participants prefer Cap'n Crunch with a whole grain logo over one without. The same can be said for Special K. There is a negative interaction between Honey Nut Cheerios and the warning label, meaning that people prefer them without one. Mini Wheats has a negative warning label interaction and a positive whole grain interaction, meaning that respondents

order of preference is Mini Wheats with a whole grain logo, then Mini Wheats with no additional labels, and finally Mini Wheats with a warning label. Corn Pops and Corn Flakes both have a positive whole grain interaction, meaning that its presence increases peoples' preferences for those products. The signs of these coefficients are not surprising, but the fact that these label mechanisms affect only some of the brands is interesting. It goes to show that policymakers should not assume that implementing a warning label (or possibly other label mechanisms) will have a homogeneous impact across brands or products. These estimates will be used to calculate WTP in the next section where variation between brands can be compared on a monetary basis.

Table 3.12 Unrestricted brand interacted MNL estimates

	Reduced Sample		Whole Sample	
	Coefficient	St. Error	Coefficient	St. Error
Price	-0.169***	(0.010)	-0.159***	(0.009)
Cap'n Crunch	-0.624***	(0.098)	-0.610***	(0.083)
Cap'n Crunch * WL	-0.012	(0.092)	-0.005	(0.078)
Cap'n Crunch * WG	0.225**	(0.091)	0.139*	(0.077)
Cap'n Crunch * Info	-0.408***	(0.107)	-0.301***	(0.091)
Special K	-0.104	(0.071)	-0.094	(0.060)
Special K* WG	0.125*	(0.076)	0.1	(0.064)
Special K * Info	-0.318***	(0.094)	-0.244***	(0.080)
Honey Nut Cheerios	0.057	(0.081)	0.023	(0.069)
Honey Nut Cheerios * WL	-0.121*	(0.070)	-0.073	(0.059)
Honey Nut Cheerios * WG	0.031	(0.069)	0.032	(0.058)
Honey Nut Cheerios * Info	-0.212**	(0.089)	-0.116	(0.076)
Mini Wheats	-0.095	(0.086)	-0.127*	(0.073)
Mini Wheats * WL	-0.141*	(0.074)	-0.146**	(0.065)
Mini Wheats * WG	0.132*	(0.073)	0.133**	(0.064)
Mini Wheats * Info	-0.279***	(0.092)	-0.293***	(0.080)
Frosted Flakes	-0.202**	(0.087)	-0.224***	(0.074)
Frosted Flakes * WL	-0.123	(0.079)	-0.138**	(0.067)
Frosted Flakes * WG	0.074	(0.081)	0.042	(0.068)
Frosted Flakes * Info	-0.291***	(0.098)	-0.131	(0.083)
Corn Pops	-0.612***	(0.093)	-0.673***	(0.081)
Corn Pops * WL	-0.023	(0.083)	-0.047	(0.074)
Corn Pops * WG	0.167**	(0.084)	0.161**	(0.075)
Corn Pops * Info	0.029	(0.102)	0.051	(0.089)
Corn Flakes	-0.136*	(0.078)	-0.155**	(0.064)
Corn Flakes * WG	0.058	(0.073)	0.056	(0.061)

Corn Flakes * Info	-0.236***	(0.092)	-0.098	(0.078)
Rice Krispies	-0.117	(0.075)	-0.156**	(0.064)
Rice Krispies * WG	0.105	(0.069)	0.106*	(0.060)
Rice Krispies * Info	-0.114	(0.089)	-0.021	(0.076)
Shreddies	-0.334***	(0.081)	-0.338***	(0.068)
Shreddies * WG	0.024	(0.076)	0.004	(0.066)
Shreddies * Info	0.006	(0.095)	-0.056	(0.082)
LLF	-18952.58		-25666.71	
AIC/N	24.278		24.429	

Abbreviations: NK=Nutrition Knowledge, WL=Warning Label, WG=Whole Grain
***, **, and * indicate statistical significance at 1%, 5%, and 10% respectively

3.5.3 WTP Calculations

The purpose of calculating WTP in this chapter is to demonstrate the variation in how the label mechanisms affect peoples' choices, based on individual specific characteristics and/or brand. Please note that for reference, based on the basic MNL estimation, the average values based on the basic model were a $0.57 reduction in WTP for a box of cereal carrying a warning label and a $0.45 increase in WTP for a box of cereal carrying a whole grain logo. We will first look at variation by individual.

Willingness to pay for a warning label and a whole grain logo for respondents with high vs. low nutrition knowledge, with or without the information treatment, and males vs. females was calculated using the estimates from the individual interacted MNL model to see how people with different characteristics respond to these label mechanisms. For this scenario, low nutrition knowledge was defined as the 25th percentile score and high nutrition knowledge was defined as the 75th percentile score. These calculated values vary only by individual; they are constant in terms of what brand they are applied to. Results are shown in table 3.13.

These results show two different trends for the two label attributes being considered. For the warning label, people who had received the information treatment explaining the significance of the label prior to the choice experiment had larger reductions in WTP for a box of cereal than those who didn't ($0-$1.55 vs. $0-$1.02), regardless of gender or nutrition knowledge level. Among those who

received the information treatment, women had a greater WTP reduction than men ($1.48-$1.55 vs. $0-$0.95) when a warning label was present. Higher nutrition knowledge increased the reduction in WTP for a box of cereal with a warning label on it for women without the information treatment from $0.79-$1.02 and for men with the information treatment from $0-$0.95. For the whole grain logo, the main factor influencing whether it increased people's WTP for a box of cereal was whether the individual received the information treatment. The only group who received the information treatment and had a significant change in WTP due to the whole grain logo were men with high nutrition knowledge. For those who did not receive the information treatment, the increase in WTP for a box of cereal due to the whole grain logo was higher for men with low nutrition knowledge than for men with high nutrition knowledge ($0.95 vs. $0.69) while the opposite was true for women ($0 for women with low nutrition knowledge and $0.35 for women with high nutrition knowledge).

Table 3.13: Reduction in WTP for any cereal carrying a warning label and increase in WTP for any cereal carrying a whole grain logo for individuals with differing nutrition knowledge, gender, and information treatment.

	Reduced Sample		Whole Sample	
	Reduction in WTP for any cereal carrying a warning label ($CAD)	Increase in WTP for any cereal carrying a whole grain logo ($CAD)	Reduction in WTP for any cereal carrying a warning label ($CAD)	Increase in WTP for any cereal carrying a whole grain logo ($CAD)
No info, male, low NK	-0.61	0.95**	-0.65	0.76*
No info, male, high NK	0.37	0.69***	0.43*	0.70***
No info, female, low NK	0.79**	0.31	0.41	0.12
No info, female, high NK	1.02***	0.35**	0.83***	0.33**
Info, male, low NK	0.54	0.34	0.84*	0.46
Info, male, high NK	0.95***	0.38*	1.13***	0.54***
Info, female, low NK	1.55***	-0.1	1.32***	-0.03

Info, female, high NK	1.48***	0.11	1.37***	0.22

***, **, and * indicate statistical significance at 1%, 5%, and 10% respectively

Using the estimates from the unrestricted brand interacted MNL model, the reduction in WTP for each brand of cereal due to the presence of a warning label and the increase in WTP for each brand of cereal due to the presence of a whole grain logo is calculated (shown in Table 3.14). There is no variation by individual specific characteristic in this calculation, only variation by brand.

With a warning label present, only Honey Nut Cheerios and Mini Wheats had a significant reduction in WTP of $0.72 and $0.83 respectively. None of the other three that the warning label appeared on (Cap'n Crunch, Frosted Flakes, and Corn Pops) had a significant reduction in WTP when a warning label was applied. For the whole grain logo, 7 of the 10 cereals had no significant increase in WTP when it was applied. None of the lower sugar cereals were affected by the whole grain logo. The WTP for Mini Wheats, Corn Pops, and Cap'n Crunch increased by $0.83, $0.99 and $1.33 with the addition of a whole grain logo. Again, this demonstrates that applying the same mechanism to different brands within the same product category will not have homogenous effects across these brands – some will be more heavily impacted than others. It should be noted that the two sugary cereals showing a significant decrease in WTP due to a warning label are actually marginally healthier (mainly in terms of fibre content) than the products that appear to be unaffected by the warning label. Also worth noting is that only some of the higher sugar products are positively impacted by the whole grain logo – none of the healthier products are.

Table 3.14 Reduction or increase in WTP for different brands of cereal when a warning label or whole grain logo is present (in $CAD)

	Reduced Sample		Whole Sample	
	Reduction in WTP due to warning label	Increase in WTP due to whole grain logo	Reduction in WTP due to warning label	Increase in WTP due to whole grain logo
Special K		0.74		0.63
Corn Flakes		0.34		0.35

Rice Krispies		0.62		0.67*
Shreddies		0.14		0.03
Cap'n Crunch	0.07	1.33**	0.03	0.87*
Honey Nut Cheerios	0.72*	0.18	0.46	0.20
Frosted Flakes	0.73	0.44	0.87**	0.26
Mini Wheats	0.83*	0.78*	0.92**	0.84**
Corn Pops	0.14	0.99**	0.31	1.01**

***, **, and * indicate statistical significance at 1%, 5%, and 10% respectively

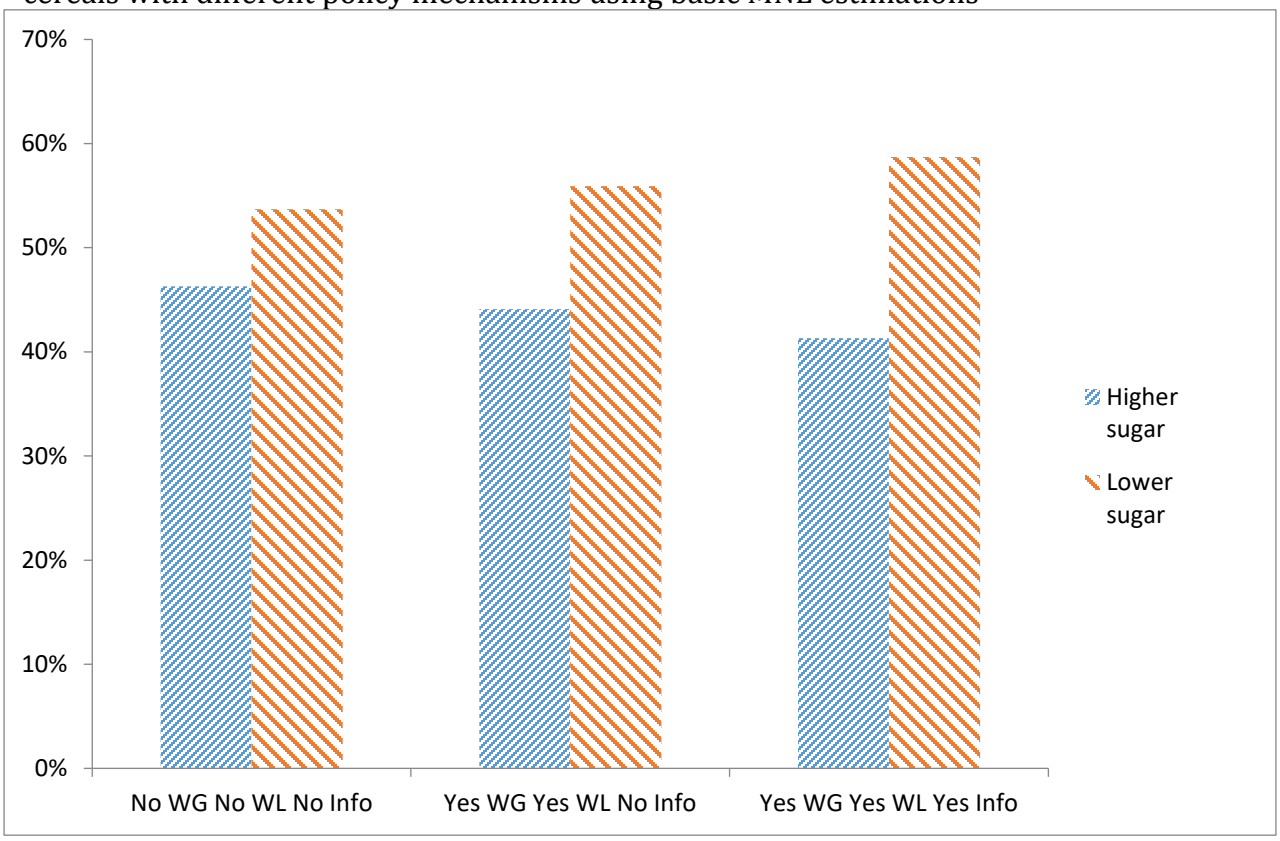
3.5.4 Simulations

Two of the most commonly discussed policies in combating the obesity epidemic are price and label mechanisms. As the focus of this chapter has been label mechanisms, we will examine how the warning label and whole grain logo could impact purchase probability of higher and lower sugar breakfast cereals. This will be done by running a simulation using the estimates from the basic MNL model which are found in Table 3.8. In all scenarios, the prices for the different products are set at the average and are thus equal. Results are shown in Figure 3.5. In the first scenario, there are no warning labels or whole grain logos applied, nor is the information treatment given. In the second scenario, warning labels have been applied to the products that have passed the 20g of sugar/100g of cereal threshold, and whole grain logos have been applied to all products that would currently qualify for one (Cheerios, Honey Nut Cheerios, Shreddies, and Mini Wheats). The second scenario assumes no information treatment has been given. In the third scenario, the warning label and whole grain logo have been applied to the same products as in the second scenario, but now we assume that respondents have been given the information treatment. We examine the purchase probabilities under different policy scenarios first by product type (lower vs. higher sugar), then by individual brand.

In the first scenario (no policy mechanisms), the purchase probability for higher sugar cereals is about 46%. When the warning label and whole grain logo are applied in the second scenario, the purchase probability for higher sugar cereals decreases to 44%. When the label mechanisms are applied and individuals are

given information about the significance of them, the purchase probability of higher sugar cereals decreases further to 41%.

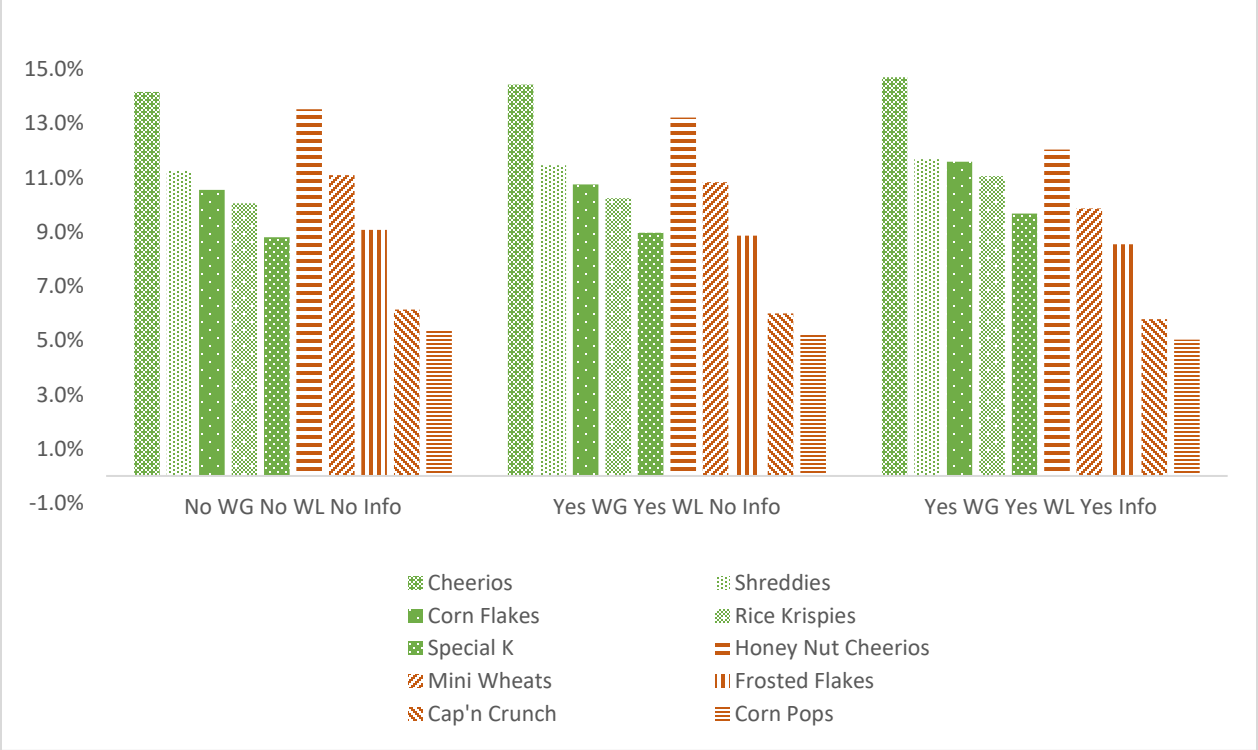
Figure 3.5 Purchase probability simulation for higher and lower sugar breakfast cereals with different policy mechanisms using basic MNL estimations



Looking at individual brands (shown in Figure 3.6) all lower sugar products increased in purchase probability with a simulated warning label policy, with greater effects seen when the information treatment was applied. Increases in purchase probability ranged from 0.4% for Shreddies to 1.1% for Corn Flakes. All higher sugar products decreased in purchase probability under the simulated warning label policy, again with greater effects under the information treatment. The biggest decreases in purchase probability were for the two healthier products within the higher sugar category, Honey Nut Cheerios (1.5%) and Mini Wheats (1.2%). Other higher sugar cereals decreased by 0.3% to 0.6%. Given that the purchase probabilities for all higher sugar cereals decreased while that for all lower

sugar cereals increased, we cannot claim that these policies would induce switching to different brands within the same category, at least not aggregately.

Figure 3.6 Purchase probability simulation for individual brands with different policy mechanisms using basic MNL estimations



3.6 Discussion

The overall objective of this dissertation is to evaluate the effectiveness of potential policies to improve children's diets in order to improve their long-term health outcomes and reduce the financial burden that diet-related diseases place on the health care system. This chapter specifically examined how parents of 8-12 year old children would respond to an explicit text-based warning label on high-sugar breakfast cereals, with consideration given to how responses would differ by both individual and brand. The analysis showed that parents would be less likely to purchase a high-sugar product if it carried a warning label, but the effects are heterogeneous. Firstly, parents with higher levels of nutrition knowledge as well as

women would be more responsive to a high sugar warning label. This means that households where a woman or someone with high nutrition knowledge is the primary grocery shopper will be more positively impacted by a warning label policy as our results show that these people are more likely to decrease the amounts of products they buy that carry a warning label. Overall, men would be more responsive to a whole grain logo. In addition, getting information about the labels increased responsiveness to the warning label but not the whole grain logo. Descriptive analysis of the choice experiment data implied that children would be more responsive to a warning label than their parents would be. In addition, it was found that older children are more price sensitive. Secondly, although the basic MNL model shows that parents would be willing to pay $0.57 less for a product with a warning label and $0.45 to purchase a product with a whole grain logo, these averages don't account for the fact that consumers would not respond to these label attributes to the same extent for different cereals. This is demonstrated by the brand interacted model estimates, where differences in WTP for a product with or without a warning label vary by $0.83/box and by $1.33/box for products with or without a whole grain logo. It should be noted that the brands most affected by the warning label were those with a healthy reputation (Honey Nut Cheerios and Mini Wheats). The brands that most people realize are high in sugar were less affected. This is consistent with the findings of Araya et al (2018) where purchases of juices and cereals were impacted by a warning label in Chile but purchases of chocolates, candies, and cookies were not, and is supported by the theory of Loewenstein, et al (2014), which posits that additional information will only affect decisions if it was previously unknown. Thus prior to the warning label, respondents thought that Honey Nut Cheerios and Mini Wheats were healthy but recognized that the other high sugar options were not; when this perception was corrected, they adjusted their choices accordingly.

The issue around consequentiality and design of this experiment, while not causing concerns for internal validity, can have implications for external validity. It should also be noted that overall, responsiveness to a warning label is likely overstated in an experimental setting; in real life parents' response to a warning

label will be somewhat mitigated by their child's preferences and/or the child pestering them to buy certain products. This is an important reason to consider how children will react to a warning label, as it might influence their preferences. However, it could be argued that because the choice experiment was set up in a way that people could adjust the proportions of each cereal they chose as the attributes changed rather than only being able to choose one product each time, the estimates are likely more realistic. If a warning label were suddenly implemented on breakfast cereals (or some other commonly consumed food product), it is more likely that people will react by buying less of the product in question or buying it more infrequently than ceasing purchases of it altogether. Therefore the frequency format of the choice experiment likely has more external validity than a traditional binary choice format would for this scenario. Future research on how policies may affect the consumption of frequently purchased products should consider allowing for more flexibility in consumer reactions by choosing experimental designs that don't force respondents to react in a binary manner. This frequency approach to choice experiments in the field of food choice and public nutrition deserves further exploration. In addition, the type of messaging on a warning label will likely impact reactions to it, as found by Purmehdi et al (2017), so evaluating consumer response to different wording strategies of warning labels would likely be a worthwhile research activity.

When considering the effectiveness of the warning label, although any reduction in the consumption of sugar is good, it would likely have greater benefits for public health if it were the greater consumers of sugar whose consumption was decreased. Our results show, however, that people with lower levels of nutrition knowledge purchase more high-sugar cereals than do people with higher levels of nutrition knowledge, indicating that a policy targeted at individuals with low nutrition knowledge would be more effective. Unfortunately, our results also indicated that people with lower nutrition knowledge would be less responsive to a warning label, so Health Canada's pending warning label may be less effective than hoped for, but this doesn't mean that it's not worth trying. Even if it doesn't reduce sugar consumption to the extent hoped for, its mere presence might increase

consumer awareness about nutrition and healthy food choices which could improve public health in the long run. It could also motivate manufacturers to adjust their product formulation to avoid the warning label.

In addition, it is important to consider how such a warning label will impact how consumers perceive food products and their nutritional value. On one hand, if people see a warning label on a product, they may be surprised and investigate further by reading the nutrition facts panel, possibly comparing the product to other similar offerings, or start paying more attention to food and nutrition in general, improving their overall food choices. On the other hand, people might see all products with a warning label as bad and not differentiate between them. In our study, Mini Wheats, which is the healthiest product that merited the warning label (lower in sugar, higher in fibre and iron), was the most negatively impacted with the application of the warning label. So if someone sees the warning label and assumes that all of the products carrying it are uniformly unhealthy, they might end up making worse choices if they don't avoid the products with the label.

In general, consumers will be more responsive to a label mechanism if they have some prior awareness and/or understanding of it. Health Canada has made a good start towards this in engaging the public's feedback on the design of the upcoming warning label, but they will need to find other ways to enlighten consumers as to the significance of it when they see it on products they are considering purchasing (Cohen and Lesser 2016). Ways to do this could include giving information on their website, providing pamphlets in grocery stores, utilizing social media, television or radio commercials, or even teaching children about it in school, as we have seen that approximately 80% of children play a role in grocery store decisions (as shown in Table 3.3). That way when an individual sees it on a food package, they don't have to exert any time or cognitive effort in interpreting it, they will already know what it signifies which increases the likelihood that it affects their choice.

Although Health Canada needs to be consistent in how they apply the impending high sugar/sodium/saturated fat warning label, they should expect that the warning labels will have more impact not only on some types of products, but

also on some specific brands. This difference in response to a policy mechanism based on individual brand is also an area that merits further research. Firms could react to this warning label in several different ways depending on its effects on their products. If demand for a product is largely unaffected by the warning label, they may do nothing. If, however, a firm anticipates that demand for their product will decline if a warning label is applied to it, they may preemptively decrease its sugar/sodium/saturated fat content. If a firm takes no action prior to the warning label implementation then suffers from it, they may decide to discount the product to increase its appeal to consumers. How this warning label will affect the choices made by both consumers and manufacturers remains to be seen, but will undoubtedly merit further research. While these first two studies have focused on choices made by consumers, the next chapter will shift the focus to the food manufacturers to further explore the factors impacting their decision-making and the subsequent nutritional quality of their food.

Chapter 4: Nutritional trends in the breakfast cereal industry

4.1 Introduction

The overall objective of this thesis is to determine the effectiveness of potential policy tools in improving the diets of children. Thus far, policies aiming to influence the choices of consumers (both children and their parents) have been discussed. Another potential approach is to bypass consumer decision-making and address the issue at the source, regulating the food manufacturers. In general, regulation of manufacturing activities is utilized to ensure consumer safety, such as in the production of electrical appliances, children's toys, and protective headgear. In the food industry, regulations have addressed labeling requirements, food safety concerns (such as protecting consumers from food-borne illnesses by pasteurization of milk or minimum heating requirements for canning food), and mandatory fortification of some products to address population-level deficiencies (such as iodine in salt to prevent goiter). Thus far, the nutritional content of foods has largely been unregulated (with the exception of the recent trans fat ban), which is a policy decision in and of itself. The type of regulation on food manufacturers being discussed here could pertain to product formulation, such as placing limits on undesirable components like sugar and sodium, or using taxes/subsidies to incentivize firms to improve the nutritional quality of their food. It could also pertain to labelling requirements which could lead to voluntary reformulation as disclosure of information often does. It is possible, however, that food manufacturers already perceive a demand for healthy foods, and have already improved the nutritional profile of their products in response to the demand. In the US, 16 major packaged food and beverage manufacturers voluntarily pledged to remove 1 trillion calories collectively between 2007 and 2012, eliciting a drop of 56 calories purchased per household per day in that time frame (Slining et al 2013). In their 2016 Corporate Responsibility Report, Kellogg's states that they are 90% complete in their goal to ensure that by 2020, 90% of their cereals have 10g or less of sugar per 30g of cereal.

