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Historical Trends in Attitudes, Knowledge and Behaviours of Canadian Consumers: Analysis of Sugar Tracking Studies from 1998-2007

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ABSTRACT

To date there has been limited research that has assessed the changing attitudes and perceptions of sugar. While the assumption could be made that public perception regarding sugar intake has become more negative, this has not been determined through research. Recent interest in food labeling, guidelines for sugars intake, popular diets, and the role of sugar-sweetened beverages in the obesity epidemic have generated media attention and initiated research that has focused on sugars intake and health.

The Canadian Sugar Institute (CSI) has been conducting research on tracking consumer behaviour, attitudes, and knowledge of sugar and sugar substitutes within the context of a number of health issues. Data from the tracking studies collected in 1998, 2000, 2002, 2004, 2006, and 2007 have been analyzed for temporal changes in behaviour, attitude, and knowledge towards sugar consumption and for predictors of behaviour and attitude towards sugar consumption. The Theory of Reasoned Action (TRA) provided a theoretical framework for understanding the influence of external factors on behaviour.

Behaviour, attitude, and knowledge index scores were tabulated for each survey year. Tukey's multiple range T-test showed temporal changes in mean behaviour scores over the time span of data collection. From 1998 to 2007 the behaviour index score (BIS) decreased by 15.7% indicating consumer's behaviour had become more negative as respondents adopted ways to decrease sugars consumption and dieting behaviours. Tukey's multiple range T-test showed temporal changes in mean knowledge index score (KIS) and mean attitude index score (AIS) however the magnitude of the differences were small and mean scores remained fairly constant over the data collection period.

When assessed for predictors of sugar consumption behaviour regression analysis showed that the strongest negative predictor of BIS was time and the strongest positive predictor was AIS. Other positive but less robust predictors were being male, having a low income, living in households with >5 people, and being a resident of Quebec, while being from an older age group had a negative impact. The regression model accounted for ~24% of the variance in BIS. When predictors of attitude towards sugar consumption was assessed regression analysis showed that the strongest positive predictor was KIS, while being a resident of Quebec was the most important negative predictor. Other positive but less robust predictors were survey year 2002, being male, being unemployed, and being from a younger age group. The regression model accounted for ~20% of the variance in AIS.

Changing subjective norms proposed within the TRA may account for the remainder of the variance in BIS and could explain the temporal changes in BIS without the same changes in AIS. External influences such as media messages, changing public health policy, and food labeling may be impacting on behaviour towards sugar consumption among Canadian consumers.

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CHAPTER 1.0: INTRODUCTION

1.1 Problem Statement

Sucrose, also known as sugar, is a disaccharide that is found naturally in most fruits and vegetables. Added sugar, derived from either sugar cane or sugar beet, is an important constituent of many foods consumed by Canadians and has a role in the context of the total diet. As part of food, sugar imparts flavour to enhance the sensory experience of eating/drinking; and it plays a functional role in food product stability and appearance. For example, browning reactions like the Maillard reaction and caramelization that occur when a food product containing sugar is heated, changes the colour of the food product while caramelization also imparts flavour changes. Sugar is an important source of food energy contributing four kilocalories per gram. The body degrades sugar into fructose and glucose. The glucose moiety of sucrose is required for optimal brain function and for synthesis of glycogen in muscle and liver tissue. The fructose moiety of sugar can enter glycolysis in the first step past phosphofructokinase, the key regulatory site of the pathway.

Despite the important role sugar plays as a dietary constituent, public perception is largely negative with consumption being blamed for the obesity epidemic, behavioural problems in children, dental caries, and increased disease risk. To a large extent, the media rather than scientific evidence have shaped these negative perceptions. There is controversy within lay and scientific literature on recommendations for sugar consumption and the role sugar plays in human health.

We know little about the perceptions of Canadian consumers toward sugar consumption. General attitudes and knowledge of sugar in relation to other common food ingredients, the

attitudes of sugar consumption on health, and the attitudes of sugar consumption in children are unknown. The Information Service of the Canadian Sugar Institute (CSI) has conducted a tracking survey biennially since 1986. However, little has been done to analyze these data in order to present an historical overview of changing perceptions of Canadians.

1.2 Research Objectives

In light of these perceptions toward sugar, the purpose of this research was to use the Tracking Sugar Trends survey to better understand how Canadian consumers view dietary sugars and to determine how this has changed over time. The specific objectives of the research were to:

(1) Determine if the attitudes, knowledge, and behaviours of sugar consumption changed among Canadians from 1998 to 2007 using the results of the Sugar Tracking survey data;

(2) Determine the predictors of attitudes towards sugar consumption behaviour in the Canadian population using the Sugar Tracking survey data.

1.3 Key Terms

Sugar: Common refined sugar, which consists of pure sucrose (1).

Sugars: All monosaccharides (e.g., glucose, fructose) and disaccharides (e.g., sucrose, lactose) in foods (e.g., milk, fruit and vegetables) or added to foods (e.g., white sugar, brown sugar, honey, syrups) (1).