If enough manufacturers continue to improve their products in this fashion, responding to societal concerns for diet and health, committing government resources to imposing and enforcing new regulations would be inefficient, but if the trend is short lived, not adopted by enough firms, or only implemented in convenient products, regulations on food manufacturers could be helpful in improving children's diets. The negative aspect of a policy regulating product formulation is that it could be viewed as paternalistic and infringing upon consumers' rights to choose. The positive is that all consumers of the regulated product would benefit from a health perspective provided that they consume the healthier formulations in reasonable quantities. Overall, a policy like this might be more effective because many consumers might not respond in an economically rational way to a price mechanism (Miljkovic et al 2008). If input prices are the main drivers of production decisions, then taxes or subsidies on ingredients could be a more effective approach to attain desired outcomes. A study by Miao et al (2012) found that taxing sugar as an input at the firm level would be a more efficient approach to decreasing sugar intake than adding a tax onto high sugar products at the consumer level.

This study focuses on the firms that manufacture ready to eat cold breakfast cereals. Some breakfast cereals are relatively healthy foods, being high in fibre and vitamins while being low in saturated fat and cholesterol, and when consumed with milk increase calcium and vitamin D intake. The consumption of breakfast cereal has been shown to have positive effects on micronutrient and fibre intakes (Barton et al 2005; Galvin et al 2003). Other cereals, however, have high levels of sugar which make them inappropriate for regular consumption, especially for children. Using nutritional data on breakfast cereals, this paper explores whether breakfast cereal portfolios have improved or deteriorated over the last 20 years by manufacturer from a nutritional perspective, and whether these trends are associated with media coverage on nutrition issues or input prices. The firm's decisions around new or existing products could affect the price charged for the cereal, the quality (nutritional content), and/or the advertising budget for the individual cereal products.

This chapter will first reviews of the literature on how public awareness of nutrition impacts the food industry, firm behavior with respect to product quality, price, and advertising, and an overview of the breakfast cereal industry. Next, the objectives and research questions are defined, then the data and all of the various sources it was obtained from are described. Finally, the data is examined in a variety of ways, both aggregated by firm and nutritional quality as well as disaggregated into individual products to see how quality, price, and advertising correspond with each other and how public awareness of specific nutrients as well as input prices play a role. Examining the data from various angles in different categories allows us to better understand the strategy of food manufacturers and identify where regulations could be beneficial. Potential issues that could require policy measures include healthier products being more expensive, encouraging the consumption of less healthy products, higher levels of advertising for less healthy products, encouraging their consumption, or an increasing segmentation of products in terms of nutritional quality which could increase health inequities.

4.2 Literature Review

4.2.1 Impacts of public nutrition awareness on industry

The links between diet and health have become increasingly well understood in recent years, eliciting a high level of consumer interest. Media coverage describing the benefits of the newest superfood like chia or the evils of high-fructose corn syrup can be seen regularly in newspapers and magazines. Task forces addressing public consumption of trans-fats (2005-2010) and sodium (2007-2011) have been created and disbanded by the Canadian government. During their tenure, the Canadian trans fat task force made various industry focused recommendations to reduce trans fat consumption among Canadians, many of which were voluntarily adopted by food manufacturers. There is evidence (L'Abbe et al 2009) that trans fat consumption did in fact decrease following the labeling requirements and production recommendations, and L'Abbe et al emphasize the importance of active media interest in increasing consumer awareness about trans fats and increasing

pressure on the food industry to make improvements. The Sodium Working Group was appointed by the Canadian government in 2007 and recommended structured voluntary sodium reductions by the food processing industry with the possibility of imposing regulations should the industry not comply (Arcand et al 2013). However, the group was disbanded in 2011, and with the exception of some public education and suggested sodium reduction targets for the food processing industry, there is no known action, implementation, or monitoring based on the group's recommendations. From 1999-2014, the Heart and Stroke Foundation of Canada had the Health Check symbol licensed for use on thousands of products, indicating that the product was a healthy choice based on the amount of sodium, fat, and other nutrients it contained. In the 2011 criteria, breakfast cereals were limited to contain no more than 3g of fat, 240mg of sodium, 6g of sugar, trans fat as 5% or less of total fat, and had to contain at least 2g of fibre in order to qualify for the Health Check symbol. Given this high level of attention nutrition has been receiving, it is possible that food manufacturers have already adapted their products to meet demand for healthier products or trendy nutrients without any sort of government regulation.

One of the characteristics of the highly concentrated breakfast cereal industry is the frequent introduction of new products (Nevo 2001). Given the level of attention that nutrition has been garnering, it is possible that cereal manufacturers are developing new products that appeal to health conscious consumers. It is also possible that as health claim regulations evolve or third party certifications become available that firms will adapt or expand product lines to take advantage of the opportunity to be seen as a health conscious manufacturer. Mancino et al (2008) found that almost immediately following the release of the 2005 Dietary Guidelines in the US, which were unique in quantitatively recommending consumption of whole-grain products, consumption of whole-grain foods, especially cereals, breads, and pastas increased significantly. Sales of whole grain bread and baked goods increased by 23% in the year following the recommendation while sales of whole grain pasta increased by 27% (Whole Grain Council 2008). Given that prior recommendations pertaining to increasing consumption of fruits and vegetables and decreasing consumption of sugar, sodium, and saturated fat did not elicit the same

level of consumer response, Mancino et al (2008) hypothesized that food manufacturers, having prior awareness that whole grain recommendations were going to be made, increased the supply of whole-grain products in anticipation of the new dietary guidelines. They found evidence that the new guidelines induced competition among manufacturers, resulting in an increased level of availability of whole-grain products due to the introduction of both new and reformulated whole-grain products, demonstrating that competition among manufacturers can be beneficial in supporting dietary recommendations, a finding supported by Golan and Unnevehr (2008). Similarly, Dummer (2012) found that many firms in Canada reformulated their products to contain less sodium or sugar in order to qualify for a Health Check™ symbol.

Both the trans-fat and sodium task forces proposed regulations to be imposed on the food industry if recommendations weren't effective prior to being disbanded, and some firms may have preemptively adjusted their product formulations to be ahead of the curve incase the regulations were implemented. While none of these recommendations or proposed standards have resulted in mandatory regulations on food manufacturers by the government, they may have nonetheless been effective. Determining whether recommendations, proposed regulations, or perceived market pressure to provide healthier options has affected the nutritional quality of products in the breakfast cereal category is one of the main objectives of this paper.

4.2.2 Firm Behaviour

Various components of firm behaviour can contribute to the decision to make products healthier. Firms need to choose their optimal mix of price, advertising, and quality in order to maximize profits (Dorfman and Steiner 1954). According to Dorfman and Steiner, monopolistic firms will maximize profits when they meet the following condition:

$$\mu = \eta = \eta_c(p/c)$$

where μ is the marginal value product of advertising, η is the ordinary elasticity of demand, η_c is the elasticity of demand with respect to changes in quality,

p is price and c is the cost which is a function of both quantity and quality. Consumer sensitivity to these components affects the outcome both in terms of chosen levels and in segment differentiation.

Firm behaviour is also largely dependent on market structure (Lambin et al 1975). The breakfast cereal industry can be characterized as an oligopoly (Nevo 2001 and Schmalensee 1978), which affects how firms react to each other's actions. In the breakfast cereal case, if one firm is going to offer a higher quality product (perhaps incorporating ancient grains, increasing fibre, and lowering sugar), a competitor could choose to create a competing product (perhaps adding chia seeds and acai berries to an existing cereal), decrease their prices, or increase their amount of advertising spending. The outcome could be more nutritious products, but it could also be that the less nutritious products have just gotten cheaper. We need to consider that the nutritional profile of foods (one aspect of product quality) is an outcome generated by the firm's objective function, constraints, strategic decisions, and market structure. Understanding the impacts of these factors on food quality will allow for more informed policy suggestions to improve children's diets.

Lambin et al (1975) generalized the Dorfman-Steiner theorem to the case of an oligopoly with multiple competitive reactions. In this case, they found that if one firm decreases the price of their product, another could react by adjusting their price, quality, advertising, or some combination thereof. In addition, some firms will predict a given reaction from a competitor and incorporate this reaction into their objective function accordingly.

4.2.2.1 Quality

When it comes to choosing the level of quality to provide, market structure plays an important role, along with relative cost functions and order of entry/product introduction. According to Gale and Branch (1982) product quality, rather than market share, explains most price variation in concentrated industries. Facing a potential new entrant into a concentrated market often affects incumbent firms' chosen product quality. By providing a close substitute to the product of the new entrant, firms can 'crowd out' their rivals, ultimately deterring entrance

(Schmalensee 1978). In the model developed by Hung and Schmitt (1988), if it is infeasible or not profitable for a monopolist to deter entry of a new firm, the incumbent will produce the higher quality product in the resulting duopoly. This result is supported by Buzzell et al's (1975) findings that market leaders typically produce higher quality products than their competitors and that they command higher prices for their higher quality products. Lutz (1997) found that in terms of the entrant's strategy, their best response is dependent on the product quality of the incumbent. If the incumbent's product quality is high, the new entrant's best response will be to choose a relatively low quality whereas if the incumbent's product quality is low, the entrant's best response will be to choose a relatively high quality. The entrant can be profitable so long as there is adequate product quality differentiation. It is also possible that the incumbent will choose to deter entry by increasing the quality of their product.

4.2.2.1.1 Evaluating Nutritional Quality

Several systems have been developed to measure the nutritional quality of foods. In a review and comparison of the different systems, Azais-Braesco et al (2006) evaluated the Calorie for Nutrient (CFN), Nutritious Food Index (NFI), Ratio of Recommended to Restricted Nutrients (RRR), and The Nutrient Profile (NP) systems. Their findings were that in general, all systems rated fresh fruits and vegetables highly while processed foods high in fat and sugar were rated poorly. Each system, however, had some questionable rankings and there were discrepancies between how the systems ranked various foods. Azais-Braesco et al concluded that none of the systems were without flaws, but that the NP was likely the most promising. What is interesting to note is the nutrients included in the different rating equations. (Nutrients are broadly classified as micro and macronutrients; micronutrients are vitamins and minerals, macronutrients are fats, protein, carbohydrates, and fibre.) The CFN accounts for only the amount of micronutrients and protein on a per calorie basis. It does not take the amount of fat, sugar, or fibre into account. The NFI measure includes calories, fats, sodium, cholesterol, fibre, and many micronutrients, but not sugar or protein. The RRR

takes into account the ratio of calories, saturated fats, sugar, sodium, cholesterol, protein, and fibre as well as vitamins A and C as well as calcium and iron (all of which are mandatory to include on food packaging in Canada and the US). It does not include any of the B vitamins, magnesium, phosphorous, or potassium. The NP includes the same macronutrients as the RRR but does not include cholesterol or any micronutrients (as is mandatory for labeling in the EU).

Given that more vs. less healthy breakfast cereals are distinguished largely by their sugar content, it is important for this study to choose a nutrition measurement that accounts for sugar. As such, the RRR or NP are more appropriate than the CFN or NFI. Because breakfast cereals are an important source of several micronutrients, the RRR, which takes several micronutrients into account, generates a more comprehensive comparison of breakfast cereals than the NP which ignores all micronutrients. Although ratio-based scores such as the RRR have been criticized as too complex for consumers to utilize at the point-of-purchase (Drewnowski and Fulgoni 2014), they are relatively straightforward to calculate using a spreadsheet. Therefore, the nutrition scores of breakfast cereals for this study were evaluated using the RRR system, developed by Scheidt and Daniel (2004).

One of the benefits of the RRR system is that it can be calculated using only the information provided on the nutrition facts panel which is mandatory on all processed foods in Canada and many other countries. The concept is quite straight-forward; the average of % daily value of recommended nutrients (protein, fibre, calcium, iron, vitamin A, and vitamin C) is in the numerator, while the average of % daily value of restricted nutrients (calories, sugar, cholesterol, saturated fat, and sodium) is in the denominator. Therefore a product which contains a higher level of beneficial nutrients than harmful ones will have a score greater than 1. If two products are equal in their level of beneficial nutrients but one is higher in sugar, the item with less sugar will have a higher score. This score is especially useful in comparing similar products to see which is healthier. Several studies have employed the RRR to evaluate the nutritional quality of various products (Byrd-Bredbenner et al 2009, Byrd-Bredbenner et al 2012, Roseman et al 2014, Heller et al

2011). Specific to cereal, Roth (2016) used the RRR to compare how nutritious national brands, organic brands, store brands, and basic brands were in the UK. Roth found that when aggregated and averaged by brand type, basic brands had the highest RRR, followed by national then store brands while organic brands had the lowest average RRR.

4.2.2.2 Price

Classical economic theory suggests that firms in an oligopolistic industry can compete through quantity (Cournot) or price (Bertrand), each approach having its own outcomes. When price competition is assumed, Bertrand's result is that each firm sets price equal to marginal cost which is the same as the perfectly competitive outcome. This result depends on several assumptions, however, which are not necessarily realistic in a real world setting; product homogeneity, identical production costs, and capacity constraints are all required for the Bertrand result.

According to Schulz and Stahl (1996), with differentiated products sold by multi-product firms, the oligopolistic prices are higher than the monopolistic prices, and monopolistic firms offer a larger number of variants than does an oligopolistic industry. Singh and Vives (1984) find that when goods are substitutes, duopolistic firms will have higher profits when they compete in quantity rather than price. Hackner (2000), however, points out that when they extend this model to a larger number of firms, the advantage of price vs. quantity competition is less clear but depends somewhat on the degree of quality differentiation. In an experiment on oligopolistic price competition, Dufwenberg and Gneezy (2000) found that in a duopoly, prices remained higher than theory predicted, but when 3 or 4 competitors were present, there was much less cooperation and prices converged rapidly to theoretical predictions. Kadiyali et al (1996) summarize key findings on price strategy as 1) the effects of price cuts on market shares are asymmetric, 2) price behaviour is influenced by a firm's proportion of loyal customers vs. switchers, and 3) weaker brands should offer price promotions more frequently than a stronger brand.

4.2.2.3 Advertising

When considering the optimal level of advertising, Nelson (1974) points out that false advertising with respect to search goods of a product will not induce purchases because consumers can verify claims before purchasing. The same is not true for experience goods because misleading claims can lead to trial purchases. Because higher quality brands will garner more repeat purchases than lower quality ones, *ceteris paribus*, and thus have higher present values of trial purchases, firms selling higher quality brands will spend more on advertising them. As such, the level of advertising, and not the advertising message itself, is an indicator of quality to many consumers. Schmalensee (1978) agrees that high quality brands have higher probability of repeat purchases and thus higher present value returns on advertising, resulting in higher equilibrium market shares. However, depending on some model parameters, there exist possible equilibria where lower quality brands have higher advertising expenditures, larger market shares and higher profits than higher quality brands. Considering the relative advantage of leaders versus followers, Schmalensee (1982) suggests a model where consumers are skeptical upon initial introduction of a new brand, but when they are convinced of its quality, new brands are judged against it. Therefore later entrants have a harder time convincing consumers to try them than does the first brand. This suggests that there is an advantage to early product differentiation that is not a function of advertising. The new entrants who are successful will typically have adequately differentiated their product from other earlier products to be perceived as 'pioneering' to some segment of consumers.

4.2.2.3.1 Corporate Social Responsibility

Corporate Social Responsibility (CSR) has been defined in the business and economics literature as firms contributing to society in some positive way beyond the profit-maximizing objective (McWilliams 2000). It can also be viewed as a marketing tool, providing the consumer with an incentive to purchase a particular firm's product regardless of the product's specific attributes. The most common approaches to CSR involve environmental protection, community development, and

charitable donations, and the food industry participates heavily in the CSR game. Across Canada, Tim Horton's sponsors children's hockey and soccer. McDonald's maintains the Ronald McDonald House charity, providing a place for families to stay when a child needs to be hospitalized away from home. Coca-Cola has incorporated positive recycling messages into their television commercials. Firms can use many different ways of contributing positively to society to increase their appeal to consumers and investors, and to increase their impact, they may choose to focus on current issues prevalent in the public's mind. For example, immediately following the FIFA World Cup in Brazil, Coca-Cola invested in a program developing the skills of Brazilian youth growing up in Rio De Janeiro's favelas.

The obesity issue has become a CSR concern which most food companies are reluctant to ignore, partly due to the threat of regulatory measures, partly to maintain a positive image in the public's eye (Lee et al 2013). Whether or not they felt they had a choice, food companies have reacted to this issue through a variety of measures including provision of nutrition information, decreasing portion sizes, and product reformulation. Whole Foods Market offers products differentiated as healthier and is consistently growing sales and profits while doing it (Galbreath 2009). By expressing concern for the health and well-being of the population, a food manufacturing firm can secure brand value and consumer goodwill (Herrick 2009). CSR measures taken by food companies have been negatively received by many, however, who claim that their main approach is to transfer responsibility to personal willpower (Lee et al 2013). According to Richards et al (2015), the manufacturers of processed 'junk' foods and beverages use "public relations campaigns and public statements to state company concerns about the health of their customers and populations… [then utilize] tactical campaigns that emphasize freedom of choice and personal responsibility to encourage consumers to oppose regulation of the industry" (pg. 550). One example of this is Coca-Cola's two-minute television commercial emphasizing that they have low-calorie options available and that overconsumption of calories will lead to weight gain.

Many companies discuss their CSR approaches in their annual reports which are available online for those which are publicly traded. Coca-Cola Enterprises Inc.

states that their CSR focus is "from recycling, water use, and climate change, to our product portfolio and encouraging active healthy living in our workplace and communities"(pg.13). Tim Horton's CSR section of their 2014 Sustainability and Responsibility Report focused mainly on charitable activities and environmental impact goals. The nutrition section mentioned the reduction of sodium in their menu items as well as increasing the number of healthier options available. In their 2015 Global Responsibility Report, General Mills highlighted the number of food donations they make to food banks and disaster relief efforts, as well as the fact that they fund cooking classes, nutrition education, and active living programs in the US, and have improved over 850 of their products from a nutritional standpoint since 2005. Kellogg's 2014 corporate responsibility report discussed their commitments to the environment, sustainable sourcing of ingredients, and charitable donations, along with their goals to increase the fibre and protein content of their products while lowering the sugar and sodium content. They also highlighted the fact that they support nutrition research and education.

4.2.2.4 Product Line Extensions

Product line extensions are an important facet of a firm's strategy, especially in the market for nondurable goods (Kadiayli et al 1998, Bayus and Putsis 1999, Draganska and Jain 2005). In the food industry, product line extensions are typically new varieties of goods already in the firm's portfolio, such as a lower-fat, probiotic, or different flavoured yogurts by Yoplait. In 1991, 89% of new (nondurable) products sold by retailers were extensions of existing lines (Kadiayli et al 1998). Line extensions can be used to meet the demands of different consumer segments, to give consumers variety, to increase the firm's shelf space, to cannibalize lagging or competing products, or to compete with a new product of a rival firm. Having large product lines can also deter entry by new firms, potentially allowing the incumbent firm to raise prices (Bayus and Putsis 1999). In response to a line extension, a rival firm may adjust their price or advertising strategy, target new consumer segments, or extend one of their existing product lines. In a case study on Yoplait and Dannon yogurts, Kadiayli et al found that when Yoplait extended its product line, it won price-setting power from Dannon, and this shift led

to higher prices, margins, and profits for both firms despite cannibalization of pre-extension sales. Also examining the market for yogurt, Draganska and Jain (2005) found that there are decreasing returns to length of product line. In the breakfast cereal industry, price competition is avoided and rivalry is channeled largely into product line extensions, which tends to deter entry by new firms (Schmalensee 1978).

4.2.3 Breakfast cereal industry

According to Nevo (2001), the breakfast cereal industry is highly concentrated, has high advertising to sales ratios, has high price cost margins, and has frequent introduction of new products. In 1972, the US Federal Trade Commission issued a complaint against the top four breakfast cereal manufacturers in the US: Kellogg's, General Mills, Post, and Quaker Oats for using product differentiation, brand proliferation, and trademark promotion through intensive advertising to create high barriers to entry in the breakfast cereal market (Schmalensee 1978). Despite claims that collusive pricing behaviour exists in the breakfast cereal industry, Nevo (2001) was able to separate the price cost margins into that which is due to 1) product differentiation, 2) multi-product firm pricing, and 3) potential price collusion. He concluded that the industry is non-collusive in its pricing behaviour and that the high price cost margins can be attributed to differentiated product portfolios and using advertising to enhance perceived product quality. Advertising to sales ratios in the breakfast cereal industry were approximately 13% in 2001 (as high as 18% for well established brands), relatively higher than the typical 2-4% of other food products (Nevo 2001). He further states that the main firms in the industry neither compete nor collude in prices but rather that rivalry is channeled into aggressive new product introduction and advertising. The frequent product introductions by the main multi-product firms result in high product differentiation with many available products of varying degrees of quality. (For the purposes of this paper, quality in the context of breakfast cereals will be with respect to nutrition.) Therefore, given how concentrated the industry is, established firms may deter entry to new firms by providing healthy cereal options if they anticipate new firms

focusing on health. In addition, Anderson and de Palma (1992) show that consumers have heterogeneous preferences for variety and that in an oligopolistic industry, the amount of variety desired by consumers influences the number of firms that can operate within that product space. Connor (1999) points out that the cereal industry has a unique mixture of incredibly long-running brands – Kellogg's Corn Flakes have been around since 1902 – and varieties that are available for very short times, often less than a year. He also posits that new product introductions are one of the main ways that breakfast cereal manufacturers affect price increases. While the role of breakfast cereals in the North American diet has been changing in recent years, with some people moving towards more convenient, grab-and-go options (Harris, 2017), a 2018 poll found that 90% of Canadians still eat cereal, with over 50% consuming it one to three times per week (Food in Canada 2018).

It should be noted that both Kellogg's and General Mills (the firms we will be more closely examining) are very old companies with different strategies. Kellogg's was founded in 1898 and its focus has generally been on breakfast cereals, also adding snack categories since around 2000, purchasing the Keebler company, Cheez-it, Famous Amos, and Pringles since then. In 2016, Kellogg's CEO reported that its cereal business now contributes around 42% to their product portfolio (Davis 2016). General Mills was founded in 1928 and has been involved in a broader range of product categories over the years. They've ventured into toys (Parker Bros), aeronautical research, and TV shows. In 1970 they acquired the five unit restaurant chain Red Lobster and expanded it, also adding Good Earth and Olive Garden into their restaurant portfolio over the years. This branch of the company was spun off into Darden Restaurants in 1995. Around this time, General Mills decided to refocus on foods, and now owns Pillsbury, Betty Crocker, Bisquick, Bugles, Nature Valley, Old El Paso, Hamburger Helper, Haagen Dazs, and a controlling share in Yoplait. In 2016, General Mills became the third largest producer of organic food in the US (General Mills 2018). In the US, cereal is now their second largest product category, just behind meal offerings such as soups, taco ingredients, pizza, and dinner kits.

Given that breakfast cereals compete largely through advertising, Clark (2007) explored the possibility that the ban on advertising to children in Quebec could have resulted in unintentionally hindering competition. He found that the prices of children's cereals in Quebec were higher than in the rest of Canada despite the prices of adult and family cereals being consistent across the country. This is likely explained by the absence of informative advertising resulting in higher perceived product differentiation which hinders price competition. Established children's brands thus benefit from the advertising ban because newer products cannot advertise to announce their existence to children.

Canadians spend about $1.4 billion annually on breakfast cereals (Euromonitor 2014), eating a little over 4kg of cereal per capita annually (Precision Nutrition 2015), however other types of breakfast such as breakfast sandwiches and yogurt based meals are increasing the competition breakfast cereals face. In 2009, 79% of households reported consuming cereal in the past 6 months, but this number dropped to 67.1%by 2015 (PMB 2015). The main drivers of breakfast food choices are health and convenience, according to the 2008 NPD Eating Patterns in Canada Report (AAF 2009). Kellogg's Canada Inc., General Mills Canada Corp, and Pepsi-QTG Canada Inc. (producer of Quaker Oats products) together account for 75% of the breakfast cereal sales in Canada, with Kellogg's Special K being having the highest value share at 12% (Euromonitor 2014). Data collected by the Print Measurement Bureau shows the most common types of cereal used in Canada are multigrain and bran, while General Mills' Cheerios are the most frequently consumed (PMB 2015). In 2013 in the US alone, over $500 million was spent on advertising breakfast cereals (Nestle 2013). The advertising of nutritionally poor foods to children has been touted as one of the causes of the rising incidence of childhood obesity (Veerman et al 2009). Schwartz et al (2008) found that breakfast cereals marketed towards children were higher in sugar and lower in fibre and protein than those targeted at adults. LoDolce et al (2013) found that high-sugar breakfast cereals were the most commonly advertised packaged food to children on TV.

While many cereal manufacturers are modifying their products targeted at children to be healthier, they continue to target advertising of their least healthy products towards children (Baertlein 2012). This isn't always done through traditional media; it is often achieved through the use of cartoon characters and bright colours to appeal to children. Breakfast cereal manufacturers General Mills, Kellogg's, and Post are among the companies that are part of the voluntary, self-regulated Council of Better Business Bureaus' Children's Food and Beverage Advertising Initiative (CFBAI), in which the participants have agreed to only advertise products meeting an industry-created nutrient criteria to children under 12. On the one hand, critics have argued that the standards (especially sugar limits) are not good enough, and thus high sugar products are being promoted to children, but on the other hand, many firms have reduced the amount of sugar in their products to meet this standard (Baertlein 2012). A study examining the foods targeted at children based on their packaging found that 90% of the breakfast cereals targeting children were rated as nutritionally poor based on the high sugar content (Elliott 2008).

4.3 Objectives and Research Question

The overall goal of this dissertation is to evaluate the effectiveness of potential policy instruments in improving children's diets. This study explores firm behaviour in the breakfast cereal industry to see how various factors influence the nutritional profile of food products and how the top breakfast cereal manufacturers compare in terms of nutritional quality. Firms may reformulate their products in response to public awareness of different nutrients, in which case educating consumers about nutrition would result in healthier food products being maunfactured. It is possible that the primary determinant of a food's nutritional profile is simply the relative prices of inputs. Recommendations and regulations (such as those to reduce sodium in the food supply or mandatory labeling of trans fats) could also influence how firms choose to formulate their products. We also

need to consider how firms choose to market the different components of their product line and how they react to the actions of other firms.

The data that have been compiled for this study from such a variety of sources presents us with a unique opportunity to see how this industry has evolved over the past two decades. The goal is to examine this data descriptively, at various degrees of aggregation, in order to answer several questions: Are breakfast cereals getting healthier, less healthy, or staying the same? Do cereal manufacturers spend more to advertise healthier or less healthy products? Are their healthier products more or less expensive than their less healthy offerings? Do changing input prices affect the retail prices or nutritional quality of breakfast cereals? Are firms adjusting the formulations of their products in response to consumer awareness about various nutrients?

This chapter examines the trends in nutritional quality, price, and advertising of Kellogg's and General Mills' breakfast cereals between 1999-2017, and observes how external factors (such as input prices and public awareness of nutrition) influence these. We then address these questions in order to determine what factors influence the healthfulness of breakfast cereals and whether or not there is merit in the government placing regulations on the production of foods consumed frequently by children.

4.4 Data

A summary of the sources for various data collected for this study are shown in Table 4.1, with a detailed summary of each following.

Table 4.1 Data sources for breakfast cereal industry analysis

Source	**Variables**	**Years**
Mintel New Product Database (Food and Beverage)	Nutrient profile of each cold breakfast cereal produced by General Mills and Kellogg's sold in Canada	1999-2017
Datastream	Commodity prices RICEBR$ (rice), OATSMP2 (oats), HRWWNO2 (wheat), CORNUS2 (corn), WSUGDLY (sugar)	Rice: 2005-2017 Others: 1999-2017
Factiva	Number of stories in Canadian Print	1999-2017

	Media where the health implications of consuming sugar/sodium/fibre are included.	
IRi Worldwide Consumer and Shopper Marketing	Retail prices of breakfast cereals in the US	2002-2012
Nielsen	Advertising spending by product	1999-2013
Collected in person at various grocery stores in the Edmonton, AB area	Retail prices and nutrient profiles of all breakfast cereals offered for sale	2015-2017

The Mintel Global New Product Database (Food and Beverage) contains data on all breakfast cereals introduced to the North American market since 1996, be they new products or simply reformulations, and is accessible through the University of Alberta library. Records contain information on the nutrient profile of the product, including information on all the nutrients needed to calculate the RRR score. Canadian breakfast cereal portfolios of Kellogg's and General Mills, the top two manufacturers, were assessed (sample characteristics shown in Table 4.2). Current nutrient profiles and prices of the products in the data set were collected at grocery stores in the Edmonton, Alberta area in 2015, 2016, and 2017. Nutrient profiles at the time of introduction and any reformulations were obtained from the Mintel New Product Database. For a list of products included in this analysis, along with their average RRR, retail price, advertising spending, and sugar level, please see Table 4A.1 in Appendix 4A.

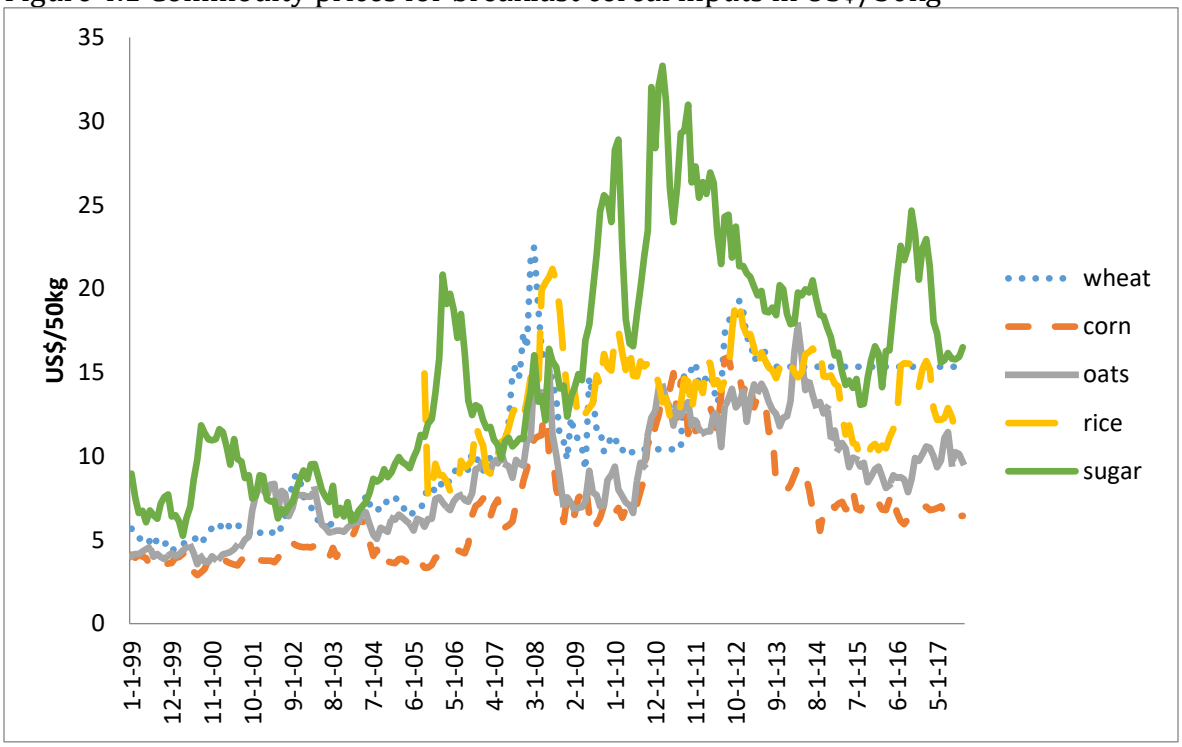
Table 4.2: Summary statistics of data collected from Mintel database

	Kellogg's	**General Mills**
Sample size	126	67
Missing data	15	11
Average RRR	1.42	1.82
Minimum RRR	0.21	0.44
Maximum RRR	5.02	11.83

It is necessary to consider input prices of breakfast cereals as it is possible that formulations adjust to prevailing costs. The main inputs in breakfast cereal production are wheat, corn, oats, rice, and sugar, prices of which are shown in

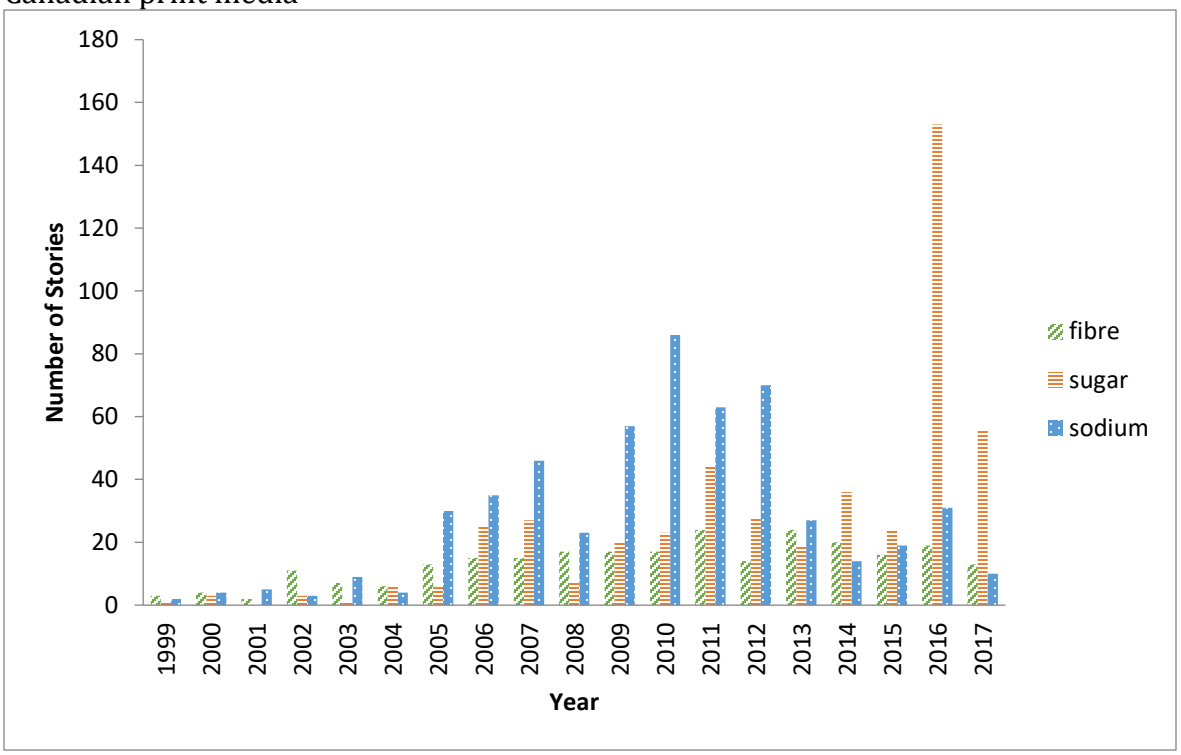
Figure 4.1. Data on the historical prices for these commodities was obtained from Datastream, a database containing historical commodity prices available through the University of Alberta Library.

Figure 4.1 Commodity prices for breakfast cereal inputs in US$/50kg



To establish what nutrition topics were prevalent in the public's mind over the period in question, the Factiva database (accessible through the University of Alberta Library) was used to compile data on the number of news stories appearing in Canadian print media in a given month about specific nutrients. The number of stories about the health impacts of nutrients prevalent in breakfast cereals, specifically sodium, sugar, and fibre were tabulated and are shown in Figure 4.2.

Figure 4.2 Coverage of health implications of consuming specific nutrients in Canadian print media



Price data was obtained from several sources for our analysis. Retail price data for 2002-2012 was obtained from IRi Worldwide Consumer and Shopper Marketing. This database is for the US market, thus prices were converted to Canadian currency using historical exchange rate data. Retail price data was collected in-person at various grocery stores in the Edmonton, AB area in 2015, 2016, and 2017. Missing price data was filled in using historical prices from Statistics Canada as well as by regressing the existing data over time.

Advertising data on a variety of breakfast foods were purchased from Neilsen in 2013 for various research projects. This study utilizes the subset of this data pertaining to breakfast cereal advertising in Canada (in all formats) between 1999-2013.

Once all of these data were assembled, we had a panel consisting of all the breakfast cereal products being sold by Kellogg's and General Mills from 1999-2017. Each individual brand had a value for RRR, sugar content, sodium content, fibre content, price, and advertising associated with it for all the years it was on the

market (or until 2013 for advertising). The non-product-specific variables included in the panel were the media measures for sugar, sodium, and fibre, as well as the input costs.

4.5 Analysis and Results

The main economic question that is addressed in this paper is how the various factors discussed previously (input prices and public health focus) impact the nutritional quality of breakfast cereals, which is an outcome of the firm's objective function and constraints.

The first step of the analysis was to download the data on all breakfast cereal products introduced, changed, or reformulated by Kellogg's and General Mills since 1999 from the Mintel database. Next, the RRR score was calculated for each product over the time frame in question as well as for current products (calculation described in section 4.2.2.1.1). Data were then collected on input prices, current retail prices, past retail prices, advertising expenditures, and media exposure. The analysis focuses on the evolution of breakfast cereals from 1999 to 2017 from a nutrient profile perspective. How the RRR as well as sugar, sodium, and fibre content of individual products has changed is assessed to determine what trends are occurring in the industry. The nutritional quality of Kellogg's products vs. General Mills are compared, as are the retail prices and advertising spending for products with differing levels of healthiness.

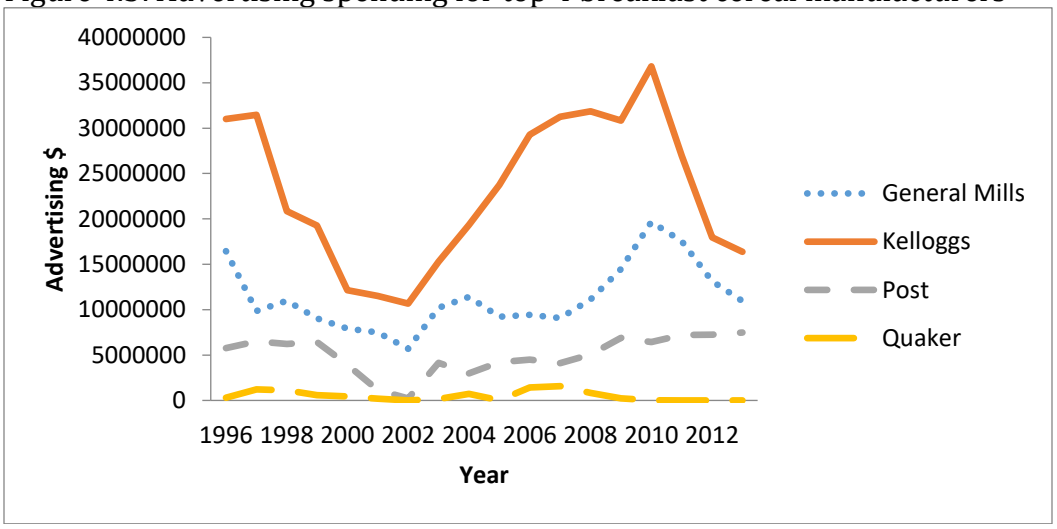
For some portions of the analysis, cereals are split into categories based on their RRR score. Cereals defined as having low RRR are those with a score below 1, medium RRR cereals are those with a score between 1 and 1.5, and cereals defined as having a high RRR are those with a score above 1.5.

4.5.1 Advertising spending

Advertising is an important component of a firm's marketing mix and is closely examined for the top four breakfast cereal manufacturers in Canada. From 1996 to

2013 in Canada, Kellogg's spent the most of all breakfast cereal manufacturers on advertising, with the highest level being $36,810,143 in 2010 and the lowest being $10,670,118 in 2002. General Mills is second highest in advertising spending, followed by Post and finally Quaker. It should be pointed out that advertising spending on individual products fluctuates greatly from year to year. For example, General Mills spent about $2.5 million advertising Cheerios in 2006 but only $600,000 in 2008. They spent around $750,000 advertising Honey Nut Cheerios in 2007 and $3.4 million on it in 2010. Kellogg's spent about $3.9 million advertising Vector in 2000, then $100,000 in 2002, nothing at all from 2007-2009, coming back up to $2.2 million in 2010. All firms discussed had their lowest levels of overall advertising spending in 2002, as illustrated in Figure 4.3 below.

Figure 4.3: Advertising spending for top 4 breakfast cereal manufacturers



When we segregated advertising spending by high, medium, or low RRR products, some interesting trends were noted (see Figures 4.4 and 4.5). In all years, Kellogg's spent more money advertising its high or medium RRR products (often both) than its low RRR products, often twice as much. The highest proportion Kellogg's spent on advertising their low RRR products was 31% in 2010. Similarly, General Mills highest advertising spending alternated between their middle and high RRR products, seeming to focus more on advertising its high RRR products

between 2004 and 2010. The highest proportion General Mills allocated to advertising their low RRR products was 18% in 2013.

Figure 4.4 Kellogg's advertising spending on high and low RRR breakfast cereals

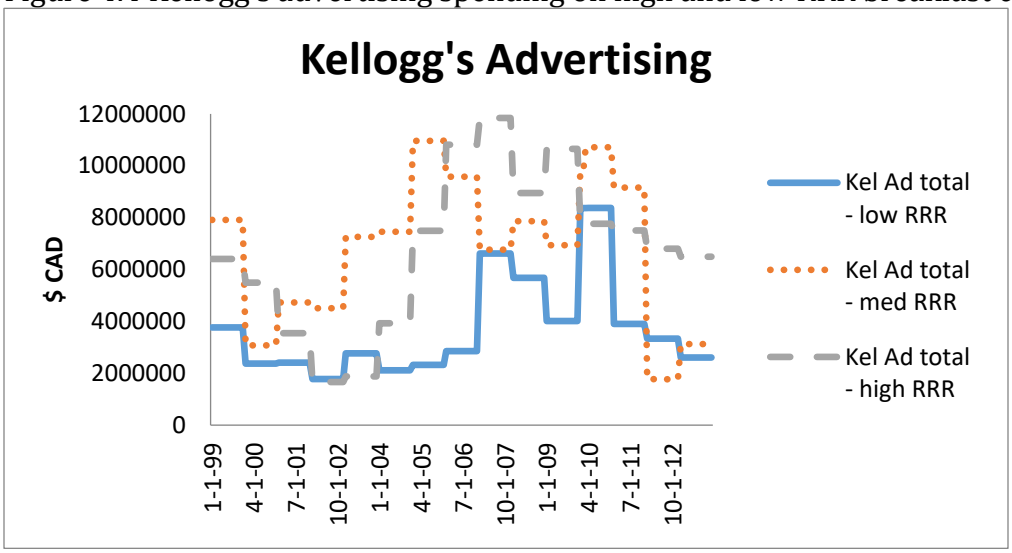
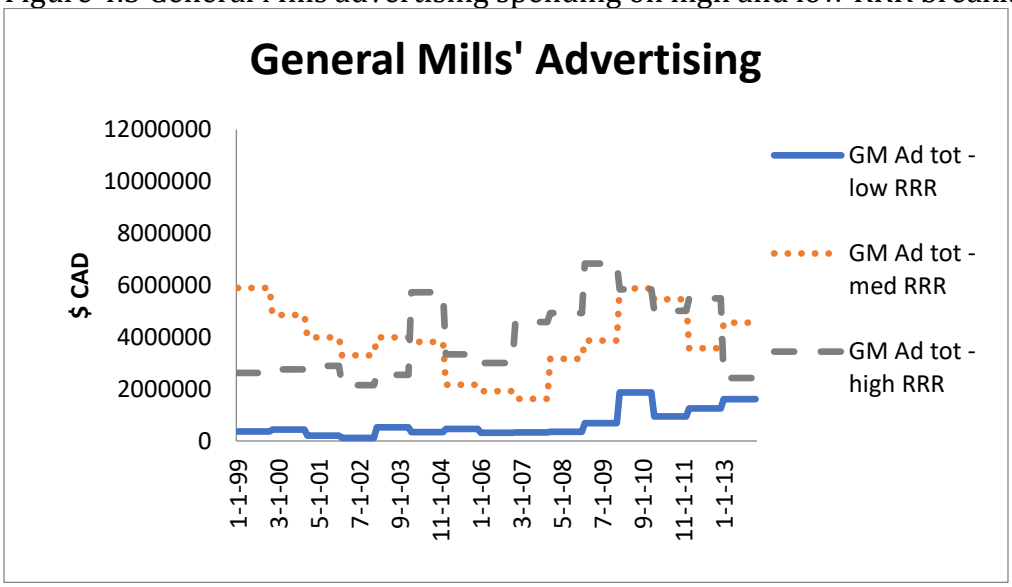


Figure 4.5 General Mills advertising spending on high and low RRR breakfast cereals



4.5.2 Retail Prices

One concern about the consumption of breakfast cereals is that manufacturers could be selling their healthier products for a higher price to the health conscious consumer while making their less healthy products more appealing to low income

consumers by selling them cheaper. In order to determine if there is any evidence that Kellogg's or General Mills has exhibited this behaviour, we examined the average prices (in $/100g) of the low, medium, and high RRR products for both firms from 1999-2017 (see Figures 4.6 and 4.7).

Kellogg's products are fairly similar across RRR category from 1999-2007. From 2007-2012, there appears to be some discounting of low RRR products (around $0.08 lower than high RRR products). Conversely, from 2013-2017 their low RRR products are the most expensive on average, peaking at about a $0.10 difference. For the timeline in question, General Mills had their low RRR products as the most expensive for many years, the exception being in 2007 when the high RRR products were about $0.18 more expensive. Overall, there is no evidence that either of these firms is pricing their products in a manner that would encourage consumption of the less healthy products.

Figure 4.6 Retail prices for high, medium, and low RRR Kellogg's products

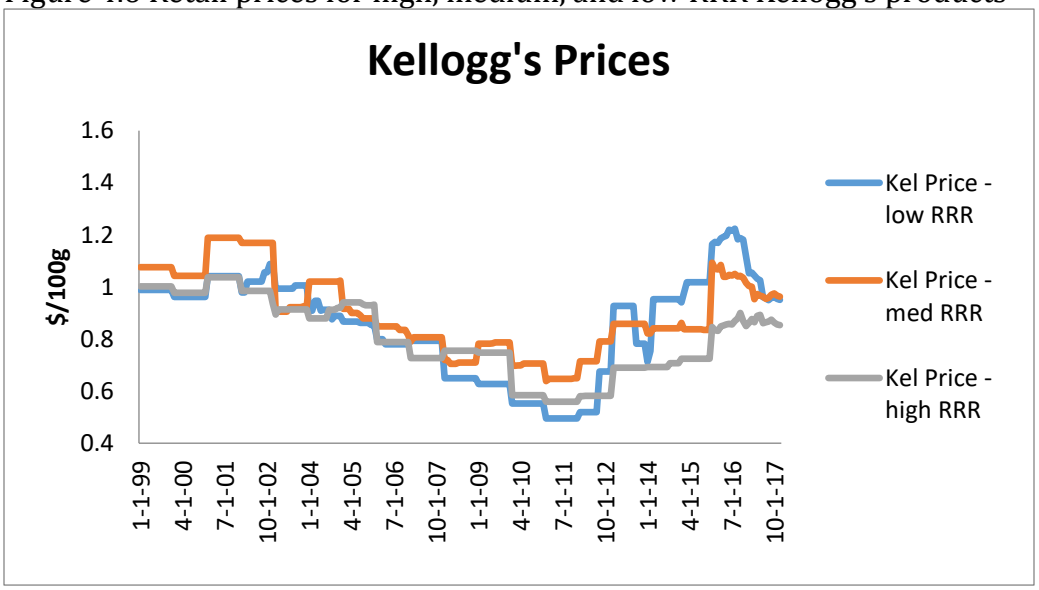
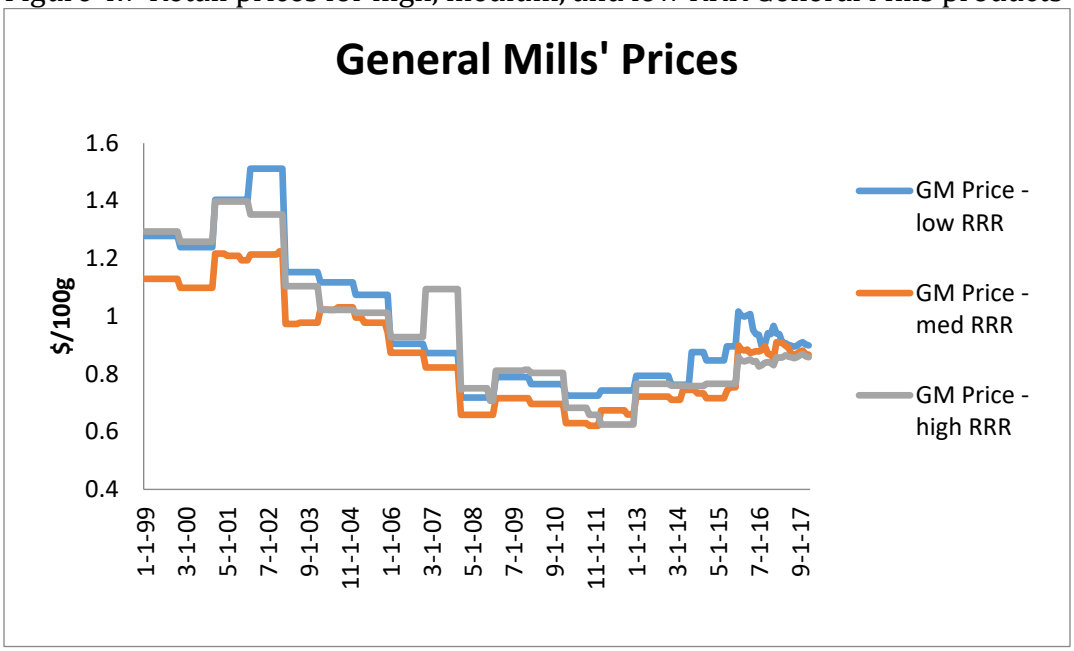


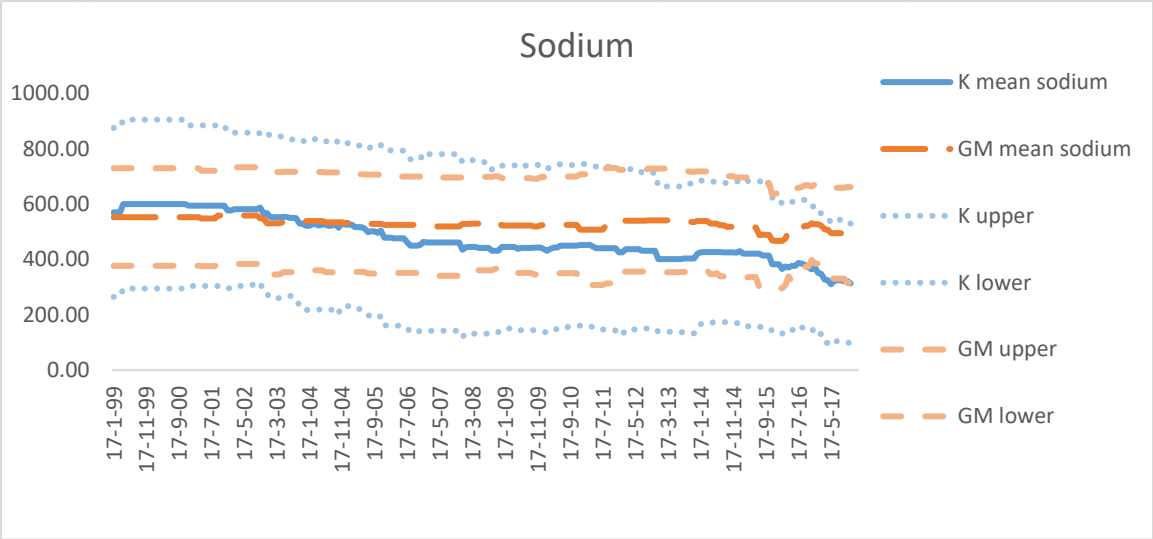
Figure 4.7 Retail prices for high, medium, and low RRR General Mills products



4.5.3 Nutrient Trends

Next, we looked at some specific nutrients with major implications for health which vary widely in the amount found in different breakfast cereals. The nutrients with negative health impacts being examined are sodium and sugar (see Figures 4.8 and 4.9). Fibre is the nutrient with positive health impacts under discussion (Figure 4.10). On average, Kellogg's has made the biggest decrease in the sodium content of their cereal at 45% from 1999-2017. General Mills decreased the sodium content of their cereal by 12% in the same time frame. Kellogg's has had a lower average sodium content in their products than General Mills since 2003. Kellogg's does, however, have a larger variance of sodium content, meaning that some of their products are quite high in sodium compared to others, but this variance is also decreasing. Overall, Kellogg's is showing a commitment to improve the healthfulness of their cereals through nearly halving the average amount of sodium in their breakfast cereals since 1999.