Added sugars: The sugars added to foods, including white sugar, brown sugar, and sugars from honey, maple syrup, and corn sweeteners (dextrose, glucose syrup, and high-fructose corn syrup) (1).

Carbohydrates (CHO): All digestible carbohydrates including sugars (mono- and disaccharides), oligosaccharides, starches, and sugar alcohols. Non-digestible carbohydrates (dietary fiber) are not included as part of total carbohydrate (2).

Intrinsic Sugars: Sugars in whole fruit (3).

Non-milk Extrinsic (NME) Sugars: Sugars added to food and those naturally present in fruit juices (3).

Free sugars: All monosaccharides and disaccharides added to foods by the manufacturer, cook or consumer, plus sugars naturally present in honey, syrups and fruit juices (4,5).

CHAPTER 2.0: LITERATURE REVIEW

2.1 Introduction

Consumer knowledge, attitudes and behaviour can be influenced by many factors with media, the Internet, television, newspapers, magazines, books, and food product labels playing a role (6). The use of the Internet for nutrition information has risen substantially in Canada, from 6% in 1997 to 51% in 2008 (6). While information from these sources is not always based on strong scientific evidence, they do influence public opinion. Sugar has received much attention and often the 'go to' sources for information on sugar intake are the sources mentioned above. The popularity of low carbohydrate diets and categorizing CHO's into 'good carbs' and 'bad carbs' based on their Glycaemic Index (GI) are example of trends contributing to negative perceptions surrounding sugar intake. In an effort to offer guidance on sugar intake grounded in scientific literature, national guidelines, and guidelines supported by health organizations and associations have been developed. The following review will explore sugars consumption in Canada, sugar and human health, guidelines for sugars consumption, and perceptions and attitudes of sugars consumption by consumers.

2.2 Sugar Consumption

The two methods used for estimating food consumption are surveys of individual and household food intake and food disappearance data, which is used to determine per capita availability (7,8). The limitation of using surveys to estimate food intake data are under-reporting of actual intakes, whereas with disappearance data, average intakes are over-estimated (7,8).

In the U.S.A. sugar intake data have been obtained from United States Department of Agriculture (USDA) and National Center for Health Statistics (NCHS) surveys. The USDA has conducted food consumption surveys from 1935 to 1998 (9). Two of the surveys are the Nationwide Food Consumption Survey (NFCS) and the Continuing Survey of Food Intakes by Individuals (CSFII). The NCHS began conducting the National Health and Nutrition Examination Survey (NHANES) in 1960 and has been conducting a continuous survey since 1999 (10). These three surveys are used most often to determine food intake from which sugar intake values are derived. Food disappearance data or availability data are sourced from the USDA Economic Research Service (ERS) (11).

Actual intakes of "added sugars" are not available in Canada because the Canadian Community Health Survey (CCHS) Cycle 2.2 which focused on nutrition did not include estimates of "added sugar" intake (2). The Canadian Nutrient File does not contain information on added sugars content in foods therefore it cannot be reported in the CCHS. In Canada sugar intake is estimated using Canadian disappearance data, which is determined from Statistics Canada data on refined sugar available for consumption (1). The proportion of added sugars losses such as waste or spoilage has been derived from U.S.A survey and disappearance data because this information is not available in Canada (1). It is assumed that the proportion of waste is the same in both Canada and the U.S.A. (1).

Average sugar intake in the U.S.A. when expressed as a percentage of total daily calories is estimated to be 15.8% of total energy intake and in Canada it is estimated to be 13% of total energy intake (2,8,12). The amount of sugars and syrups available for consumption has remained stable from 2006 to 2010 (13).

2.3 Sugar and Health

The effect of sugar, notably "added sugars" on human health has received a lot of attention. Consumption of sugar has been linked to the obesity epidemic, chronic diseases, micronutrient dilution of the diet, hyperactivity in children, and dental caries.

2.3.1 Overweight & Obesity

Social, psychological, genetic, and environmental factors play a role in weight gain (14,15). In 2007, 15.5% of Canadians were obese compared to 14.1% in 2000-2001 (16). The increase in the prevalence of obesity has sparked interest in the composition of our diet, and with it, opposing views on the role of dietary sugars and whether they contribute to a positive energy balance. Positive energy balance results in weight gain but knowledge on precise causal food-related determinants of weight gain is lacking (14).

Different methods have been used to measure obesity. Body Mass Index (BMI) is most often used however, weight gain over time, and body fatness are also popular measures of obesity. Differences in study design and the variables measured when investigating sugars intake and obesity have contributed to varying results. Recent systematic reviews and meta-analysis of the literature have reached different conclusions on the role of sugar on obesity although many of the same studies were reviewed (15,17-25). Difficulties exist in the interpretation of research on obesity because methodological issues like design (cross-sectional, longitudinal, or experimental), small sample sizes, short duration, lack of repeated measures in dietary exposures and outcomes, measures of body weight, and confounding dietary and lifestyle factors decrease the strength of the findings and make it hard to compare results (19,20,23-25).