Figure 4.8 Mean sodium content and standard deviation of sodium content in Kellogg's and General Mills breakfast cereals (mg of sodium / 100 g of cereal)



Kellogg's has generally had a lower average sugar content than General Mills, but both have shown decreasing amounts of sugar overall. Kellogg's decreased their sugar content by 17% from 1999-2017 while General Mills decreased their average sugar content by 19%. Kellogg's has a slightly lower level of variance in sugar content, indicating that they have less of a difference between their high and low sugar products.

At the start of the time period being examined, the average fibre content of Kellogg's and General Mills breakfast cereal portfolios was very similar. Kellogg's however, has since increased the avearge fibre content of their breakfast cereals by 28%, while General Mills has only increased their fibre content by 8%, thus Kellogg's product have been higher in fibre, on average, since 2003. Kellogg's had higher variance in fibre content for most of 2003-2016, meaning that there were bigger differences between their high and low fiber cereals.

Figure 4.9 Average sugar content and standard deviation of sugar content in Kellogg's and General Mills breakfast cereals (g of sugar / 100 g of cereal)

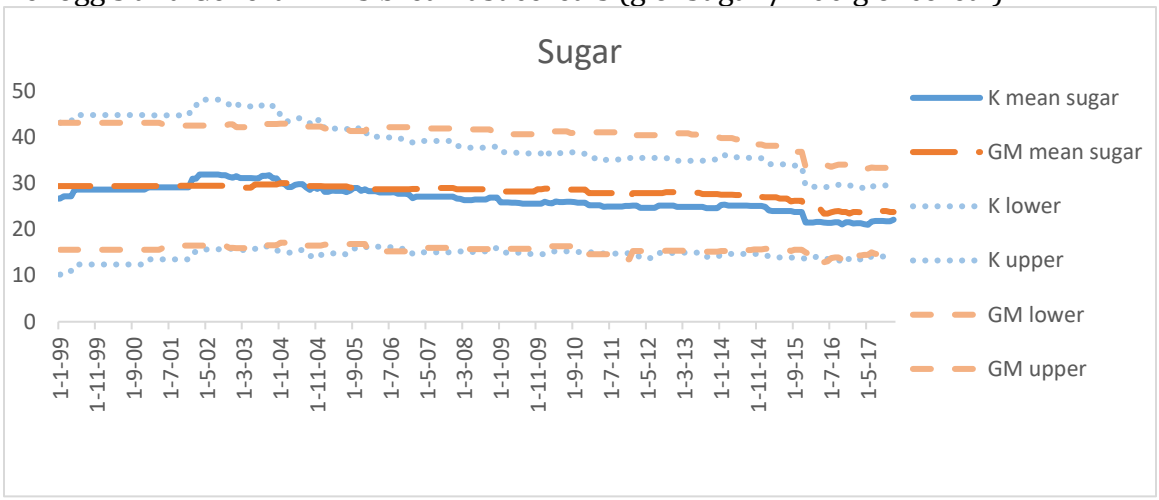
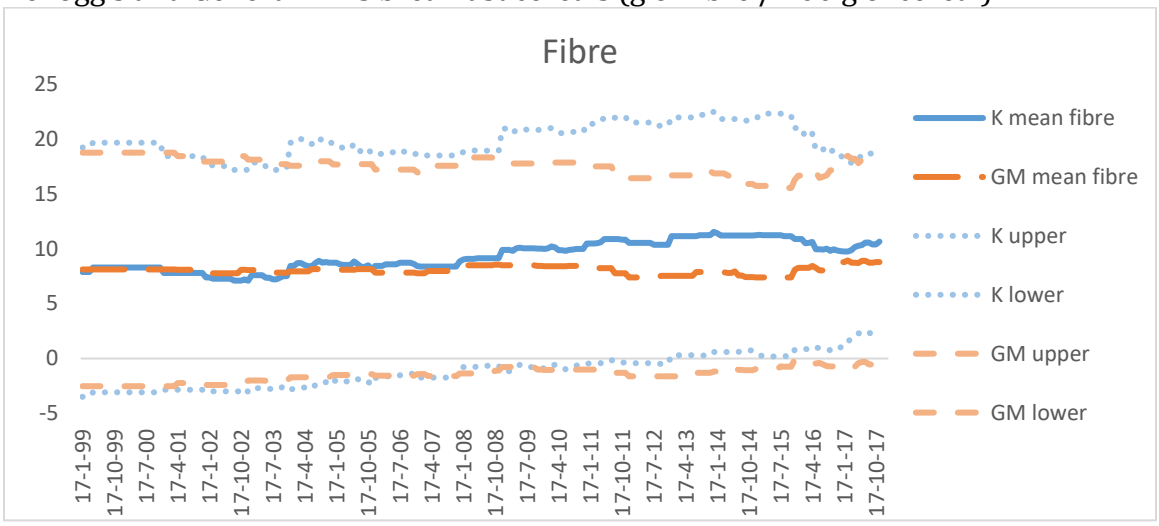
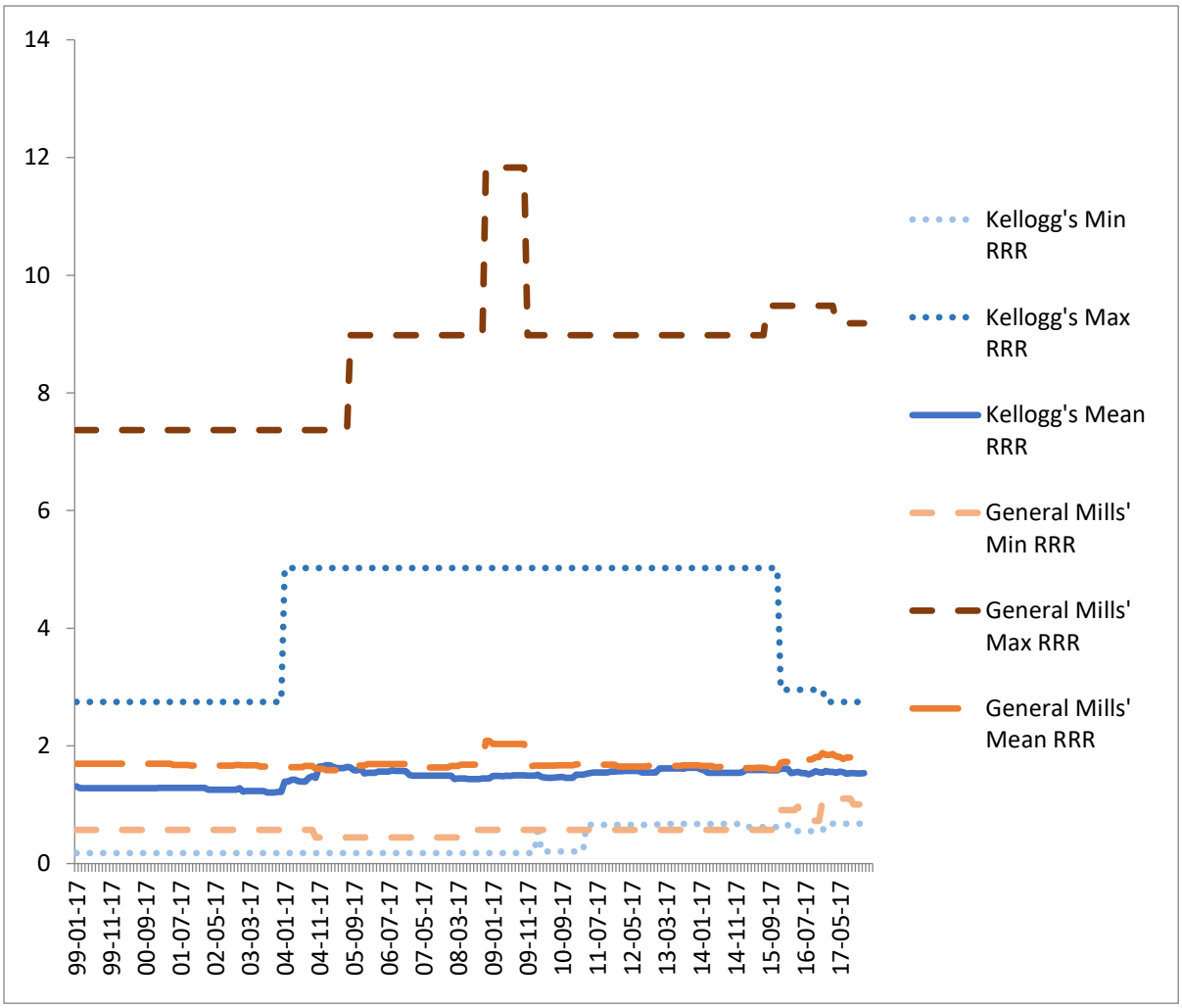


Figure 4.10 Average fibre content and standard deviation of fibre content in Kellogg's and General Mills breakfast cereals (g of fibre / 100 g of cereal)



When we examined the overall RRR in terms of mean, minimum, and maximum from 1999-2017 for both firms (Figure 4.11), we saw that General Mills' healthiest product had a higher RRR than did Kellogg's healthiest product. General Mills' mean RRR was slightly higher than Kellogg's for most years, more notably from 1999-2004, 2008-2009, and 2015-2017. General Mills' minimum RRR was higher than Kellogg's except between 2010-2014, meaning that in general, their least healthy product was not quite as bad as Kellogg's least healthy product.

Figure 4.11 Mean, minimum, and maximum RRR for Kellogg's and General Mills from 1999-2017

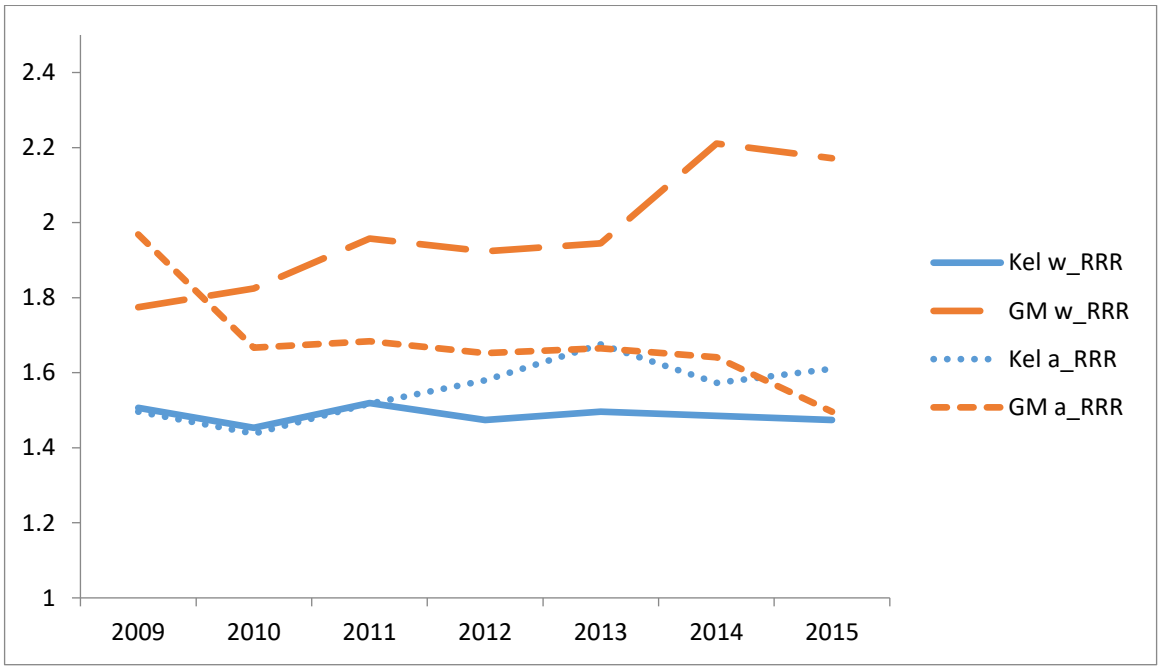


The problem with examining the overall means for each firm is that it assumes that all products receive equal weight. However, if we weight the RRR of each of their products by its market share to get a better idea of which products people are actually consuming more of, we might note some different trends. We do not have access to any sales data for these products, but we have constructed a proxy of market share based on PMB data for most preferred brands of breakfast cereal. This data was only available for 2009-2015, thus the smaller timeframe.

Using the weighted approach (Figure 4.12), we can see that General Mills had a higher weighted RRR than average RRR, indicating that their healthier varieties

were the most popular and trending in a positive direction. Kellogg's weighted RRR held relatively constant but was lower than that of General Mills, indicating that in general their less healthy products were more popular.

Figure 4.12 Average and weighted RRR of Kellogg's and General Mills product portfolio from 2009-2015



w_RRR = RRR weighted by market share proxy of individual products
a_RRR = average RRR

4.5.4 Long running brands

Next, we examine both General Mills and Kellogg's long running brands (those that were being sold in Canada for the duration of our time frame – 1999 to 2017). General Mills' long running brands made up a much larger percentage of their portfolio (14 out of 56 or 25%) than did Kellogg's (12 out of 111 or 11%) and are discussed first.

General Mills' long running products include Cheerios and Honey Nut Cheerios, neither of which were reformulated at any point in our time frame and thus did not change in terms of RRR or any nutrient contents. Also in this long running group are Apple Cinnamon Cheerios, Multigrain Cheerios, Honey Nut Chex, Cinnamon Chex, Cinnamon Toast Crunch, Fibre 1, Golden Grahams, Lucky Charms,

Reese Puffs, Fibre 1 Honey Clusters, Maple Nut Oatmeal Crisp, and Nesquik cereal. In terms of RRR, 8 of the 14 cereals improved over this time period while 3 got nutritionally worse (Lucky Charms, Reese Puffs, and Fibre 1 Honey Clusters) and 3 stayed the same (Multigrain, Honey Nut, and regular Cheerios). Overall, the average RRR for General Mills' long run brands increased from 1.88 to 2.11 between 1999 and 2017.

In terms of sugar, 2 of General Mills' long running brands (Apple Cinnamon Cheerios and Fibre1 Honey Clusters) increased their sugar content in this time frame. As previously mentioned, the sugar content of Cheerios and Honey Nut Cheerios stayed the same, while all of the other 10 brands decreased their sugar content. The average sugar content for these products decreased from 27.1g/100g to 23.5g/100g from 1999 to 2017.

General Mills increased the sodium content in 3 of their long running brands (Fibre 1 Honey Clusters, Apple Cinnamon Cheerios, and Multigrain Cheerios) over our time frame. Cheerios and Honey Nut Cheerios stayed the same in terms of sodium content, and the other 10 products decreased their sodium content. The average sodium content of General Mills long running brands decreased from 581mg/100g in 1999 to 530.6mg/100g in 2017.

Looking at the fibre content of General Mills' long running brands, 11 products increased, 2 stayed the same, and 2 (Cinnamon Chex and Multigrain Cheerios) decreased. The average fibre content went from 8.97g/100g in 1999 to 10.86g/100g in 2017. Overall, it appears as though General Mills has been making efforts to improve the healthfulness of their long run brands.

Kellogg's only long running brands that were not reformulated at any point during our time frame are All Bran Original and Corn Flakes. Their other long running products are All Bran Buds, All Bran Flakes, Corn Pops, Froot Loops, Frosted Flakes, Frosted Mini Wheats, Raisin Bran, Rice Krispies, Special K, and Vector. Three of Kellogg's long running brands (Frosted Flakes, Vector, and All Bran Buds) have declined in terms of RRR. Corn Flakes and All Bran Original have stayed the same. The other 7 products improved in terms of RRR.

When examining sugar content, 3 of Kellogg's long running products have increased (Rice Krispies, Frosted Flakes, and All Bran Flakes), 4 have stayed the same (Special K, Vector, All Bran Original, and Corn Flakes), and the other 5 have decreased their sugar content. The average sugar content of Kellogg's long running brands was 23.7g/100g in 1999, reached a maximum of 25.4g/100g in 2008, and had declined to 22.2g/100g by 2017.

None of Kellogg's long running products increased their sodium content during this time frame. Three products (Frosted Mini Wheats, Corn Flakes, and All Bran Original) maintained the same sodium content. It should be noted however that Mini Wheats had 0mg of sodium throughout the timeframe, so it would have been impossible to reduce the sodium in that product. The other 9 long running Kellogg's products decreased their sodium contents over this time frame. The average sodium content of Kellogg's long running products decreased from 634mg/100g in 1999 to 473mg/100g in 2017.

Kellogg's increased the fibre content in 4 of their long running products (Raisin Bran, Frosted Mini Wheats, Froot Loops, and Corn Pops) and decreased the fibre content in 4 of their long running products (All Bran Buds, All Bran Flakes, Frosted Flakes, and Vector). Of the remaining 4 that stayed the same, 3 of them had absolutely no fibre at all at any point in our time frame. The average fibre content of Kellogg's long running products has increased slightly from 10.4g/100g in 1999 to 11g/100g in 2017.

Kellogg's has shown some effort in improving the healthfulness of their long run products, but it has focused more on sodium reduction than sugar reduction or increasing fibre.

4.5.5 Correlations between nutrition and other factors

The next step of this analysis was to examine the correlation between nutritional quality and the other factors under discussion – price, advertising, price of sugar (only input included since it is the main ingredient impacting the RRR), media coverage of sugar, sodium, and fibre, and the competitor's RRR, price, and

advertising. These correlations were done separately for each firm to identify differences in relationships, and are shown in Tables 4.3 and 4.4.

Both firms show a negative correlation between RRR and price, indicating that the higher the nutritional quality of a product, the lower the price, more so for Kellogg's. General Mills shows a positive correlation between advertising and RRR, demonstrating that they spend more to advertise their products with higher nutritional quality. Both firms also demonstrate a positive correlation between the price of sugar and RRR, indicating that as the cost of sugar goes up, their products get healthier. Just to put this into perspective, sugar can account for as low as around 5% of ingredient costs in healthier cereals like Cheerios or as high as around 40% of ingredient costs for sugary cereals like Honey Nut Cheerios (based on 2017 commodity prices). This relationship is stronger for Kellogg's than for General Mills. Larger differences between firms were noted when examining correlation between RRR and media coverage of nutrients. While both firms have a positive correlation between RRR and media coverage of sugar, it is stronger for Kellogg's. Kellogg's also has a positive correlation between media coverage of fibre and sodium in the media and RRR, meaning that they have made their products healthier as public nutrition awareness has increased. No significant correlation was found between General Mills' RRR and media coverage of fibre or sodium. There is also evidence that Kellogg's RRR moves in the opposite direction of General Mills' average retail price and that General Mills RRR moves in the same direction as Kellogg's advertising.

There are a few other notable relationships. Both firms have a negative correlation between retail price and the cost of sugar, media coverage of nutrients, and competitor's RRR. They also both have a positive relationship between their own retail price and their competitor's retail price. Kellogg's demonstrates a negative correlation between advertising and the cost of sugar which General Mills does not. Kellogg's level of advertising appears to be related to media coverage on sugar and sodium which General Mills' does not. How they adjust their advertising spending in relation to their competitor's actions also differs; Kellogg's increases it when General Mills increases their RRR or decreases their advertising. General Mills

increases their advertising spending when Kellogg's decreases their RRR or retail price or increases their advertising spending.

Table 4.3 Correlations between RRR and other factors for General Mills

	RRR	Retail price	Advertising
RRR	1		
Retail price	-0.13**	1	
Advertising	0.14*	0.03	1
Cost of Sugar	0.17***	-0.78***	0.09
Media - fibre	0.08	-0.82***	0.10
Media - sugar	0.21***	-0.45***	-0.07
Media - sodium	0.08	-0.76***	0.05
Competitor RRR	0.11	-0.71***	-0.36***
Competitor retail price	-0.07	0.85***	-0.17**
Competitor advertising	0.16**	0.06	0.27***

*, **, and *** indicate statistical significance at 10%, 5%, and 1% respectively.

Table 4.4 Correlations between RRR and other factors for Kellogg's

	RRR	Retail price	Advertising
RRR	1		
Retail price	-0.53***	1	
Advertising	-0.04	-0.04	1
Cost of Sugar	0.63***	-0.70***	-0.13*
Media - fibre	0.66***	-0.58***	0.06
Media - sugar	0.45***	-0.15**	-0.24***
Media - sodium	0.51***	-0.73***	-0.22***
Competitor RRR	-0.08	-0.24***	0.28***
Competitor retail price	-0.81***	0.68***	-0.07
Competitor advertising	-0.03	0.05	-0.15*

*, **, and *** indicate statistical significance at 10%, 5%, and 1% respectively.

4.5.6 Fixed Effects Model

The last stage of the analysis was to run fixed effects models where the dependent variables were average RRR, sugar, sodium, or fibre content serving as nutritional quality indicators (coefficients shown in Table 4.4, elasticities shown in Table 4.5). The independent variables were the firm's average retail price, the firm's total advertising spending, the costs of wheat, corn, oats, rice, and sugar, their competitor's level of nutritional quality, retail price, and advertising spending from

the previous year, and the media coverage of sugar, sodium, and fibre from the previous year. Effects are fixed by firm. The nutritional quality indicators are the average amounts of the item in question of all the products in the firm's portfolio for the time period in question. So although products are not reformulated frequently, variance in these variables is present due to new product introductions and product discontinuations in addition to reformulations. Price is also an average across the portfolio, while advertising spending is aggregated for each firm's entire portfolio of breakfast cereals. It was decided to lag the competitor's actions and media coverage as firms cannot adjust product formulation instantaneously when reacting to public awareness or their competitors. It should be noted that time dummy variables were initially included but created convergence issues so were thus omitted.

It was found that sugar content was positively associated with retail price, meaning that products get more expensive when the sugar content goes up. The opposite is true for sodium, with the sodium content decreasing as retail prices go up. Sugar content is increasing as advertising spending increases. The fibre content decreases as the cost of wheat goes up, which is not surprising given that wheat is one of the primary sources of fibre in breakfast cereals. The overall RRR decreases as the cost of oats goes up, which again makes sense because oats would have the highest nutritional score among the grains used as inputs. The sodium content decreases while the fibre content increases as the cost of rice increases. The sugar content goes down and fibre content goes up as the cost of sugar increases. If we look at the nutritional indicator of the competitor, we see a negative association in every model, meaning that firms react to their competitor's nutrient input decisions by doing the opposite. It is hard to say exactly what the strategy is that is being seen here, but it is possible that firms are looking to fill a niche that is not already occupied. So for example, if Kellogg's is focusing on decreasing their sodium content, rather than compete for the low sodium consumers, General Mills focuses on decreasing their sugar content, potentially appealing to a different consumer segment. Although competitor's price does not appear to affect a firm's RRR, it does significantly affect sugar, sodium, and fibre content. As the competitor's retail price increases, the sugar and sodium content of the other firm increase while their fibre

content decreases. This could again be firms trying to attract different customers than their competitor; if one firm has the lower prices, the other tries to make their product healthier rather than compete on the price front. The advertising relationship is less clear – as a competitor increases their advertising spending, the other firm increase their sugar and fibre content but decrease their sodium content. As for media coverage of the individual nutrients, we don't always see the expected effects. With more media coverage on fibre, the fibre and sodium contents decreased. With more media coverage on sugar, the average sugar content increased. Increased media coverage on sodium did however result in a decrease in sodium content along with a decrease in sugar and an increase in fibre.

Table 4.4 Fixed effects model coefficients with dependent variable as either RRR, sugar, sodium, or fibre as a function of the firm's own price and advertising spending, costs of inputs, media coverage of the nutrients in the previous year, and their competitor's action from the previous year. (n=456)

	RRR	**Sugar**	**Sodium**	**Fibre**
Retail Price	-0.099	1.943***	-86.582***	0.546
	(0.144)	(0.490)	(20.865)	(0.613)
Advertising	-0.123	2.165***	14.008	-0.410
	(0.091)	(0.343)	(14.158)	(0.415)
Cost of Wheat	0.000	-0.010	-0.096	-0.025*
	(0.003)	(0.011)	(0.474)	(0.014)
Cost of Corn	-0.007	0.055***	1.375**	-0.042**
	(0.005)	(0.016)	(0.669)	(0.021)
Cost of Oats	-0.021***	-0.026	-0.329	-0.039
	(0.006)	(0.020)	(0.817)	(0.024)
Cost of Rice	-0.003	-0.017	-1.945***	0.048***
	(0.003)	(0.011)	(0.464)	(0.014)
Cost of Sugar	0.001	-0.015**	0.002	0.041***
	(0.002)	(0.006)	(0.252)	(0.008)
RRR/nutrient of competitor - L	-0.324***	-0.333***	-0.175**	-0.625***
	(0.068)	(0.050)	(0.073)	(0.072)
Retail Price of competitor - L	-0.184	6.463***	62.513***	-4.688***
	(0.128)	(0.485)	(17.836)	(0.551)
Advertising of competitor - L	0.122	0.892***	-43.997***	1.324***
	(0.077)	(0.303)	(11.307)	(0.398)
Fibre in Media - L	0.000	0.003	-0.585*	-0.030***
	(0.002)	(0.008)	(0.339)	(0.010)

Sugar in Media - L	0.002	0.009*	0.239	0.005
	(0.001)	(0.005)	(0.201)	(0.006)
Sodium in Media - L	0.001	-0.012***	-0.319***	0.007***
	(0.001)	(0.002)	(0.086)	(0.003)
Constant	2.576***	29.493***	639.896***	16.766***
	(0.291)	(1.472)	(49.371)	(1.296)
sigma_u	0.052	1.560	65.062	1.134
sigma_e	0.083	0.290	12.024	0.358
rho	0.282	0.967	0.967	0.909
Prob > F	0.005	0.000	0.000	0.000
R-sq within	0.696	0.906	0.539	0.769
R-sq between	1.000	1.000	1.000	1.000
R-sq overall	0.037	0.379	0.005	0.380

***, **, and * indicate statistical significance at 1%, 5%, and 10% respectively, L=lagged

Table 4.5 Fixed effects model elasticities with dependent variable as either RRR, sugar, sodium, or fibre as a function of the firm's own price and advertising spending, costs of inputs, media coverage of the nutrients in the previous year, and their competitor's action from the previous year. (n=456)

	RRR	**Sugar**	**Sodium**	**Fibre**
Retail Price	-0.045	0.052***	-0.131***	0.046
	(0.065)	(0.013)	(0.032)	(0.051)
Advertising	-0.034	0.035***	0.013	-0.021
	(0.025)	(0.006)	(0.013)	(0.021)
Cost of Wheat	0.002	-0.005	-0.003	-0.036*
	(0.026)	(0.005)	(0.012)	(0.020)
Cost of Corn	-0.039	0.019***	0.026**	-0.043**
	(0.027)	(0.005)	(0.013)	(0.021)
Cost of Oats	-0.134***	-0.010	-0.007	-0.045
	(0.037)	(0.007)	(0.017)	(0.028)
Cost of Rice	-0.022	-0.009	-0.056***	0.074***
	(0.028)	(0.006)	(0.013)	(0.022)
Cost of Sugar	0.012	-0.011**	0.000	0.087***
	(0.021)	(0.004)	(0.010)	(0.017)
RRR/nutrient of competitor - L	-0.325***	-0.337***	-0.177**	-0.620***
	(0.069)	(0.050)	(0.074)	(0.072)
Retail Price of competitor - L	-0.086	0.179***	0.097***	-0.405***
	(0.060)	(0.013)	(0.028)	(0.048)
Advertising of competitor - L	0.034	0.015***	-0.041***	0.067***
	(0.021)	(0.005)	(0.011)	(0.020)

Fibre in Media - L	-0.004	0.002	-0.019*	-0.054***
	(0.022)	(0.005)	(0.011)	(0.017)
Sugar in Media - L	0.023	0.007*	0.010	0.011
	(0.018)	(0.004)	(0.009)	(0.014)
Sodium in Media - L	0.024	-0.022***	-0.031***	0.039***
	(0.018)	(0.004)	(0.009)	(0.013)

***, **, and * indicate statistical significance at 1%, 5%, and 10% respectively, L=lagged

4.6 Discussion

The overall goal of this thesis is to determine what potential policy tools could be effective in improving children's diets in order to improve the long-term health of the population and reduce public spending on health care. The objective of this paper specifically is to evaluate the behavioural trends of breakfast cereal manufacturers in order to better understand what influences the nutritional quality of processed foods that are commonly consumed by children. We assume that firms are profit maximizing entities, but activities promoting unhealthy choices such as making sugar-laden varieties of breakfast cereals cheaper or more heavily advertised could merit correction through policy actions. This paper used 19 years of data to assess whether these kinds of things have been happening and to determine whether breakfast cereals have been getting better, worse, or staying the same from a nutritional perspective.

Several trends were noted in our analysis, most of them positive from the perspective of public nutrition. Between 1999-2017, 32% of General Mills' new products were in the high RRR category, while 58% were medium and 10% were low RRR products, indicating a primary focus on developing products that were mid-range in terms of nutritional quality. Kellogg's new product development was more evenly dispersed with 36% in the high RRR category, 32% in the medium RRR category and 32% in the low RRR category. In the timeframe being considered, neither Kellogg's nor General Mills spent higher amounts on advertising their less healthy products than their more healthy ones. Nor did either company make their less healthy products more appealing to consumers by pricing them lower than

their healthier counterparts. Although we found no evidence of it in the breakfast cereal industry, making sure that firms aren't discounting their less healthy products or advertising them more across a variety of food sectors would be an important activity going forward. Of course, this type of monitoring would only make sense for firms producing foods with a variety of nutritional profiles; if a company only makes candy, it would be a waste of time and energy to worry about which product they're advertising more.

Across their product portfolios, both firms showed marked decreases in their sugar content, which is a positive outcome from a public health perspective. Also good is that Kellogg's showed a major decrease in the average sodium content of their products, likely as a response to growing awareness of the negative consequences of overconsuming sodium. Kellogg's also gradually increased their average fibre content. General Mills, on the other hand, showed only minimal improvements in the sodium and fibre categories. While Kellogg's had more improvement on average throughout their portfolio, General Mills had more improvement in their long-running brands which make up a larger percentage of their portfolio. We also see that the firms do react to each other's actions through their product formulations, moving in the opposite direction of their competitor, nutrient-wise. The fixed effects models showed that the costs of inputs do affect the amounts of nutrients contained in breakfast cereals. Specifically, when the cost of sugar increased, the average amount of sugar in breakfast cereals decreased. These findings are both important to keep in mind when making policy decisions. While we see that a policy mechanism affecting the relative cost of inputs will likely affect change in product formulation, we also see that these two firms tend to move in opposite directions of each other in terms of their product placement. So if one firm reacts to a sugar tax, for example, by reducing the amount of sugar they use, the other might react by adjusting their advertising or pricing strategy and leaving the sugar content unchanged. How firms react both to policies and to each other's actions will determine the impact of a given policy.

There is no evidence of firms over-promoting their less healthy offerings via price or advertising decisions. It also appears that in general, nutritional

improvements are being made. The question is whether they are good enough, happening fast enough, and will they continue? If firms are going to continue on this trajectory, regulation would likely be inefficient and possibly unnecessary. Kellogg's has committed to improving its breakfast cereal portfolio by reducing its sugar and sodium content, but their target of reducing sugar content to no more than 33% of the cereal's weight is still more than twice as high as the WHO's recommendation that cereals higher than 15% sugar not be marketed to children. In other words, if they stop at this goal, they haven't done well enough. Both firms still have an average sugar content of over 20%, with well over half of their products above the 15% WHO threshold. The issue of how quickly changes are being made is not as easy to criticize. Firms need to make incremental changes so as not to offend the palates of their customers. Therefore if breakfast cereal manufacturers wish to avoid targeted policy measures, they don't necessarily need to speed up changes, but they do need to maintain the positive momentum they've shown in terms of improving the nutritional profile of their products.

It is a worthwhile endeavour to monitor the food processing industry to ensure that improvements continue to be made beyond their current targets, both in the breakfast cereal industry as well as in other categories. Given the increasing level of public awareness about food and nutrition, the demand for healthier foods will likely continue to grow which provides food manufacturers with an incentive to make their products healthier, or at least to provide some healthy products. There was a focus in the media on the negative impacts of consuming sodium from 2005-2013, during which time Kellogg's decreased their average sodium content by 25%. This was a major improvement for which Kellogg's should be commended. Sugar took over as the nutrition villain in 2014, which is likely one of the reasons for the 13.5% decrease in the sugar content of both firms' products since then. These observations emphasize the impact that nutrition education, media attention, and overall awareness can have on firms' decision making.

One of the potential downsides to a more restrictive policy where the government regulates the composition of food is that if the imposed regulations are too strict, the products could become unpalatable. This could result in a shift in the

types of products people consume, which could be less healthy than the original product. Firms are better off adjusting their product formulations gradually so that their consumers' palates can adjust over time with the product. If the government wants to incentivize food manufacturers to improve their products without directly regulating product composition, they could consider taxing unhealthy inputs such as sugar or salt, or implementing some type of label mechanism disclosing information about the amount of unhealthy nutrients. Our analysis showed that there was a statistically significant relationship between the cost of sugar manufacturers faced and the average amount of sugar their products. Also supporting this approach are the findings of Miao et al (2012), which showed that taxing sugar at a firm level would have a greater impact on the population's sugar consumption than would a retail level sugar tax. We don't know with any certainty whether firms would actually reformulate their products if relative input costs changed or if they would shift additional costs to the consumer. They might respond by shifting their advertising spending to their healthier products as those profit margins would increase relative to those high in sugar (or whatever the taxed nutrient is). There is also substantial evidence that firms will reformulate products in response to information disclosure related policies (see section 4.2.1).

The bottom line is that firms are profit maximizing entities that produce what they think consumers want to purchase. If firms perceive a demand for breakfast cereals that are lower in sugar and sodium, they will manufacture them. But if the healthier products don't sell, they won't last long. If only adults are consuming the healthier products, children are no better off. So in order to improve the diets of children, not only do manufacturers need to produce healthy options, but either kids or their parents need to recognize the healthier products and choose them, and then the kids need to actually eat them instead of the less healthy products. This is an important reason to improve the public's level of nutrition knowledge (including at the elementary school level), regardless of whether policies aimed at food manufacturers are implemented.

Another area of research that would be worthwhile is to evaluate price elasticities for different cereal products to anticipate how price changes might alter

consumption; do people react more to price changes in high sugar cereals than low sugar ones or to price changes in new products compared to long-running familiar brands? If consumers don't react the same way to a policy implemented in various products (as was seen with warning labels on breakfast cereals), this would be an important outcome to consider.

It is important to acknowledge some limitations of the data used in this study; the price data was pieced together from various sources, some of which were American (converted using historical exchange rates), but all of which are observed product prices at retail locations on various dates. We have no way of confirming that these observed prices are representative of national averages. In addition, we have information about when products were introduced to the market, but no information about when they were discontinued. (Information about a few discontinued products was found online, but was only available for a limited number of products.) Generally it was assumed that if a product had several data points throughout our timeframe, and is still currently available, it was available for purchase for the duration of 1999-2017. In cases where the product is no longer available, a change in price from some positive value to no data was used to indicate discontinuation. These proxies, although not perfect, are the best available method we had to identify product discontinuation dates. Therefore it is possible that some products are represented in our data set for longer or shorter durations than is accurate.

Chapter 5: Synopsis of dissertation

5.1 Summary of background and objectives

As has been well established, an individual's diet has long-term health implications, with current consumption decisions potentially generating externalities that may not be realized until years later. In the North American diet, the main issues are the overconsumption of sugar, sodium, saturated fat, and calories, which contribute to a myriad of health problems including diabetes, cardiovascular disease, and cancer (Grosso et al 2017; McGuire 2016; Yang et al 2014; Johnson et al 2007). The relationship between diet and health is complex, and because it can be decades before the negative impacts of dietary choices are felt by an individual, it may be difficult for people to make what are lifetime utility maximizing choices. Also, in many countries an individual does not bear the full cost of their own health care, thus poor dietary choices may pose an externality on society in the form of increased government spending on health care.

Many have argued that this justifies the use of policy measures to address the externality, but these measures could take a variety of forms, some of which could be viewed as informative (label mechanisms) while others could be seen as paternalistic (regulations). When Health Canada mandated that the trans-fat content of foods had to be listed on the nutrition facts panel in 2004, many companies reformulated their products to reduce or eliminate their trans-fat content and thus avoid negative reactions from consumers who read the back of the package. This was an informative policy mechanism that had a positive outcome, but evidently the effect was not large enough as Health Canada implemented the more paternalistic ban on putting trans-fats in foods as of September 17, 2018 (Health Canada 2018). The effectiveness of this ban in Canada remains to be seen, but a similar ban has been effective in reducing the risk of cardiovascular disease in Denmark (Stender et al 2006).

When it comes to public policy, it is important to note that not all population groups are treated equally. Of particular interest in this research are children, and there are far more policies protecting children than there are adults as they are not

expected to be capable of protecting themselves (though with the exception of advertising there are no current policies protecting children from unhealthy foods). Despite this there are no federal policies as of yet pertaining to protecting children from poor dietary choices, although the province of Quebec has restricted advertising to children since 1980 (Dhar and Bayliss 2011). A bill banning the marketing of unhealthy foods to children across Canada was passed in September 2018 but has since stalled and is currently in limbo (Robertson 2018).

In addition to the problem of long-term health repercussions of an unhealthy diet, there is also increasing evidence that diet-related health problems once assumed to be exclusive to adults are being seen more frequently in children. Therefore it is increasingly important that children should be protected from poor diets just as they are protected from tobacco use, unsafe toys, and inadequate seatbelts. Also important to consider is that dietary habits and preferences developed in childhood can persist into adulthood, so improving children's diets will likely improve their dietary choices and overall health throughout their lives. Given that children merit higher levels of protection as consumers than adults do, policies to improve the diets of children and protect them from high levels of sugar, sodium, saturated fat, and excess calories are being advocated by many parties, both to correct the health care spending externality as well as to improve the population's long-term health and quality of life. Among the suggested policy measures are financial mechanisms (such as soda taxes), label mechanisms (which will soon be implemented by Health Canada on foods high in sugar, sodium, and saturated fats), and direct regulation of food manufacturers (similar to the trans-fat ban). Thus far the only federal policy targeted at protecting children from unhealthy diets is the proposed ban on advertising unhealthy foods to children. The incoming Health Canada warning label will be on a variety of products, not just those targeted at children, though it may affect their preferences.

The objective of this study is to explore the underlying decision-making that impacts the effectiveness of potential policies that could be implemented by the government in an effort to improve children's diets and subsequent health outcomes. Under investigation are how choices are affected by the following types

of policies: 1) a price mechanism at the retail level, 2) a warning label mechanism similar to one that will soon be found on foods in Canada, and 3) the necessity for policies targeting food manufacturers. The price and label mechanisms could influence parents' or children's food choices, but likely would not affect all consumers' choices equally. Some might place more importance on price while others on preferences and still others on nutrition information. How both parents and children with different characteristics are affected by these mechanisms is important to explore and were explored in the first two studies discussed in this dissertation. In terms of food manufacturers, getting a better grasp on their strategic behavior will help to identify what types of policy measures could be effective in improving the nutritional quality of their products, specifically the nutritional quality of foods commonly consumed by children. The last study in this dissertation examines how breakfast cereal manufacturers choose a combination of price, advertising, and nutritional quality for the products in their portfolio and how these decisions correspond to input prices and consumer awareness of nutrition.

By examining the findings from these three studies, we can start to discern what policy approaches to improve children's diets hold promise, and whether a policy option that respects consumer sovereignty could be effective. Will warning labels on foods be effective in reducing the probability that children will choose unhealthy products? Will they reduce the probability of parents choosing them? Will the effect differ between parents and children? Is there any merit in imposing regulations on the manufacturers of children's foods? The findings from each study are now discussed in an effort to answer these questions, followed by overall implications, limitations, and areas for further research.

5.2 Children's choices

Although various other parties play a role in providing children with food, it is the children themselves who ultimately choose whether or not to consume it. In some situations, we need to consider that children could be purchasing food independently, which is justified both by the literature as well as by our own findings indicating that 80% of our sample of 8-12 year olds purchase food

autonomously. Given that our overall objective is to evaluate the effectiveness of potential policy tools to improve children's diets, it is critical that we consider children's food purchasing decisions and their responses to these policies. Children are rarely studied as consumers in the economics literature as they are in this study, which is what makes this research an important contribution.

The economic objective of this study was to explore how children, as autonomous consumers, respond to two of the proposed policy instruments: price and label mechanisms. What we really want to know is if a child decided to buy a snack at a vending machine or in a convenience store, would their choice be affected by the price or something they saw on the label? If it was, we could use this information to help increase the likelihood that children will buy the healthier options. To address this, a simulated purchase environment where a child was choosing a pre-packaged salty snack was created with legitimate, recognizable brands. In order to determine whether the children exhibit any sensitivity to price changes or a traffic light style warning label, prices were varied and the traffic light label was applied to the products higher in saturated fat and calories on some occasions. Given that children develop at different rates and that they have a wide range of cognitive abilities, it was also of interest to consider whether the policies would elicit an equitably distributed change or if only some segments of the child population would be affected. Therefore, measures of cognitive development (IQ, vocabulary, and executive functioning) in addition to age and gender were used to explain variation in responses to pricing and label interventions.

The results from this experiment suggest that both taxes and traffic light style labels could be effective tools in encouraging children to purchase healthier snacks, but that the effect of taxes would likely not be uniform across children. The analysis showed that children with higher executive functioning skills and boys would be more responsive to price changes while children with higher IQs and girls would be less sensitive to price changes. Traffic light style labels appear to have a more homogeneous effect, on the other hand, showing no significant interaction between the children's characteristics and how sensitive they would be to the label mechanism. Additionally, in the breakfast cereal choice study, children reduced the

number of high sugar cereals chosen when the text-based warning label was applied, so similar to what Arrua et al (2017) found, either label type would likely be effective among children.

When considering which policy should be recommended, it should be noted that taxes could be applied at various levels, giving policy makers more flexibility, whereas the traffic light style label is either present or not. Since this study was completed, however, Health Canada announced that it would be implementing warning labels not dissimilar from the traffic light label used in this experiment on foods high in sugar, sodium, and/or saturated fat. If consistent with our findings, this warning label should have a somewhat uniform effect on children's autonomous food purchases across different age, gender, and cognitively developed groups. It also has the added benefit of improving their awareness as to what foods they should be eating more and less often which could carry over to future consumption decisions. If a tax on unhealthy foods were to be considered, it should be ensured that children can still afford enough food to meet their caloric needs – in other words there need to be healthy alternatives that are not more expensive for them to purchase in an absolute sense, not just relatively speaking. Many people have suggested that the success of soda taxes (which are under some debate) justify the implementation of taxes on junk foods. It is critical to realize, however, that if someone is thirsty and can't afford soda, there is a widely available and usually free substitute: water. The same does not hold true for food, thus implementing taxes on foods should be done with the utmost caution.

5.3 Parents' choices

The policy tools proposed to improve children's diets affect various avenues through which children obtain food. The first study examined children's autonomous food purchases. The second study shifted the focus from children's choices to parents' choices. Parents not only purchase and prepare food for their children, but they also influence long-term dietary preferences and habits that could play a role in their child's health throughout their life. Utilizing the same types of

mechanisms as the first study, this study examined how parents would respond to different policy measures and how these responses differ by individual characteristics. More specifically the label mechanism being investigated in this study is a text-based explicit warning label being placed on the front of boxes of breakfast cereals high in sugar. This is particularly timely given that Health Canada is currently working on the implementation of a front-of-package warning label to be applied to products high in sugar, sodium, and/or saturated fat, but there is limited evidence pertaining to how consumers will react to this type of mechanism on food products.

It is possible that a warning label indicating that a product is inappropriate for regular consumption by children due to poor nutritional content would affect a parent's willingness to purchase it, or perhaps just the amount they'd be willing to pay for it. The economic objective of this study was to determine how parents of 8-12 year olds would alter their purchasing behavior if a warning label were present on high sugar breakfast cereals and how parents with different characteristics might react differently or how different products might be affected differently.

In order to address this objective, a choice experiment was carried out with 10 of the most popular breakfast cereals in Canada, with warning labels applied to products with a sugar content above 20% (by weight) and whole grain council logos applied to any of the products. In addition, respondents were asked about typical purchasing behavior, their child's role in choosing foods, and nutrition knowledge.

The analysis showed that parents would be less likely to purchase a high-sugar product if it carried a warning label, but the effects are heterogeneous. Firstly, parents with higher levels of nutrition knowledge as well as women would be more responsive to a high sugar warning label. Overall, men would be more responsive to a whole grain logo. In addition, getting information about the labels increased responsiveness to the warning label overall but did not affect responsiveness to the whole grain logo. Secondly, although the basic MNL model shows that parents would be willing to pay $0.57 less for a product with a warning label and $0.45 more to purchase a product with a whole grain logo, these averages don't account for the fact that consumers would not respond to these label attributes to the same extent

for different cereals. This is demonstrated by the brand interacted model estimates, where decrease in WTP due to a warning label is not significantly different than zero for some products while it is as much as $0.83/box for others. The difference between cereals in the increase in WTP due to a whole grain logo varies even more. Simulations showed that imposing a warning label on high-sugar breakfast cereals would reduce their purchase probability from 46% to either 44% or 41%, depending on whether we assume an information campaign accompanies the policy implementation.

These findings suggest that Health Canada's forthcoming warning label could reduce the consumption of high-sugar cereals (and likely other less healthy products as well) but that the effect will likely not be that large, nor is it likely to impact the choices of people with low levels of nutrition knowledge as much as their higher nutrition knowledge counterparts. In addition, to be effective the label will have to be large enough to be noticed, and even if noticeable the effect could wear off over time. One would hope that a warning label would decrease the cognitive effort or ability required to identify healthy choices and thus decrease nutritional disparities between the different demographic sectors, but unfortunately our evidence showed that people with lower nutrition knowledge were less responsive to the warning label. In addition, the warning label will likely not affect preferences for all brands (within the same product category) equally – thus the aggregate effects are impossible to estimate *a priori*. This doesn't mean that the warning label is without merit, but its anticipated effects on public health should not be overestimated.

5.4 Food manufacturer behaviour

As previously stated, the overall objective of this thesis is to determine the effectiveness of potential policy tools in improving the diets of children. Thus far, policies aiming to influence the choices of consumers (both children and their parents) have been discussed. Another potential approach is to bypass consumer decision-making and address the issue at the source, imposing policies on the food

manufacturers. Until the recent ban on trans-fats, the nutritional content of foods has been largely unregulated with the exception of micronutrient fortification to address population level deficiencies. Placing limits on the levels of sugar or sodium put in foods targeted at children is one type of policy that could be imposed on food manufacturers, while a less restrictive approach would be to implement a tax on undesirable inputs, a subsidy on healthy ones, or some kind of label mechanism. Either way, imposing a policy on manufacturers would consume a considerable amount of time and resources, so its necessity should be evaluated before such action could be recommended. If manufacturers perceive a demand for healthier products or want to improve their public image, they may choose to improve their foods' nutritional quality on their own. If this is the case, committing government resources to imposing and enforcing policy measures on manufacturers would be inefficient, but if the trend is short lived, not adopted by enough firms, or only implemented in convenient products, policies targeting the manufacturers of foods consumed frequently by children could be helpful in improving children's diets.

This study explored firm behaviour in the breakfast cereal industry (as breakfast cereals are commonly consumed by children) to see how various factors influence the nutritional profile of food products and how the top breakfast cereal manufacturers compare in terms of nutritional quality. We looked for evidence that firms reformulate their products in response to public awareness of different nutrients, in which case educating consumers about nutrition would result in healthier food products being manufactured. We also looked at whether a food's nutritional profile is related to the price of sugar (a primary input). We considered how firms choose to market the different components of their product line, how they price their different products, and how these relate to the nutritional quality of their products. By examining the trends in nutritional quality, price, and advertising of Kellogg's and General Mills' breakfast cereals between 1999-2017, and observing how external factors like input prices and public awareness of nutrition influence these, we can determine what factors influence the healthfulness of breakfast cereals and whether companies are improving their product categories

independently or whether there is merit in the government imposing policies on the production of foods consumed frequently by children.

Several trends were noted in our analysis, most of them positive from the perspective of public nutrition and children's diets. In the timeframe being considered, neither firm spent higher amounts on advertising their less healthy products than their more healthy ones, nor did they make their less healthy products cheaper. If legislation banning the advertising of unhealthy foods to kids is implemented, how firms spend their advertising dollars will likely shift, but how is not yet known. Across their product portfolios, both firms have shown marked decreases in their sugar content. Kellogg's has also shown notable decreases in their sodium content and increases in their fibre content, as has General Mills but to a lesser extent. While Kellogg's has shown more improvement on average throughout their portfolio, General Mills has shown more improvement in their long-running (and most popular) brands which make up a larger percentage of their sales portfolio. It was found that input costs were associated with nutritional quality, making firm level taxes or subsidies a viable policy option. There was also evidence in the fixed effects model that firms decreased their products' sodium content as public awareness of the harms of sodium overconsumption increased, but the same could not be said for the levels of sugar or fibre.

Our analysis shows that improvements are being made. Given the increasing level of public awareness about food and nutrition, the demand for healthier foods will likely continue to grow which provides food manufacturers with an incentive to make their products healthier. If firms are going to continue on this trajectory, regulation would likely be inefficient and possibly unnecessary, but it would be worthwhile to monitor the food processing industry to ensure that improvements continue to be made and that improvements are aligned with dietary guidelines.

5.5 Implications

The overall goal of this dissertation was to examine how different policy measures might help improve the diets of children, improving their long-term

health and quality of life while reducing the externality that diet-related diseases impose on public health care spending. We have identified several measures that show some promise in working towards this goal that do not infringe on consumer choice, but it should be emphasized that no one policy will have huge success on its own. If real improvements are going to be made, it will take a multi-faceted approach that takes into account a variety of issues including, but not limited to, food environments, availability and affordability of healthy and unhealthy foods, food marketing, the composition of food products, consumer awareness of nutrition and healthy choices, and societal norms around food consumption.

The main research question addressed by this dissertation is what policies might be effective in improving children's diets. To answer this, some key research findings are as follows: Both children and parents are responsive to warning labels and taxes. Children appear somewhat homogeneous in their response to warning labels while their reaction to price changes depends on various characteristics. Parents have differing responses to both taxes and warning labels that vary based on their individual characteristics. The decrease in simulated purchase probability of less healthy snacks among our child sample when a warning label was applied was 5%, whereas with parents it was 2%. However, due to their lower price sensitivity, parents were willing to pay $0.90 on average to avoid a product with a warning label while children were only willing to pay $0.21. Therefore, a policy targeting either children or their parents in the form of price or label mechanisms could be effective in improving food choices, and would likely be more efficient given that manufacturers are improving the nutrition profiles of their product lines independently. Given this finding, imposing regulations on product formulation is not recommended at this time, but the food industry should continue to be monitored to ensure that improvements continue to be made in the long run.

Health Canada will soon be applying a warning label to products that are high in sugar, sodium, and/or saturated fat. Based on our findings, this warning label could influence both children and their parents to choose healthier options that don't have the warning, but the decrease in purchase probability for the less healthy options will likely only be around 5% or lower, and changes in purchasing behavior

will probably be heterogeneous across both consumer categories and different brands. While any reduction in the consumption of less healthy products is a good thing, it will likely take a multifaceted policy approach achieve significant improvements in public health. However, the warning label could affect other changes that we can't yet quantify. It could impact consumer perceptions about entire food categories, causing a shift in the types of foods people are choosing, not only the specific brands. The size of the effect could largely depend on consumer's perceptions about different products, as Loewenstein et al (2014) point out that warnings will typically only impact behaviour if they provide new information. It could also incentivize firms to reformulate their products so as to not require the warning label, similar to what happened with trans-fat labeling in North America and sodium warnings in Finland.

The government could also consider imposing financial mechanisms at either the retail or manufacturing level as both children and parents were found to be price sensitive in food purchases and the nutritional quality of breakfast cereals was found to be correlated with the cost of sugar as an input. Our data showed that children's reactions to taxes varied by gender and level of cognitive development while parents' reactions varied by gender, age, education level, and nutrition knowledge. It can't be ignored, therefore, that not only is imposing a tax at the retail level regressive and would impact low-income consumers the most (Allais et al 2010; Chouinard et al 2005), but it would have different levels of effectiveness among various population groups. As far as taxing the inputs of manufacturers, we don't know with any certainty whether firms would actually reformulate their products if input costs changed or if they would rather shift the additional cost to the consumer. Perhaps they would respond by shifting their advertising spending to their healthier products as those profit margins would increase relative to those high in sugar (or whatever the taxed nutrient is). As previously noted, Miao et al (2012) found that a firm level sugar tax would be more effective in decreasing sugar consumption than a retail level tax would be.

Regulations on food manufacturers could be imposed in manners other than using financial mechanisms or warning labels, such as in the form of product

formulation requirements or stricter rules around advertising. As previously mentioned, Canada has a pending bill banning the advertising of junk food to children. Canada has also recently banned trans fats from foods. However, it appears as though the manufacturers of breakfast cereals are improving the nutritional content of their foods, likely in response to growing concern with and awareness of nutrition, so it could be inefficient to regulate them at a product category level. Imposing a warning label may have unanticipated effects – we would expect demand for products carrying one to decrease, but companies might pre-emptively reformulate products to avoid the label, leaving demand relatively constant. This is similar to what happened with a high sodium warning label in Finland and with trans-fat labelling in North America. This outcome wouldn't be negative, as all consumers of the products in question would be better off from a dietary perspective, but this type of firm reaction is difficult to anticipate quantitatively.

One thing Health Canada should consider as it rolls out the new warning label is that consumers will be more responsive to a label mechanism if they have some prior understanding of it. This was demonstrated by the significant effect of the information treatment on sensitivity to the warning label in chapter 3. They could do this in a variety of ways, including putting information on their website, providing pamphlets in grocery stores, utilizing social media, television or radio commercials, or even teaching children about it in school. Informing both children and adults about the label would be beneficial, given that both groups independently displayed some level of sensitivity to a warning label in our choice experiments. By familiarizing the public with the warning label, they will make it easy for people to identify it and know what it means without having to commit additional time or cognitive effort when making their purchasing decisions, thus increasing the likelihood that it will affect their choices. It should also be considered that our study only addressed the initial impacts of warning labels on people's purchasing behaviours; long term trends have not been addressed. It is possible that people could get used to seeing the warning label and stop paying attention to it after a while. It is also possible that a warning label on one product could transfer to

individuals' perceptions about other products from the same company. For example, if someone sees a warning label on a Quaker granola bar, will their subconscious transfer that negative health perception to Quaker cereal products? Or will the presence of a warning label shift the consumption from one product category to another category entirely rather than within the same category? There are many possible complex outcomes, both in the short and long term, of which the surface has only been scratched in this research. Additionally, if Health Canada really wants to improve diet-related health outcomes, the warning label should only be a starting point; other policies addressing public nutrition will also be needed.

5.6 Limitations of study

The research discussed in this study has several limitations that should be considered. The first is that the first two studies, focusing on children's and parents' choices are both based on choice experiment data which always has its limitations. In the children's study one of the 12 choices was binding so there was consequentiality and therefore motivation for participants to indicate their true preferences. For the parents however, all choices were hypothetical and thus inconsequential, so there was little motivation for the respondents to ensure that their choices were representative of their true purchasing behaviour. In addition, people may have felt obliged or pressured to choose fewer products with a warning label than they normally would (social desirability bias), leading to our results overestimating the effectiveness of such a mechanism.

There are also some limitations to the data used in this dissertation. The sample size for the children's study was only 58 due to the amount of time it took (approximately two hours) to complete the choice experiment, questionnaire, and all of the cognitive assessment tasks for each child. The small sample size limited the types of analysis that could be done (for example it could not support a scaled generalized multinomial logit model), but it was still large enough to generate significant estimates for the models presented. In the parent study, the experimental design was only generated to estimate main effects, interaction effects

were not accounted for, but the data collected was able to support models with interactions so they were conducted nonetheless. In the firm behavior study, retail price data were only available for the US for some years. Given that there are no trade barriers on breakfast cereals between Canada and the US, it was decided that it would be acceptable to use the American data and convert it to Canadian currency using historical exchange rates, but it is possible that some differences in prices between countries existed that were not accounted for.

5.7 Future research

There are several areas this dissertation has explored that merit further research. The first and most obvious area is the effect of warning labels on consumers' food choices. Our examination of this topic was based on hypothetical purchases in a choice experiment, which is the only type of data available when a product (such as food with a warning label) doesn't exist in the marketplace. However, warning labels will soon be mandated in Canada on foods high in sugar, sodium, and/or saturated fat by Health Canada, which presents a unique opportunity for a natural experiment with revealed preference data. Comparing purchasing and consumption patterns pre- and post-warning label will provide excellent insight into consumer decision-making and the effect of information provision on dietary choices. Evaluating the effectiveness of the warning label will help to inform future policy decisions both in Canada and internationally. It will also present an opportunity to see how the warning label indirectly affects the food industry, be it through manufacturer reformulations, other changes in firm strategy, or consumers' changing perceptions about what are healthy foods. It is possible that consumers might view all products with warning labels as equally bad and switch to worse products if they have no intention of avoiding the warning. There are always unanticipated consequences to policy measures, and identifying them is an important role of researchers.

Another area of interest for future research is the frequency rather than binary set up of the choice experiment. Most research in the consumer choice field

has an experimental design that only allows respondents to choose one alternative (or none) from a set of 2-4 options. This makes sense in a situation where a consumer would only ever choose one product (such as a car), but for non-durable goods that are purchased and consumed frequently, this likely wouldn't represent actual purchasing behavior. Policy-makers can't assume that a mechanism such as a warning label on food products will have an all-or-nothing effect, which is what a binary choice framework implies. If a warning label were suddenly implemented on breakfast cereals (or some other commonly consumed food product), it is more likely that people will react by buying less of the product in question or buying it more infrequently than ceasing purchases of it altogether. Perhaps high sugar cereals would become a weekend-only food in some households. Utilizing a frequency framework allows researchers and policy-makers to better capture these nuances thus improving the accuracy of estimated effectiveness or costs and benefits of such a program and should be explored further.

Finally, the first study in this dissertation collected data on children's autonomous food purchases and provided evidence that they do in fact purchase food independently, but one thing it does not investigate is whether children exhibit compensatory behaviour. For example, if a child is fed mostly healthy food at home, does this shape their preferences that determine what they purchase when out in the world on their own, increasing the likelihood that they make healthy choices independently? Or does it create the opposite effect, where children don't get unhealthy foods from their parents so seek them out when given the chance to make autonomous food choices? Further research on this topic could increase the understanding of children's food choices.

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Appendix 2A - Questionnaire

Questionnaire: Usual Snack Food Purchases

1. **Do you get a regular allowance?**
   - ○ YES
   - ○ NO

2. (If yes to #1) **How much do you get per week?**
   $_____

3. (If yes to #1) **Do you ever buy yourself food with this money?**
   - ○ YES
   - ○ NO

4. **Do your parent(s) ever give you money to buy a snack and let you choose something for yourself?**
   - ○ YES
   - ○ NO

5. (If yes to #3 or #4) **What types of snack food products do you usually buy on your own? Please check all that apply:**
   - ○ Fruit
   - ○ Potato chips
   - ○ Corn chips
   - ○ Cheese puffs
   - ○ Pretzels
   - ○ Popcorn
   - ○ Chocolate bars
   - ○ Cookies or crackers
   - ○ Candy
   - ○ Gum
   - ○ Soda
   - ○ Ice-cream
   - ○ Vegetables
   - ○ Others (please list): _____

Appendix 2B – Information and Consent Forms

Influence of Developmental Differences on Children's Response to Information on Food

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Purpose: The purpose of this project is to learn about the connections between children's food choices and their language, math and reasoning skills. By understanding how children and adolescents make food choices, we can help to inform policies that attempt to improve public health in Canada by reducing the incidence of childhood obesity. We are inviting your child to participate because he/she is between 8 and 12 years old, which is the age range we are focusing on in our study. A companion study of this sort was conducted in the United States by the three researchers listed at the top of this page. These individuals are now conducting this parallel study in Canada for comparative purposes.

Methods: If your child participates, he/she will meet with the researcher in a room at their after school care facility that is free from distractions. We will complete 7 short activities (5-25 minutes each). These activities will feel like conversations or games. All together, these activities take around 1.25 hours to complete – if your child participates, we are able to split the activities into multiple sessions if need be.

Below are descriptions of the 7 activities your child will be asked to complete should he/she participate:

- **The Peabody Picture Vocabulary Test:** This test asks the child to listen and make choices. The researcher will say a word that corresponds to an image on the page of a book. The child will be asked to indicate which image on that page matches the researcher's words.

- **The Stanford Binet Intelligence Scales:** These scales ask the child to play lots of small, fun games. This is a standardized test that assesses IQ and cognitive abilities.
- **The Sort Task:** This task asks the child to use his/her hands to sort shapes that he/she is unable to see.
- **The Tower of London Task:** This task asks the child to move pieces on a game to match a picture.
- **The Circle Trace Task:** This task asks the child to trace over a circle that is printed on letter-sized paper. The child is asked to trace the circle as slowly as possible, while the researcher records the time they take to complete the task.
- **The Stroop Test**: This test asks the child to read words and name colours on a page. The researcher will time the child as he/she completes the task using a stopwatch and will use a tape recorder to record the words the child says. This recording will be used to make sure the researcher's scoring of the test is correct, as the activity moves quickly. The researcher will erase the recording in 48 hours or less.
- **The Purchase Exercise**: This exercise asks the child to make a series of hypothetical purchasing decisions between different types of snack foods. The child will be given a small amount of money ($5 or less) and one of the purchasing decisions will be randomly chosen to be binding. For that decision, the child will use their money to buy the snack they had indicated they would purchase. The child will also answer some questions about his/her snack-buying habits.

Confidentiality: If your child participates, all information your child provides will be considered confidential and will be grouped with responses from other participants. Names will not be associated with responses. Access to the data will be restricted to investigators. Your child's data, without any identifying features, will be stored on a secure server at the University of Alberta.

Benefits: Survey participants will assist the researchers in learning about the ways in which children and adolescents make food choices. This information may help policy makers determine ways to improve adolescent health. In thanks for participating, your child will be permitted to keep the snack he/she chooses to purchase as well as any of the allotted money he/she may have remaining after making the purchase.

Risks: If your child participates, he/she will have the opportunity to purchase real food. **If your child has any known or suspected food allergies, intolerances or sensitivities, please alert the research team to these allergies *in advance of your child's participation in this study*. For their safety, any child with known or suspected allergies, intolerances or sensitivities to *any* types of foods will not be included in this study.**

Withdrawal from the Study: Participation in this study is voluntary. If you or your child wishes, he/she may decline to answer any questions or participate in any component of the study. Further, you or your child may decide to withdraw your child from this study at any time and may do so without any penalty.

Use of Your Information: Information collected as part of this study will be used in academic papers and publications as well as conference presentations. If your child is withdrawn during the survey, the information he/she provided will be deleted from the data set as it cannot be used in the analysis.

Questions: If you have any questions about the study, please contact the investigator, Vic Adamowicz (vic.adamowicz@ualberta.ca or 780-492-4603).

If you would like to talk with someone about your child's rights as a potential research participant or would like to report concerns, complaints or consequences, please contact the University of Alberta's Research Ethics Office at:

Research Ethics Office
University of Alberta
Edmonton, Alberta, Canada T6G 2H1
Phone: 780-492-2615

Influence of Developmental Differences on Children's Response to Information on Food

Investigators:

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Stephanie Simpson
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Please circle your answers.

1. Do you understand that your child has been asked to participate in a study?	*YES*	*NO*
2. Have you received and read the Information Sheet?	*YES*	*NO*
3. Do you understand the benefits and risks involved in permitting your child to take part in this study as outlined in the Information Sheet?	*YES*	*NO*
4. Do you understand that you or your child can withdraw your child from the study at any time? There is no penalty for withdrawing and no reason has to be provided for withdrawing from the study.	*YES*	*NO*
5. Do you understand who will be able to see or hear what your child says or does during the study?	*YES*	*NO*
6. Do you understand that an audio recording of your child will be made during the Stroop Test?	*YES*	*NO*
7. Do you know what the information your child provides will be used for?	*YES*	*NO*
8. Do you give us permission to use your child's data for the purposes specified?	*YES*	*NO*
9. Does your child have known/suspected food allergies, intolerances or sensitivities?	*YES*	*NO*
a. If you answered yes to the question above, please list all known/suspected food allergies, intolerances or sensitivities:		

_____

10. Do you consent to your child participating in this study?	*YES*	*NO*

_____ _____

Name of Child Date

_____ _____

Name of Parent/Guardian (printed) Signature of Parent/Guardian

Influence of Developmental Differences on Children's Response to Information on Food

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ss34@ualberta.ca

Please circle your answers.

1. Do you understand that you have been asked to take part in a study? *YES* *NO*
2. Have you read the Information Sheet? *YES* *NO*
3. Do you understand that we will record what you say during one of the tasks? *YES* *NO*
4. Do you understand that you are allowed to stop doing the tasks at any time? You won't be punished for stopping. You don't have to tell us why you want to stop. *YES* *NO*
5. Are you, or do you think you might be, allergic, intolerant or sensitive to some kinds of foods? *YES* *NO*
    a. Please list all of the foods you are or think you might be allergic, intolerant or sensitive to:

    YES *NO*

    _____

6. Do you agree to take part in this study?

_____
Name of Child (printed)

Appendix 3A – Parent Questionnaire

In order to view some of the graphics properly, we recommend using a computer rather than a tablet or smartphone to complete this survey.

*1) How many years old are you?**

_____

2) Do you identify as*
( ) Male
( ) Female
( ) Other: _____

3) How many adults live in your household?*
( ) 1
( ) 2
( ) 3
( ) 4
( ) More than 4

4) How many children live in your household?*
( ) 1
( ) 2
( ) 3
( ) 4
( ) More than 4
( ) Not applicable/ No children live in my house

5) In what age groups are your child(ren)?*
[ ] under 2
[ ] 2-3
[ ] 4-5
[ ] 6-7
[ ] 8-9
[ ] 9-10
[ ] 11-12
[ ] 13-14
[ ] 15-16
[ ] 17+

Information and Consent

Research Investigator:
Shannon Allen
515 General Services Building
University of Alberta
Edmonton, Alberta
T6G 2H1

Supervisor:
Ellen Goddard
515 General Services Building
University of Alberta
Edmonton, Alberta
T6G 2H1

Background
You are being invited to participate in this study because we are investigating parental food choices.
The results of this study will be used as a portion of Shannon Allen's PhD dissertation and potentially for research articles to be submitted to scholarly journals and conference presentations.

Purpose
The purpose of this research is to better understand what influences parents' choices when purchasing food for their children.

Study Procedures
We are asking participants to complete an online survey which explores food choices and gives several food shopping scenarios and asks which product(s) you would choose under the described circumstances.
The survey takes approximately 15-30 minutes to complete.

Benefits
The benefits of participating in this study are solely financial.
Society could benefit from this research if it allows us to gain a better understanding of how parents choose foods for their children.

Risk
There is no known risk of participating in this study.

Voluntary Participation
You are under no obligation to participate in this study. Your participation is completely voluntary.

Even if you agree to be in the study you can change your mind and withdraw by contacting Shannon Allen at ssaville@ualberta.ca within one week of participating.

Confidentiality and Anonymity

This research will be used in Shannon Allen's PhD dissertation as well as in conference presentations and research articles. No participants will be personally identifiable in any of these uses.

The data collected will be kept confidential and accessible only to the lead researcher and supervisor. It will be stored on a secure server and password protected for a minimum of 5 years following completion of the research project. After this time period, the data will be destroyed.

We may use the data we collect from this study in future research, but if we do this it will first have to be approved by a Research Ethics Board.

Further Information

If you have any further questions regarding this study, please do not hesitate to contact

Lead researcher: Shannon Allen at ssaville@ualberta.ca

or

Supervisor: Ellen Goddard at egoddard@ualberta.ca

The plan for this study has been reviewed for its adherence to ethical guidelines by a Research Ethics Board at the University of Alberta. For questions regarding participant rights and ethical conduct of research, contact the Research Ethics Office at 780-492-2615.

Consent

By completing this survey you are implying that you have read the above information and consent to participating in our study.

Choice Experiment Description:
Next, we will present you with 4 different shopping scenarios in which we will ask you to select breakfast cereals. We want you to imagine that you are purchasing all of the cereal your whole household will need for one entire month. You can choose as many boxes of as many different kinds of cereal shown as you like, but remember that the more money you spend on cereal, the less you have left for your other groceries. Assume all of the boxes contain the same amount of cereal. If you wouldn't purchase any of the offered brands, you may choose zero for all of them. Please keep in mind that while the brands presented stay the same, there are some differences between the scenarios. We ask you to make choices that most closely reflect what you would really purchase if faced with the same combination of brands, prices, etc. at a grocery store.

Whole Grain Stamp
The following Whole Grain Stamp was created by the Whole Grains Council to indicate that the product bearing it contains at least 8 grams of whole grains per serving. In this survey, we are occasionally applying the Whole Grain Stamp to any breakfast cereal, although in reality they may not all qualify for it.

Warning Label
The World Health Organization has stated that breakfast cereals containing more than 15 grams of sugar in a 100 gram portion should not be marketed to children. In this survey, we are occasionally applying the following high-sugar warning label to breakfast cereals that contain 20 grams or more of sugar in a 100 gram portion.

Choice Experiment

6) If you were purchasing all of the groceries for your household for one month and the choices below represented all of the choices available at the grocery store, how many boxes of each would you buy? ***(repeated with 4 different choice sets which included graphics)***

_____Cap'n Crunch
_____Special K
_____Cheerios
_____Honey Nut Cheerios
_____Frosted Flakes
_____Mini Wheats
_____Corn Pops
_____Corn Flakes
_____Rice Krispies
_____Shreddies

Food Choices

14) On <u>weekdays at home or school</u>, who would you say chooses what your child will eat in the following meal situations?*

	Child chooses	**Parent chooses**	**Both choose**
Breakfast	( )	( )	( )
Lunch	( )	( )	( )
Dinner	( )	( )	( )

15) On <u>weekends at home</u>, who would you say chooses what your child will eat in the following meal situations?*

	Child chooses	**Parent chooses**	**Both choose**
Breakfast	( )	( )	( )
Lunch	( )	( )	( )
Dinner	( )	( )	( )

16) On <u>holidays</u>, who would you say chooses what your child will eat in the following meal situations?*

	Child chooses	Parent chooses	Both choose
Breakfast	( )	( )	( )
Lunch	( )	( )	( )
Dinner	( )	( )	( )

17) At restaurants, who would you say chooses what your child will eat in the following meal situations?*

	Child chooses	Parent chooses	Both choose
Breakfast	( )	( )	( )
Lunch	( )	( )	( )
Dinner - weekday	( )	( )	( )
Dinner - weekend	( )	( )	( )

Nutrition Questions

18) Do you think health experts recommend that people should be eating more, the same amount, or less of these foods?*

	More	Same	Less	Not sure
Vegetables	( )	( )	( )	( )
Sugary foods	( )	( )	( )	( )
Meat	( )	( )	( )	( )
Starchy foods	( )	( )	( )	( )
Fatty foods	( )	( )	( )	( )
High fibre foods	( )	( )	( )	( )
Fruit	( )	( )	( )	( )

Salty foods	( )	( )	( )	( )

19) What do nutrition experts say kids should try to eat less of?*
( ) Protein
( ) Calcium
( ) Sugar
( ) Fibre
( ) Not sure

20) Do you think these are high or low in sugar?*

	High	**Low**	**Not sure**
Peanuts	( )	( )	( )
Unflavoured yogurt	( )	( )	( )
Ice cream	( )	( )	( )
Orange juice	( )	( )	( )
Ketchup	( )	( )	( )

21) Do you think these are high or low in fat?*

	High	**Low**	**Not sure**
Pasta (without sauce)	( )	( )	( )
Baked beans	( )	( )	( )
Salami	( )	( )	( )
Honey	( )	( )	( )
Hard boiled eggs	( )	( )	( )
Nuts	( )	( )	( )
Cottage cheese	( )	( )	( )

Polyunsaturated margarine	( )	( )	( )

22) Do you think these are high or low in salt?*

	High	**Low**	**Not sure**
Sausages	( )	( )	( )
Pasta (without sauce)	( )	( )	( )
Red meat	( )	( )	( )
Frozen vegetables	( )	( )	( )
Cheese	( )	( )	( )
Canned soup	( )	( )	( )

23) Do you think these are high or low in protein?*

	High	**Low**	**Not sure**
Chicken	( )	( )	( )
Cheese	( )	( )	( )
Fruit	( )	( )	( )
Baked beans	( )	( )	( )
Butter	( )	( )	( )
Cream	( )	( )	( )

24) Do you think these are high or low in fibre/roughage?*

	High	**Low**	**Not sure**
Shreddies cereal	( )	( )	( )
Bananas	( )	( )	( )

Eggs	( )	( )	( )
Red meat	( )	( )	( )
Broccoli	( )	( )	( )
Nuts	( )	( )	( )
Fish	( )	( )	( )
Baked potato with skin	( )	( )	( )
Chicken	( )	( )	( )
Baked beans	( )	( )	( )

25) Do you think these fatty foods are high or low in saturated fat?*

	High	**Low**	**Not sure**
Salmon	( )	( )	( )
Cream	( )	( )	( )
Olive oil	( )	( )	( )
Red meat	( )	( )	( )
Sunflower margarine	( )	( )	( )
Chocolate	( )	( )	( )

26) Some foods contain a lot of fat but no cholesterol.*
( ) Agree
( ) Disagree
( ) Not sure

27) A glass of unsweetened fruit juice counts as a helping of fruit.*
( ) Agree
( ) Disagree
( ) Not sure

28) Brown sugar is a healthy alternative to white sugar.*
( ) Agree
( ) Disagree
( ) Not sure

29) There is more protein in a glass of whole milk than in a glass of skimmed milk.*
( ) Agree
( ) Disagree
( ) Not sure

30) A type of oil which contains mostly monounsaturated fat is:*
( ) Coconut oil
( ) Sunflower oil
( ) Olive oil
( ) Palm oil
( ) Not sure

31) Which of the following has the most calories per 100g?*
( ) Sugar
( ) Starchy foods
( ) Fibre
( ) Fat
( ) Protein
( ) Not sure

32) Which of the following issues are related to sugar consumption?*
( ) Obesity
( ) Dental caries (cavities)
( ) Diabetes
( ) All of the above
( ) Not sure

General Behaviours

33) How often does your child eat cereal for breakfast?*
( ) Less than once per week
( ) 1 - 3 times per week
( ) 4 - 6 times per week
( ) Every day

34) Does your child participate in any athletic activities? (not including gym class at school)*
( ) Yes
( ) No

35) If yes, how often?*

( ) Once per week
( ) 2 - 4 times per week
( ) 5 or more times per week

36) How much time does your child typically spend watching TV, playing video games, or playing on a computer / tablet / smartphone?*
( ) Less than an hour per day
( ) 1 - 2 hours per day
( ) More than 2 hours per day

37) How much time do you spend online for non-work or non-study purposes? (personal email, Facebook, online shopping, gaming, etc)*
( ) Less than 1/2 hour per day
( ) 1/2 hour to 1 hour per day
( ) 1 - 3 hours per day
( ) More than 3 hours per day

38) Does your child enjoy trying new foods?*
( ) Never
( ) Sometimes
( ) Always

39) Does your child ever ask you to buy food for them that they saw advertised?*
( ) Yes
( ) No

40) Do you ever read the warning labels on your children's toys?*
( ) Never
( ) Sometimes
( ) Always

41) When you do read the warning label, does it affect whether you let your child play with that toy (or how often)?*
( ) Never
( ) Sometimes
( ) Always

42) Do you ever read the nutrition facts panel on food packaging? (where it displays the amount of calories, fat, protein, sugar, etc)*
( ) Never
( ) Sometimes
( ) Always

43) When you do read the nutrition facts panel, does it affect which food product you choose to purchase?*
( ) Never

( ) Sometimes
( ) Always

Grocery Shopping

44) How often do you go grocery shopping?*
( ) 1-3 times per month
( ) 1-2 times per week
( ) 3-4 times per week
( ) 5 times or more per week

45) How long would you say a typical trip to the grocery store lasts for you?*
( ) Less than 15 minutes
( ) 15 - 30 minutes
( ) 30 - 60 minutes
( ) More than 60 minutes

46) How rushed (in a hurry) do you feel when grocery shopping?*
( ) Not at all rushed
( ) Somewhat rushed
( ) Very rushed

47) Does your child ever participate in making food choices at the grocery store?*
( ) Yes
( ) No

48) If yes, which of the following types of foods does your child choose? (check all that apply)*
[ ] Fruit (like apples, bananas, or grapes)
[ ] Snacks (like crackers, granola bars, chips)
[ ] Treats (like cookies, candy, or ice cream)
[ ] Drinks (like juice, milk, or pop)
[ ] Vegetables (like carrots, broccoli, or celery)
[ ] Breakfast cereal
[ ] Yogurt

49) According to Statistics Canada, the average household in 2014 spent $8,109 on groceries ($675.75 per month or $155.94 per week). Would you say that your household spends*
( ) More
( ) Less
( ) About the same

Allowance

50) Do you give your child an allowance?*
( ) Yes
( ) No

51) If yes, how much do you give them per week?*
_____
Child's food purchases

52) Does your child ever purchase food when they are not with a parent/guardian?*
( ) Yes
( ) No

53) If yes, what foods does your child typically purchase when not with a parent/guardian?*
[ ] Fruit
[ ] Chips / Cheesies / Pretzels
[ ] Popcorn
[ ] Chocolate
[ ] Cookies
[ ] Candy
[ ] Pop / Sports drinks
[ ] Ice cream
[ ] Vegetables
[ ] Cereal
[ ] Yogurt
[ ] Cheese
[ ] Pizza
[ ] Pasta
[ ] Fries
[ ] Hamburgers
[ ] Chicken fingers / nuggets
[ ] White milk
[ ] Juice
[ ] Flavoured milk (chocolate, strawberry, etc)

Usual Breakfast Cereals

54) What kind of cereal(s) do the kids in your household usually eat? (check all that apply)*
[ ] Cheerios
[ ] Honey Nut Cheerios
[ ] Other Cheerios (frosted, chocolate, multigrain, etc)
[ ] Rice Krispies

[ ] Corn Flakes
[ ] Mini Wheats - Frosted
[ ] Other Mini Wheats (strawberry, cinnamon, etc)
[ ] Froot Loops
[ ] Frosted Flakes
[ ] Corn Pops
[ ] Lucky Charms
[ ] Cap'n Crunch
[ ] Honeycomb
[ ] Nature's Path Organic (any variety)
[ ] Raisin Bran
[ ] Shreddies
[ ] Special K Original
[ ] Other Special K (vanilla almond, red berries, etc)
[ ] Vector
[ ] Alpha Bits
[ ] All Bran
[ ] None of these

55) What kind of cereal(s) do the adults in your household usually eat? (check all that apply)*
[ ] Cheerios
[ ] Honey Nut Cheerios
[ ] Other Cheerios (frosted, chocolate, multigrain, etc)
[ ] Rice Krispies
[ ] Corn Flakes
[ ] Mini Wheats - Frosted
[ ] Other Mini Wheats (strawberry, cinnamon, etc)
[ ] Froot Loops
[ ] Frosted Flakes
[ ] Corn Pops
[ ] Lucky Charms
[ ] Cap'n Crunch
[ ] Honeycomb
[ ] Nature's Path Organic (any variety)
[ ] Raisin Bran
[ ] Shreddies
[ ] Special K Original
[ ] Other Special K (vanilla almond, red berries, etc)
[ ] Vector
[ ] Alpha Bits
[ ] All Bran
[ ] None of these

56) In a typical month, how many of each of the following cereals would you buy for your household?*

	0	1	2	3	4+
Cheerios					
Honey Nut Cheerios					
Other Cheerios (frosted, chocolate, multigrain, etc)					
Rice Krispies					
Corn Flakes					
Frosted Mini Wheats					
Other Mini Wheats (strawberry, cinnamon, etc)					
Froot Loops					
Frosted Flakes					
Corn Pops					
Lucky Charms					
Cap'n Crunch					
Honeycomb					
Nature's Path Organic (any variety)					
Raisin Bran					
Shreddies					
Special K Original					
Other Special K (vanilla almond, red berries, etc)					
Vector					

Alpha Bits					
All Bran					

Respondent Characteristics

57) What is the highest level of education you've completed?*
( ) Elementary school
( ) Secondary (high) school
( ) Technical / college diploma
( ) University degree
( ) Post graduate degree

58) What is the approximate range of your total annual household income?*
( ) $24,999 or under
( ) Between $25,000 and $39,999
( ) Between $40,000 and $59,999
( ) Between $60,000 and $79,999
( ) Between $80,000 and $99,999
( ) Between $100,000 and $149,999
( ) $150,000 or more

59) Were you born in Canada?*
( ) Yes
( ) No

60) Were your parents born in Canada?*
( ) Neither
( ) One
( ) Both

Follow Up

61) Please rank how important the following factors were in choosing which cereals to purchase in this survey.*
_____Price
_____Brand
_____Warning Label
_____Whole Grain Stamp

62) Did you notice the Whole Grain Stamp that sometimes appeared on the breakfast cereals?*
( ) Yes
( ) No

63) Did the Whole Grain Stamp ever affect your choice?*
( ) Yes
( ) No

64) Did you notice the warning label that sometimes appeared on the breakfast cereals?*
( ) Yes
( ) No

65) Did the warning label ever affect your choice?*
( ) Yes
( ) No

66) Do you believe that your answers in this survey will have any affect on whether or not the government decides to implement warning labels on high sugar foods?*
( ) No
( ) Maybe
( ) Probably
( ) Yes

Thank You!

Thank you for taking our survey. Your response is very important to us.

Appendix 3B – Children's Questionnaire

1. Do you get an allowance?
   - ☐ Yes
   - ☐ No

2. If yes, how much do you get per week? _____

3. Do you ever buy food when you're not with your parents?
   - ☐ Yes
   - ☐ No

4. If yes, which of the following do you typically buy when you're not with a parent? (check all that apply)
   - ☐ fruit
   - ☐ chips/cheesies/ pretzels
   - ☐ popcorn
   - ☐ chocolate
   - ☐ cookies
   - ☐ candy
   - ☐ pop/sports drinks
   - ☐ ice cream
   - ☐ vegetables
   - ☐ cereal
   - ☐ yogurt
   - ☐ cheese
   - ☐ pizza
   - ☐ pasta
   - ☐ fries
   - ☐ hamburgers
   - ☐ chicken fingers/nuggets
   - ☐ white milk
   - ☐ juice
   - ☐ flavoured milk (like chocolate or strawberry milk)

5. Do you ever help choose what foods to buy at the grocery store?
   - ☐ Yes
   - ☐ No

6. If yes, which of the following foods do you typically choose?
   - ☐ fruit (like apples, bananas, grapes)
   - ☐ snacks (like crackers, granola bars, or chips)

- ☐ treats (like cookies, candy, or ice cream)
- ☐ drinks (like juice, milk, or pop)
- ☐ vegetables (like carrots, broccoli, celery)
- ☐ breakfast cereal
- ☐ yogurt

7. What kind of breakfast cereal(s) do you usually eat?

_____

_____

8. How often do you eat cereal for breakfast?
   - ☐ Less than once per week
   - ☐ 1-3 times per week
   - ☐ 4-6 times per week
   - ☐ 7 or more times per week

9. Have you learned about nutrition or healthy eating at school?
   - ☐ Yes
   - ☐ No
   - ☐ Not sure

10. Do you participate in any sports (other than gym class at school)?
   - ☐ Yes
   - ☐ No

11. If yes, how often?
   - ☐ Once per week
   - ☐ 2-4 times per week
   - ☐ 5 or more times per week

12. How much time do you usually spend watching TV, playing video games, or on a computer, tablet, or smartphone?
   - ☐ Less than an hour per day
   - ☐ 1-2 hours per day
   - ☐ more than 2 hours per day

13. Do you enjoy trying new foods?
- ☐ Never
- ☐ Sometimes
- ☐ Always

14. How often do you see commercials for food? (this could include on TV, on the computer, in magazines, or other places)
- ☐ Never
- ☐ 1-3 times per month
- ☐ 1-3 times per week
- ☐ 4-6 times per week
- ☐ every day

15. How often do you see commercials for cereal? (this could include on TV, on the computer, in magazines, or other places)
- ☐ Never
- ☐ 1-3 times per month
- ☐ 1-3 times per week
- ☐ 4-6 times per week
- ☐ every day

16. When you see commercials for food, does it make you want to try that food?
- ☐ Never
- ☐ Sometimes
- ☐ Always

17. Do you ever read the nutrition facts panel on food packaging? (where it says how many grams of protein, sugar, and other stuff is in the food)
- ☐ Never
- ☐ Sometimes
- ☐ Always

18. If you do, does it affect what food you choose?
- ☐ Never
- ☐ Sometimes
- ☐ Always

19. If you do, what nutrients do you look for information on? (check all that apply)
- ☐ Protein

☐ Fat
☐ Calcium
☐ Sugar
☐ Iron
☐ Fibre
☐ Vitamins
☐ Calories

20. Have you ever noticed a warning label on any of your toys?
☐ Yes
☐ No

21. If yes, does it affect how (or if) you play with that toy?
☐ Yes
☐ No

22. How old are you? _____

23. Are you a
☐ boy
☐ girl

24. How many grown-ups live in your house? _____

25. How many kids live in your house? _____

Next, we would like to ask you some questions about food and nutrition.

26. To which of the following food groups does an **apple** belong?
a. vegetables and fruit
b. grain products
c. milk and alternatives
d. meat and alternatives

27. To which of the following food groups does **yogurt** belong?
a. vegetables and fruit
b. grain products
c. milk and alternatives
d. meat and alternatives

28. To which of the following food groups do **eggs** belong?
a. vegetables and fruit
b. grain products
c. milk and alternatives

d. meat and alternatives

29. To which of the following food groups does **breakfast cereal** belong?
a. vegetables and fruit
b. grain products
c. milk and alternatives
d. meat and alternatives

30. Which nutrient is important in building strong muscles?
a. carbohydrates
b. iron
c. protein
d. calcium

31. Which nutrient is important for healthy bones?
a. carbohydrates
b. iron
c. protein
d. calcium

32. What do nutrition experts say kids should try to eat less of?
a. Protein
b. Calcium
c. Sugar
d. Fibre
e. Not sure

33. Which of the following do you think would be the healthiest snack?
a. a chocolate bar and milk
b. a granola bar and juice box
c. pretzels and raisins
d. apple slices and yogurt

34. Can a person eat enough protein to be healthy without eating meat?
a. yes
b. no

35. If you were given the following choices for lunch at a restaurant, which do you think would be the healthiest?
a. a hamburger (or veggie burger) with carrot sticks and milk
b. a hamburger (or veggie burger) with French fries and milk
c. a hamburger (or veggie burger) with carrot sticks and pop
d. a hamburger (or veggie burger) with French fries and pop

36. Do you think these foods are high or low in sugar?
Peanuts ☐High ☐Low ☐Not sure

Unflavoured yogurt	☐High	☐Low	☐Not sure
Ice cream	☐High	☐Low	☐Not sure
Orange juice	☐High	☐Low	☐Not sure
Ketchup	☐High	☐Low	☐Not sure

37. Who chooses what you eat for:

	I choose	My parents choose	We choose together
Breakfast			
Lunch			
Dinner			
Snacks			

38. Who chooses what you eat when you're:

	I choose	My parents choose	We choose together
At home			
In a restaurant			
On holiday			

39. Do your parents have rules about what food you buy with your own money?
- ☐ Never
- ☐ Sometimes
- ☐ Always

40. If you ask your parents to buy a certain kind of food, will they?
- ☐ Never
- ☐ Sometimes
- ☐ Always

Next, we would like you to pretend that you're in charge of the grocery shopping for your family. We're going to show you some pictures of food as if it is in a grocery store, and we want you to tell us how many of each thing you would buy. Imagine that you're buying enough to last your whole family for one month. Treat each picture separately from each other, what you saw in one might change in the next.

Tell the researcher you're ready for the pictures. If you're not sure how to do this part of the survey or have any questions, just ask one of the researchers and they will help explain.

(Printed out images of the choice sets were given to the children at this point and they indicated how many of each product they would purchase directly on it.)

Appendix 3C – Experimental Design

Table 3C.1 Prior estimates used to generate efficient design for main sample choice experiment

	Pilot	In person
Price	-0.375***	-0.091*
	(0.023)	(0.052)
Warning Label	0.114	-0.002
	(0.106)	(0.224)
Whole Grain	0.000	0.086
	(0.050)	(0.115)
Cap'n Crunch	-2.373***	-1.706***
	(0.189)	(0.318)
Special K	-0.544***	-1.437***
	(0.088)	(0.243)
Honey Nut Cheerios	-0.807***	-0.549**
	(0.121)	(0.243)
Mini Wheats	-0.547***	-0.112
	(0.115)	(0.229)
Frosted Flakes	-0.728***	-1.218***
	(0.119)	(0.266)
Corn Pops	-1.095***	-1.345***
	(0.130)	(0.282)
Corn Flakes	-0.938***	-0.828***
	(0.100)	(0.194)
Rice Krispies	-0.430***	-0.627***
	(0.084)	(0.181)
Shreddies	-0.766***	-0.825***
	(0.094)	(0.192)
AIC	16.263	16.928
LLF	-4037.070	-927.503

Table 3C.2 Choice sets and information treatment for each block

Block	Choice Sets Included	Information Treatment
1	6, 8, 12, 15	No
2	7, 9, 11, 16	No
3	3, 4, 13, 14	Yes
4	1, 2, 5, 10	Yes

Table 3C.3 The number of times each cereal was shown in a choice set with the different combinations of label attributes (shown) and the number of choice sets in which a respondent chose a positive amount of the cereal with that combination of label attributes (chosen).

	No WG, No WL		WG only		WL only		WG and WL	
	shown	chosen	shown	chosen	shown	chosen	shown	chosen
Cheerios	1441	568	1426	555				
Special K	1447	421	1420	433				
Corn Flakes	1427	416	1440	425				
Rice Krispies	1412	493	1455	545				
Shreddies	1431	362	1436	380				
Cap'n Crunch	607	116	674	149	825	142	761	147
Honey Nut Cheerios	651	246	638	242	781	270	797	263
Frosted Flakes	530	161	758	220	916	247	663	181
Mini Wheats	616	201	657	243	804	222	790	237
Corn Pops	668	151	628	150	793	147	778	185

WG=whole grain label, WL=warning label

Table 3C.4 Experimental design for choice sets in main sample. (WG = whole grain logo, WL = warning label, Pr = price)

Choice Set		Cheerios	Rice Krispies	Corn Flakes	Shreddies	Special K	Honey Nut Cheerios	Frosted Mini Wheats	Frosted Flakes	Corn Pops	Cap'n Crunch
1	WG	0	1	1	0	0	1	1	0	0	0
	WL	0	0	0	0	0	1	0	1	0	1
	Pr	6	4	6	5	5	7	5	5	5	5
2	WG	0	1	0	0	1	1	1	0	0	1
	WL	0	0	0	0	0	0	6	5	6	0
	Pr	5	4	5	6	4	7	1	0	1	7
3	WG	0	0	1	1	1	1	0	1	1	0
	WL	0	0	0	0	0	1	0	0	1	1
	Pr	5	5	4	7	7	4	6	7	7	6
4	WG	0	0	1	1	0	1	0	1	1	1
	WL	0	0	0	0	0	0	1	1	0	0
	Pr	6	6	7	4	6	4	5	4	7	7
5	WG	0	1	0	1	1	0	1	1	0	1
	WL	0	0	0	0	0	1	0	0	1	1
	Pr	4	7	5	7	7	6	5	7	5	4
6	WG	0	0	1	1	0	1	0	1	0	1
	WL	0	0	0	0	0	1	0	0	1	1
	Pr	7	6	7	4	5	4	4	7	5	7
7	WG	0	0	1	1	0	1	1	0	0	0
	WL	0	0	0	0	0	0	1	1	0	0
	Pr	6	6	4	7	6	6	4	6	5	5
8	WG	1	0	0	0	1	0	1	0	1	0
	WL	0	0	0	0	0	1	0	0	1	1
	Pr	7	6	6	5	7	5	4	6	4	5

9	WG	1	1	1	0	0	0	0	0	1	1
	WL	0	0	0	0	0	1	0	1	0	1
	Pr	6	4	4	6	6	5	7	5	4	7
10	WG	1	0	1	1	0	0	0	1	1	0
	WL	0	0	0	0	0	0	1	1	0	0
	Pr	7	5	7	4	6	4	6	4	4	6
11	WG	1	0	1	0	0	1	0	0	1	1
	WL	0	0	0	0	0	0	1	0	1	0
	Pr	4	5	7	5	5	7	6	5	7	4
12	WG	1	1	0	0	0	1	0	0	1	1
	WL	0	0	0	0	0	0	1	0	1	0
	Pr	4	4	6	6	5	7	6	5	7	4
13	WG	1	0	0	0	1	0	1	0	1	0
	WL	0	0	0	0	0	0	1	1	0	0
	Pr	4	6	5	6	4	5	7	6	7	6
14	WG	1	1	0	0	1	0	0	1	1	1
	WL	0	0	0	0	0	1	0	0	1	1
	Pr	7	7	6	5	4	5	4	7	4	4
15	WG	0	0	0	1	1	1	1	1	0	1
	WL	0	0	0	0	0	1	0	1	1	0
	Pr	5	5	4	4	7	7	7	4	6	4
16	WG	1	1	0	1	1	0	0	1	0	0
	WL	0	0	0	0	0	0	1	0	0	1
	Pr	5	7	5	7	4	6	5	4	6	5

Appendix 3D – Tests and RPL estimations

Table 3D.1 Log likelihood test for ordering effects

Log likelihood for basic model using:		# of parameters
Whole sample	-25688.7	12
Choice set 1	-6577.49	12
Choice set 2	-6346.66	12
Choice set 3	-6382.32	12
Choice set 4	-6369.67	12
Test:		
Unrestricted value (CS1+CS2+CS3+CS4)		-25676.14
Restricted value (whole sample)		-25688.7
degrees of freedom		48-12=36
D = 2(UR-R)		25.12
Critical Value (30df) at 0.01		50.89

We thus fail to reject the null hypothesis that the models are equivalent. There are therefore no statistically significant ordering effects.

Table 3D.2 Basic RPL estimates

	Reduced Sample		Whole Sample	
	Coefficient	St. Error	Coefficient	St. Error
Random parameters in utility functions				
Warning Label	-0.193***	0	-0.174***	0
Whole Grain	0.160***	0	0.104***	0
Nonrandom parameters in utility functions				
Price	-0.19	0	-0.173	0
Warning Label * Info	-0.091***	0	-0.113***	0
Whole Grain * Info	-0.097***	0	-0.024***	0
Cap'n Crunch	-0.669***	0	-0.643***	0
Special K	-0.218***	0	-0.180***	0
Honey Nut Cheerios	0.010***	0	0.032***	0
Mini Wheats	-0.218***	0	-0.262***	0
Frosted Flakes	-0.295***	0	-0.266***	0
Corn Pops	-0.447***	0	-0.536***	0
Corn Flakes	-0.228***	0	-0.177***	0
Rice Krispies	-0.074***	0	-0.077***	0
Shreddies	-0.332***	0	-0.387***	0
Derived standard deviations of parameter distributions				
NsWL	0.747***	0	0.761***	0
NsWG	0.619***	0	0.585***	0

LLF	-18285.49		-24969.24	
AIC/N	23.403		23.75	

Table 3D.3 Log likelihood test for inclusion of individual specific characteristics interacted with warning label, whole grain, and price for interacted MNL model. The model is significantly improved if D (2*(UR-R))>critical value (CV)

	LL	# par	D	df	CV (0.1)	keep/omit
Base (price, WL, WG, brands)	-18977.62	12				
base, income	-18977.32	15	0.6	3	6.25	omit
base, age	-18963.47	15	28.3	3	6.25	keep
base, age, education	-18952.44	18	22.06	3	6.25	keep
base, age, education, gender	-18945.30	21	14.28	3	6.25	keep
base, age, education, gender, info treatment	-18941.25	24	8.1	3	6.25	keep
base, age, education, gender, info treatment, nutrition knowledge	-18896.26	27	89.98	3	6.25	keep

Table 3D.4 Individual specific characteristic / label attribute interacted RPL

	Reduced Sample		Whole Sample	
	Coefficient	Standard Error	Coefficient	Standard Error
Random parameters in utility functions				
Warning Label	1.653***	0	1.309***	0
Whole Grain	0.395***	0	0.299***	0
Nonrandom parameters in utility functions				
Price	0.126***	0	0.177***	0
Price*Info	0.008***	0	-0.007***	0
Price*Education	0.017***	0	0.002***	0
Price*Age	-0.001***	0	-0.001***	0
Price*Female	-0.038***	0	-0.043***	0
Price*NK	-0.494***	0	-0.449***	0
WL*Info	-0.110***	0	-0.147***	0
WL*Education	-0.157***	0	-0.125***	0
WL*Age	-0.018***	0	-0.012***	0
WL*Female	-0.330***	0	-0.211***	0

WL*NK	-0.672***	0	-0.712***	0
WG*Info	-0.101***	0	-0.038***	0
WG*Education	-0.027***	0	-0.032***	0
WG*Age	-0.006***	0	-0.006***	0
WG*Female	-0.065***	0	-0.071***	0
WG*NK	0.209***	0	0.335***	0
Cap'n Crunch	-0.670***	0	-0.642***	0
Special K	-0.216***	0	-0.179***	0
Honey Nut Cheerios	0.013***	0	0.032***	0
Mini Wheats	-0.226***	0	-0.265***	0
Frosted Flakes	-0.292***	0	-0.263***	0
Corn Pops	-0.446***	0	-0.535***	0
Corn Flakes	-0.226***	0	-0.173***	0
Rice Krispies	-0.074***	0	-0.076***	0
Shreddies	-0.336***	0	-0.391***	0
Derived standard deviations of parameter distributions				
Warning Label	0.720***	0	0.744***	0
Whole Grain	0.607***	0	0.570***	0
LLF	-18215.51		-24893.74	
AIC/N	23.331		23.691	

Abbreviations: NK=Nutrition Knowledge, WL=Warning Label, WG=Whole Grain
***, **, and * indicate statistical significance at 1%, 5%, and 10% respectively

Table 3D.5 Log likelihood test to determine whether the unrestricted brand interacted MNL model is a statistically significant improvement over the restricted brand interacted MNL model.

	Reduced Sample	Whole Sample
R	-18974.42	-25691.12
UR	-18952.58	-25666.71
D	43.68	48.82
df	20	20
CV (0.01)	37	37

For both samples, using the unrestricted model is validated.

Table 3D.6 Brand / label attribute interacted RPL estimates

	Reduced Sample		Whole Sample	
	Coefficient	St. Error	Coefficient	St. Error
Random parameters in utility functions				
Cap'n Crunch	-0.710***	0	-0.696***	0
Special K	-0.385***	0	-0.355***	0
Honey Nut Cheerios	-0.064***	0	-0.081***	0
Mini Wheats	-0.304***	0	-0.315***	0
Frosted Flakes	-0.403***	0	-0.395***	0
Corn Pops	-0.987***	0	-0.978***	0
Corn Flakes	-0.228***	0	-0.228***	0
Rice Krispies	-0.240***	0	-0.241***	0
Shreddies	-0.705***	0	-0.688***	0
Nonrandom parameters in utility functions				
Price	-0.203	0	-0.203	0
Cap'n Crunch*WL	-0.018***	0	-0.012***	0
Cap'n Crunch*WG	0.245***	0	0.233***	0
Cap'n Crunch*Info	-0.342***	0	-0.358***	0
Special K*WG	0.168***	0	0.182***	0
Special K*Info	-0.411***	0	-0.417***	0
Honey Nut Cheerios*WL	-0.171***	0	-0.161***	0
Honey Nut Cheerios*WG	0.034***	0	0.048***	0
Honey Nut Cheerios*Info	-0.151***	0	-0.161***	0
Mini Wheats*WL	-0.172***	0	-0.180***	0
Mini Wheats*WG	0.192***	0	0.212***	0
Mini Wheats*Info	-0.306***	0	-0.305***	0
Frosted Flakes*WL	-0.158***	0	-0.176***	0
Frosted Flakes*WG	0.096***	0	0.125***	0
Frosted Flakes*Info	-0.183***	0	-0.216***	0
Corn Pops*WL	-0.046***	0	-0.059***	0
Corn Pops*WG	0.291***	0	0.283***	0
Corn Pops*Info	0.154***	0	0.145***	0
Corn Flakes*WG	0.044***	0	0.056***	0
Corn Flakes*Info	-0.236***	0	-0.211***	0
Rice Krispies*WG	0.069***	0	0.066***	0
Rice Krispies*Info	-0.012***	0	-0.035***	0
Shreddies*WG	0.037***	0	0.074***	0
Shreddies*Info	0.066***	0	-0.002***	0
Derived standard deviations of parameter distributions				

Cap'n Crunch	0.236***	0	0.185***	0
Special K	0.896***	0	0.867***	0
Honey Nut Cheerios	0.746***	0	0.750***	0
Mini Wheats	0.751***	0	0.769***	0
Frosted Flakes	0.660***	0	0.652***	0
Corn Pops	0.760***	0	0.748***	0
Corn Flakes	0.513***	0	0.412***	0
Rice Krispies	0.624***	0	0.641***	0
Shreddies	0.923***	0	0.912***	0
LLF	-18130.41		-18135.89	
AIC/N	23.238		23.245	

Abbreviations: WL=Warning Label, WG=Whole Grain

***, **, and * indicate statistical significance at 1%, 5%, and 10% respectively

Appendix 4A – Summary of Breakfast Cereals

Table 4A.1 Summary of all products included in Chapter 4 analysis.
Note: Values provided for RRR, Sugar, Price, and Advertising are means for the years in which the product was present in our sample, with standard deviations shown below in parentheses. RRR category indicates which group the products were included in for the comparative analyses discussed in section 4.5. High sugar warning label indicates which of the products would require a warning label based on the criteria used for the breakfast cereal choice experiment discussed in Chapter 3. (GM=General Mills, Kel=Kellogg's)

	Company	RRR	Sugar (g/ 100g)	Price ($/ 100g)	Advertising ($/year)	Years	RRR category	High sugar warning label
Cheerios	GM	2.64 (0.00)	3.7 (0.00)	0.85 (0.08)	1995583 (671651)	1999-2017	high	no
Honey Nut Cheerios	GM	1.35 (0.00)	31.0 (0.00)	0.81 (0.16)	2257510 (732196)	1999-2017	med	yes
Apple Cinnamon Cheerios	GM	1.13 (0.06)	26.8 (2.30)	0.86 (0.18)	197959 (448590)	1999-2017	med	yes
Multigrain Cheerios	GM	1.80 (0.00)	23.7 (1.28)	1.27 (0.47)	514721 (720360)	1999-2017	high	yes
Frosted Cheerios	GM	1.34 (0.02)	32.1 (0.01)	0.74 (0.14)	28634 (83044)	1999-2016	med	yes
Fruity Cheerios	GM	2.74 (0.39)	9.3 (6.27)	0.88 (0.10)	240871 (420378)	2006-2017	high	no
Oat Cluster Crunch Cheerios	GM	1.36 (0.05)	29.2 (0.93)	0.80 (0.09)	210535 (374466)	2007-2017	med	yes
Banana Nut Cheerios	GM	1.35 (0.00)	31.0 (0.00)	0.86 (0.10)	152242 (183375)	2009-2015	med	yes
Chocolate Cheerios	GM	1.32 (0.02)	31.0 (0.02)	0.68 (0.11)	404194 (381518)	2010-2017	med	yes
Multigrain Peanut Butter Cheerios	GM	1.42 (0.00)	30.8 (0.00)	0.88 (0.04)	0 (0)	2012-2015	med	yes
Protein Cheerios	GM	1.35 (0.00)	25.0 (0.00)	0.82 (0.00)	0 (0)	2014-2015	med	yes
Ancient Grain Cheerios	GM	1.60 (0.00)	24.1 (0.00)	0.88 (0.00)	0 (0)	2015	high	yes
Gluten Free Cheerios	GM	2.64 (0.00)	3.7 (0.00)	0.77 (0.01)	0 (0)	2016	high	no
Maple Cheerios	GM	1.46 (0.00)	32.1 (0.00)	0.77 (0.01)	0 (0)	2017	med	yes
Berry Burst Cheerios	GM	1.44 (0.00)	36.7 (0.00)	1.57 (0.12)	720866 (730592)	2004-2005	med	yes
Rice Chex	GM	1.84 (0.16)	7.1 (0.00)	0.74 (0.21)	0 (0)	2011-2017	high	no
Honey Nut Chex	GM	1.04 (0.03)	31.4 (0.72)	0.84 (0.19)	132208 (292083)	1999-2017	med	yes
Cinnamon Chex	GM	1.19	25.5	0.84	0	1999-2017	med	yes

		(0.04)	(1.44)	(0.16)	(0)			
Blueberry Chex	GM	1.28 (0.00)	23.3 (0.00)	1.13 (0.01)	0 (0)	2017	med	yes
Chocolate Chex	GM	1.08 (0.04)	24.2 (0.00)	1.03 (0.06)	0 (0)	2016-2017	med	yes
Apple Crisp Chex	GM	1.49 (0.00)	31.3 (0.00)	1.07 (0.03)	0 (0)	2001-2002	med	yes
Cinnamon Toast Crunch	GM	0.78 (0.16)	33.1 (0.50)	0.84 (0.21)	655924 (512343)	1999-2017	low	yes
Count Chocula	GM	0.94 (0.16)	43.3 (4.30)	0.99 (0.43)	0 (0)	1999-2016	low	yes
Fiber 1	GM	8.47 (0.82)	0.0 (0.00)	0.88 (0.23)	225341 (270621)	1999-2017	high	no
Fiber 1 Honey Clusters	GM	3.27 (0.47)	9.6 (2.09)	0.90 (0.24)	362880 (531187)	1999-2017	high	no
Fiber 1 Raisin Bran Clusters	GM	1.80 (0.00)	24.6 (0.00)	0.74 (0.04)	1001220 (253596)	2008-2010	high	yes
Fiber 1 Brown Sugar	GM	2.24 (0.00)	3.2 (0.00)	0.69 (0.00)	0 (0)	2011-2012	high	no
Fiber 1 Almonds & Cluster	GM	1.85 (0.00)	21.1 (0.00)		0 (0)	2013-2014	high	yes
Franken-Berry	GM	1.42 (0.00)	26.5 (0.00)	0.48 (0.02)	0 (0)	2014-2015	med	yes
French Toast Crunch	GM	1.06 (0.05)	39.4 (2.27)	1.07 (0.44)	63637 (158194)	1999-2016	med	yes
Golden Grahams	GM	1.08 (0.09)	32.9 (1.14)	0.95 (0.31)	38150 (84497)	1999-2017	med	yes
Kix	GM	1.45 (0.00)	21.4 (0.00)	0.77 (0.20)	0 (0)	2011-2012	med	yes
Lucky Charms	GM	1.08 (0.34)	40.7 (3.62)	0.88 (0.20)	699374 (254717)	1999-2017	med	yes
Reese's Puffs	GM	1.09 (0.06)	40.1 (3.68)	0.92 (0.32)	0 (0)	1999-2017	med	yes
Total	GM	11.83 (0.00)	16.7 (0.00)	0.72 (0.15)	0 (0)	2009	high	no
Trix	GM	1.21 (0.06)	36.6 (6.62)	0.98 (0.06)	0 (0)	2003-2004	med	yes
Banana Berry	GM	1.05 (0.00)	32.3 (0.02)	1.00 (0.01)	0 (0)	2015-2016	med	yes
Edge	GM	1.92 (0.04)	19.0 (0.02)	0.75 (0.01)	0 (0)	2014-2017	high	no
Edge with Protein	GM	2.01 (0.02)	19.0 (0.00)	0.68 (0.00)	0 (0)	2016-2017	high	no
Oatmeal Crisp Raisin	GM	1.12 (0.04)	31.0 (0.75)	0.77 (0.19)	100204 (167184)	1999-2016	med	yes
Oatmeal Crisp Dark Chocolate Cranberry	GM	1.51 (0.03)	25.5 (0.86)	0.80 (0.01)	0 (0)	2015-2016	high	yes

Oatmeal Crisp Apple Brown Sugar	GM	1.31 (0.05)	30.0 (0.84)	0.91 (0.14)	0 (0)	2001-2007	med	yes
Oatmeal Crisp Berry	GM	1.53 (0.00)	22.2 (0.00)	0.72 (0.11)	796485 (796868)	2003-2017	high	yes
Oatmeal crisp Maple Nut	GM	1.15 (0.13)	29.4 (2.57)	0.79 (0.18)	0 (0)	1999-2017	med	yes
Oatmeal Crisp Vanilla Yogurt	GM	1.06 (0.00)	27.3 (0.00)	0.74 (0.07)	0 (0)	2005-2009	med	yes
Oatmeal Crisp Coconut	GM	1.11 (0.00)	22.4 (0.00)	0.80 (0.00)	0 (0)	2017	med	yes
Oatmeal Crisp Vanilla Almond	GM	1.37 (0.11)	25.2 (1.68)	0.66 (0.08)	0 (0)	2008-2017	med	yes
Lucky Charms Chocolate	GM	0.92 (0.14)	47.3 (5.90)	0.97 (0.10)	0 (0)	2006-2017	low	yes
Nestle Nesquik	GM	0.66 (0.26)	45.0 (4.91)	0.98 (0.22)	0 (0)	1999-2017	low	yes
Nature Valley Coconut Almond	GM	0.97 (0.00)	16.9 (0.02)	1.16 (0.01)	0 (0)	2015-2016	low	no
Nature Valley Field Berry	GM	1.04 (0.00)	16.8 (0.12)	1.17 (0.01)	0 (0)	2015-2016	med	no
Nature Valley Protein Oats'n Honey	GM	1.06 (0.02)	24.3 (0.93)	1.31 (0.01)	0 (0)	2014-2016	med	yes
Nature Valley Protein Cranberry Almond	GM	0.91 (0.00)	28.3 (0.00)	1.31 (0.01)	0 (0)	2014-2016	low	yes
Teenage Mutant Ninja Turtles	GM	0.73 (0.00)	24.1 (0.00)	0.85 (0.00)	0 (0)	2016	low	yes
Star Wars	GM	1.28 (0.00)	31.0 (0.00)	0.77 (0.00)	0 (0)	2016	med	yes
Finding Dory	GM	1.34 (0.00)	27.3 (0.00)	0.94 (0.00)	0 (0)	2016	med	yes
All-Bran Buds	Kel	2.41 (0.15)	27.6 (1.24)	0.89 (0.27)	957939 (1191928)	1999-2017	high	yes
All-Bran Buds with Psyllium	Kel	2.58 (0.00)	25.0 (0.00)	0.56 (0.11)	362021 (642161)	2009-2017	high	yes
All-Bran Cranberry & Clusters	Kel	1.59 (0.08)	24.0 (1.83)	0.67 (0.05)	1147928 (0)	2013-2017	high	yes
All-Bran Flakes	Kel	2.12 (0.30)	13.8 (0.34)	0.74 (0.27)	72659 (230622)	1999-2017	high	no
All-Bran Guardian	Kel	1.66 (0.10)	28.2 (2.37)	1.23 (0.09)	1297911 (301894)	2006-2008	high	yes
All-Bran Honey Nut	Kel	1.85 (0.00)	23.5 (0.00)	1.10 (0.01)	0 (0)	2017	high	yes
All-Bran Original	Kel	2.75 (0.00)	19.4 (0.00)	0.74 (0.19)	915683 (988854)	1999-2017	high	no
All Bran Strawberry Bites	Kel	2.79 (1.11)	18.3 (0.09)	0.66 (0.18)	705362 (877415)	2004-2016	high	no

Apple Jacks	Kel	0.23 (0.17)	54.1 (3.23)	0.71 (0.20)	51391 (96021)	1999-2010	low	yes
Cadbury Crunch	Kel	0.75 (0.00)	46.7 (0.00)	0.92 (0.00)	0 (0)	2002	low	yes
Banana Crunch Corn Flakes	Kel	1.38 (0.49)	27.5 (3.10)	1.05 (0.03)	0 (0)	2003-2005	med	yes
Corn Flakes	Kel	1.43 (0.00)	10.3 (0.00)	0.83 (0.15)	281732 (382357)	1999-2017	med	no
Corn Flakes Touch of Honey	Kel	1.13 (0.00)	20.6 (0.00)	0.78 (0.10)	0 (0)	2010-2011	med	yes
Cinnamon Jacks	Kel	1.12 (0.00)	33.3 (0.00)	0.37 (0.00)	0 (0)	2014	med	yes
Cinnamon Pops	Kel	0.88 (0.00)	37.5 (0.00)	0.62 (0.00)	456544 (0)	2012	low	yes
Cracklin Oat Bran	Kel	1.13 (0.00)	30.6 (0.00)	0.75 (0.03)	0 (0)	2008-2009	med	yes
Crispix Krispies	Kel	1.32 (0.07)	10.0 (0.00)	0.93 (0.14)	7442 (18339)	2007-2017	med	no
Corn Pops	Kel	0.79 (0.13)	36.5 (1.83)	1.01 (0.27)	492357 (511988)	1999-2017	low	yes
Chocolatey Corn Pops	Kel	0.66 (0.00)	46.2 (0.00)	1.25 (0.09)	0 (0)	2003-2004	low	yes
Crunchy O's	Kel	1.01 (0.00)	40.0 (0.00)		0 (0)	2010-2011	med	yes
Extra Cereal	Kel	1.58 (0.00)	34.5 (0.00)		881341 (34012)	2005-2006	high	yes
Extra Cereal Fruit and Yogurt	Kel	0.96 (0.00)	32.2 (0.00)		1079852 (0)	2006	low	yes
Fibre Plus	Kel	2.02 (0.00)	22.2 (0.00)	0.82 (0.00)	1333225 (0)	2011	high	yes
Finding Nemo	Kel	0.66 (0.00)	51.6 (0.00)	0.96 (0.04)	0 (0)	2004-2005	low	yes
Froot Loops	Kel	0.78 (0.08)	43.2 (2.21)	0.63 (0.21)	727987 (512046)	1999-2017	low	yes
Froot Loops Berry Blue	Kel	0.73 (0.05)	44.0 (1.63)	0.57 (0.12)	0 (0)	2004-2015	low	yes
Froot Loops Reduced Sugar	Kel	1.93 (0.00)	31.0 (0.00)	0.64 (0.09)	378361 (239619)	2004-2006	high	yes
Froot Loops Marshmallow	Kel	0.61 (0.00)	53.3 (0.00)	0.94 (0.09)	59304 (52918)	1999-2004	low	yes
Froot Loops Smoothie	Kel	1.07 (0.00)	36.7 (0.00)	0.86 (0.08)	179170 (52952)	2007-2008	med	yes
Froot Loops Strawberry	Kel	0.65 (0.00)	50.0 (0.00)	0.98 (0.00)	70309 (0)	2003	low	yes
Frosted Flakes	Kel	0.80 (0.04)	34.6 (0.38)	0.71 (0.14)	1090497 (619845)	1999-2017	low	yes
Frosted Flakes Less Sugar	Kel	0.98 (0.00)	24.2 (0.00)	0.94 (0.09)	380234 (238913)	2004-2007	low	yes

Guardian Cinnamon	Kel	2.28 (0.00)	29.4 (0.00)	1.18 (0.00)	834557 (0)	2008	high	yes
Honey Loops	Kel	1.06 (0.00)	37.0 (0.00)		0 (0)	2014-2015	med	yes
Hunny B's	Kel	0.83 (0.00)	36.9 (0.44)	0.97 (0.27)	100495 (136094)	2002-2005	low	yes
Just Right	Kel	1.35 (0.14)	20.9 (1.69)	0.82 (0.07)	4115 (7303)	2006-2017	med	yes
Kashi 7 Grain	Kel	1.30 (0.06)	27.9 (1.09)	0.80 (0.24)	0 (0)	2005-2016	med	yes
Kashi Autumn Wheat	Kel	1.47 (0.05)	13.0 (0.02)	0.96 (0.04)	0 (0)	2003-2004	med	no
Kashi Blueberry Oat Clusters	Kel	0.76 (0.11)	21.1 (0.98)	1.12 (0.01)	396270 (0)	2013-2017	low	yes
Kashi Cinnamon	Kel	1.84 (0.22)	17.1 (1.05)	0.85 (0.21)	253816 (511915)	2009-2017	high	no
Kashi Good Friends	Kel	2.50 (1.25)	18.5 (3.59)	1.00 (0.05)	0 (0)	2003-2005	high	no
Kashi Go Lean Crunch	Kel	1.15 (0.19)	25.6 (1.38)	0.79 (0.13)	40166 (57424)	2005-2017	med	yes
Kashi Granola	Kel	0.73 (0.00)	21.8 (0.00)	0.76 (0.05)	133061 (1206)	2008-2009	low	yes
Kashi Honey Almond Flax	Kel	1.22 (0.02)	23.0 (0.32)	0.84 (0.13)	264481 (336379)	2008-2017	med	yes
Kashi Indigo Morning	Kel	0.77 (0.00)	20.7 (0.00)	1.51 (0.01)	0 (0)	2014-2016	low	yes
Kashi Simply Maize	Kel	0.72 (0.00)	21.4 (0.01)	1.50 (0.05)	0 (0)	2014-2017	low	yes
Kashi Nutty Chia Flax	Kel	1.02 (0.06)	21.2 (0.59)	1.28 (0.17)	0 (0)	2014-2017	med	yes
Kashi Probiotic	Kel	1.23 (0.00)	21.8 (0.00)	0.75 (0.05)	0 (0)	2009-2010	med	yes
Kashi Cocoa Crisp	Kel	0.55 (0.00)	24.6 (0.00)	1.30 (0.03)	0 (0)	2016	low	yes
Kashi Maple Brown Sugar Flake	Kel	0.74 (0.00)	29.1 (0.00)	1.30 (0.03)	0 (0)	2016	low	yes
Kashi Quinoa Multigrain Flakes	Kel	0.64 (0.02)	22.9 (0.01)	1.18 (0.05)	0 (0)	2015-2016	low	yes
Kashi Honey Sunshine	Kel	1.11 (0.16)	18.3 (1.85)	0.76 (0.15)	0 (0)	2017	med	no
Kashi Toasted Berry Crisp	Kel	1.25 (0.12)	24.5 (1.75)	0.83 (0.14)	508850 (449557)	2010-2017	med	yes
Kashi Bite Sized Whole Wheat	Kel	1.25 (0.14)	16.0 (0.63)	0.74 (0.08)	22 (40)	2006-2010	med	no
Kashi Vanilla Pepita	Kel	1.31 (0.00)	17.2 (0.00)	1.36 (0.04)	0 (0)	2016-2017	med	no
Krave Chocolate	Kel	1.32 (0.28)	34.5 (0.01)	1.57 (0.20)	0 (0)	2012-2017	med	yes

Krave Double Chocolate	Kel	0.99 (0.00)	35.7 (0.00)	1.84 (0.06)	0 (0)	2012-2013	low	yes
Multigrain Krispies	Kel	1.45 (0.00)	22.6 (0.00)	0.68 (0.00)	1869448 (0)	2009	med	yes
Mickey's Magix	Kel	0.63 (0.00)	53.3 (0.00)	1.22 (0.14)	9989 (8688)	2002-2004	low	yes
Monsters Inc.	Kel	0.76 (0.00)	46.7 (0.00)		5800 (5420)	2001-2002	low	yes
Muslix	Kel	1.05 (0.00)	27.6 (0.00)	1.19 (0.22)	909443 (880713)	1999-2007	med	yes
Blueberry Mini Wheats	Kel	2.00 (0.23)	21.4 (1.64)	0.69 (0.18)	382581 (388168)	2008-2017	high	yes
Brown Sugar Frosted Mini Wheats	Kel	1.97 (0.13)	23.5 (1.90)	0.71 (0.09)	158629 (261631)	2002-2017	high	yes
Mini Wheats Centres	Kel	2.24 (0.00)	18.2 (0.01)	0.73 (0.01)	1462088 (72245)	2012-2016	high	no
Cinnamon Mini Wheats	Kel	1.91 (0.09)	23.1 (1.11)	0.80 (0.03)	2937726 (0)	2008, 2017	high	yes
Little Bites Chocolate Mini Wheats	Kel	1.49 (0.00)	21.8 (0.00)	0.66 (0.03)	562781 (193673)	2010-2012	med	yes
Maple Mini Wheats	Kel	4.56 (1.10)	23.7 (0.63)	0.79 (0.06)	187229 (347764)	2004-2017	high	yes
Frosted Mini Whetas	Kel	1.99 (0.14)	24.6 (2.15)	0.74 (0.11)	294034 (388232)	1999-2017	high	yes
Strawberry Mini Wheats	Kel	1.78 (0.12)	23.6 (1.47)	0.56 (0.09)	1012496 (1193421)	2006-2013	high	yes
Vanilla Mini Wheats	Kel	1.85 (0.00)	24.1 (0.00)	0.59 (0.04)	1144446 (810333)	2006-2008	high	yes
Raisin Bran	Kel	1.29 (0.03)	28.9 (0.57)	0.52 (0.14)	371233 (580180)	1999-2017	med	yes
Rasin Bran Crunch	Kel	1.01 (0.00)	38.2 (0.00)	0.71 (0.16)	307170 (747641)	1999-2010	med	yes
Rice Krispies	Kel	1.20 (0.22)	17.8 (9.08)	0.95 (0.36)	1428814 (791357)	1999-2017	med	no
Chocolate Rice Krispies	Kel	1.67 (0.00)	38.7 (0.00)	0.81 (0.03)	3804 (2531)	2005-2006	high	yes
Gluten Free Rice Krispies	Kel	2.15 (0.00)	3.1 (0.01)	0.92 (0.22)	0 (0)	2012-2016	high	no
Holiday Rice Krispies	Kel	0.99 (0.00)	10.7 (0.00)	0.82 (0.23)	441634 (524452)	1999-2012	low	no
Multigrain Rice Krispies Shapes	Kel	1.55 (0.00)	21.4 (0.01)	1.09 (0.11)	0 (0)	2014-2016	high	yes
Vanilla Rice Krispies	Kel	0.80 (0.03)	28.7 (1.24)	0.77 (0.20)	509085 (478538)	2007-2017	low	yes
Rice Krispies Brown Rice	Kel	2.15 (0.00)	3.1 (0.00)	1.25 (0.00)	0 (0)	2016-2017	high	no
Robots	Kel	0.81	37.5	0.89	0	2005-2006	low	yes

		(0.00)	(0.00)	(0.03)	(0)			
Scooby Doo	Kel	0.68 (0.00)	43.3 (0.00)	1.07 (0.05)	130608 (13410)	2003-2004	low	yes
Simpsons	Kel	0.90 (0.00)	28.7 (0.00)	1.12 (0.17)	0 (0)	2002-2003	low	yes
Smacks Honey Flavoured Puffed Wheat	Kel	1.01 (0.32)	56.0 (0.10)	0.69 (0.13)	0 (0)	1999-2015	med	yes
Special K Original	Kel	1.42 (0.02)	12.5 (0.00)	0.88 (0.17)	1115128 (871847)	1999-2017	med	no
Special K 5 Grains	Kel	1.76 (0.00)	13.0 (0.00)	0.86 (0.00)	2108177 (0)	2009	high	no
Special K Blueberry	Kel	1.34 (0.48)	23.4 (4.07)	0.95 (0.07)	1865408 (0)	2010, 2017	med	yes
Special K Carbfit	Kel	3.26 (0.00)	7.1 (0.00)	1.06 (0.12)	0 (0)	2004-2005	high	no
Speical K Chocolatey Delight	Kel	0.70 (0.14)	29.0 (3.34)	0.81 (0.13)	356417 (698112)	2007-2012	low	yes
Special K Chocolatey Red Berries	Kel	0.99 (0.00)	28.6 (0.00)	0.96 (0.01)	0 (0)	2014-2015	low	yes
Special K Cinnamon Pecan	Kel	1.21 (0.00)	23.3 (0.00)	0.90 (0.00)	1184600 (0)	2008	med	yes
Special K High Fibre	Kel	1.41 (0.00)	18.3 (0.00)	1.31 (0.11)	1082853 (1497910)	1999-2001	med	no
Specail K Fruit and Yogurt	Kel	0.96 (0.07)	31.3 (1.54)	0.91 (0.14)	1608069 (297553)	2007-2008	low	yes
Special K Low Fat Granola	Kel	1.87 (0.00)	18.5 (0.00)	0.66 (0.22)	867337 (864858)	2012-2013	high	no
Special K Oats & Honey	Kel	1.24 (0.00)	27.6 (0.00)	0.93 (0.09)	777255 (1097898)	2011-2016	med	yes
Special K Protein	Kel	2.55 (0.04)	18.0 (0.00)	0.89 (0.06)	1554969 (0)	2013-2017	high	no
Special K Red Berries	Kel	1.31 (0.03)	24.2 (0.08)	1.12 (0.26)	802186 (712529)	2001-2017	med	yes
Special K Satisfaction	Kel	1.30 (0.00)	24.1 (0.00)	0.84 (0.09)	960725 (1234435)	2008-2011	med	yes
Special K Soy	Kel	1.49 (0.00)	26.8 (0.00)	1.06 (0.00)	266497 (0)	2005	med	yes
Special K Vanilla Almond	Kel	1.11 (0.04)	26.8 (0.33)	0.79 (0.18)	822201 (805047)	2005-2017	med	yes
Special K Apples Raspberries & Almonds	Kel	1.80 (0.02)	18.5 (0.00)	1.03 (0.07)	0 (0)	2016-2017	high	no
Special K Cranberry Coconut & Almond	Kel	1.37 (0.00)	20.0 (0.00)	1.01 (0.09)	0 (0)	2016-2017	med	no
Spider Man Toasted Oats	Kel	0.84 (0.00)	40.0 (0.00)	0.94 (0.01)	0 (0)	2004-2005	low	yes
Star Wars	Kel	0.77	43.3	1.21	13181	2002	low	yes

		(0.00)	(0.00)	(0.00)	(0)			
Tony's Turboz	Kel	1.82 (0.00)	22.5 (0.00)		962191 (752020)	2005-2007	high	yes
Two Scoops Crunch Cranberry	Kel	1.27 (0.00)	32.7 (0.00)	1.06 (0.00)	944366 (0)	2006	med	yes
Two Scoops Crunch Raisin and Honey Oat	Kel	1.03 (0.00)	38.2 (0.00)	1.06 (0.05)	0 (0)	2007	med	yes
Vector Honey Almond Granola	Kel	1.56 (0.00)	15.9 (0.00)	0.80 (0.00)	0 (0)	2015	high	no
Vector	Kel	1.63 (0.10)	20.0 (0.00)	0.77 (0.09)	1091803 (1179066)	1999-2017	high	no
Vive	Kel	1.45 (0.00)	26.0 (0.00)	1.21 (0.01)	1229287 (496713)	2001-2002	med	yes