Many mechanisms have been explored to explain the relationship between food intake and weight gain. Consumption of sugar-sweetened beverages (SSB), the ratio of CHO in the diet, and the glycemic index (GI)/glycemic load (GL) of foods has been identified as possible factors contributing to weight gain.

Sugar Sweetened Beverages

Beverages containing added sugars such as juice and soft drinks are referred to as SSB. Researchers often use SSB consumption as a measure of added sugars. A large contributor to added sugars intake is from SSB, contributing approximately 8% to 9% of total energy intake in children and adults (25-28).

The satiety factor of foods and liquids plays a role in weight management. Some say that liquids may induce less satiety as compared to solid foods because of rapid transit of liquids through the stomach and intestines. This may lead to reduced stimulation of satiety signals, differences in the regulation of thirst and hunger, and lower cognitively perceived energy content (17,28-30). Conversely, short-term satiety has been found with the ingestion of liquids containing glucose prior to a meal (31). The evidence for the association between SSB, obesity, and satiety has also been found to be circumstantial and more research is needed to confirm the role of SSB contributing to excess energy intake (32).

The relationship between SSB intake body weight is inconsistent and depends on the method used to measure body fatness. Some have found an association between SSB consumption and measures of body weight in children, adolescents, and adults (19,24,25,33-38). However, when total energy was controlled an association was not found between SSB consumption and body weight (39,40-42), fat-free mass (43), or physical activity (43). Limitations in the current science base have been discussed as a reason for not finding an

association between SSB consumption and body weight (15,23,44-46). However, those that have found a statistically significant effect for the association between SSB and obesity have results that were small in magnitude (15). Currently insufficient evidence from randomized controlled trials (RCTs) of sufficient size and duration, and without a large proportion of studies reporting statistically significant results, it is difficult to make conclusions over the long term (18,20,25).

Ratio and GL/GI of CHO

The evidence supporting a relationship between the ratio of fat to CHO and weight regulation is strong. Low fat diets (high CHO) have resulted in modest but significant decreases in body weight and fatness over the long-term while changing the type of CHO (simple or complex) in the diet did not cause a significant increase in weight change and no adverse effects on blood lipids occurred (47). Without energy restriction modest weight loss has been possible following an ad labitum low fat diet (48). There is some evidence that low CHO diet (high fat, high energy intake) promote obesity (49). Among healthy free-living adults, those consuming a low CHO diet of less than 47% total energy had a greater likelihood of being overweight or obese, while the lowest risk was found consuming a diet with 47% to 64% of total energy from CHO (50).

Those that have explored the quantity (GL) and quality (GI) of CHOs have found an inverse relationship between CHO intake and BMI (48). GL and BMI were also inversely associated even when adjusted for total energy intake (48). However, the role of CHO quality (GI) in relation to BMI has shown mixed results (48). Complex CHOs like whole-grains, but not refined grains, have been shown to be associated with lower BMI (48). A diet high in CHO has been found to be associated with a higher fiber intake and greater overall diet quality with cereal

fiber especially playing an important role in a lower BMI, and reduced risk of type 2 Diabetes Mellitus (DM) and cardiovascular disease (48).

In conclusion the current literature is undecided on the link between sugar consumption and weight gain. Total energy consumption and physical activity may be better predictors of weight gain than looking specifically at consumption of sugars.

2.3.2 Chronic Diseases

Consuming too much sugar has been reported to increase the risk of developing some chronic diseases notably diabetes mellitus (DM), certain types of cardiovascular diseases, and some types of cancer.

Diabetes Mellitus (DM)

DM is the world's fourth leading cause of death and it affects an estimated 246 million people globally (51). Type 1 DM is usually diagnosed in children and adolescents and occurs when the pancreas is unable to produce insulin, a hormone that controls the amount of glucose in the blood and daily injections of insulin are necessary (43). Ten percent (10%) of the people with diabetes have Type 1 while the other 90% have Type 2 DM. Type 2 DM usually develops in adulthood, although an increasing number of children in high-risk populations are being diagnosed with Type 2 DM (43). This type of DM occurs when the pancreas does not produce enough insulin or when the body does not effectively use the insulin that is produced (43). Diet, in particular the amount of CHO, plays an important role in the management DM.

A diet with a large proportion of added sugars has long been proposed to be a factor in the development of DM but the research outcomes are inconclusive. To date research has not demonstrated an obvious relationship between the intake of total simple CHOs and glycaemic

control, or risk to develop Type 2 DM, and specific evidence is missing in terms of sucrose effects on diabetes (52). The Canadian Diabetes Association and the American Diabetes Association both recommend that the total amount of carbohydrate is more important than source or type (51-53). No association has been found between total intake of grains and Type 2 DM although wholegrain consumption appears to have a protective effect (54-56) with dietary fiber playing a major role (54).

A relationship between GL and Type 2 DM is seen with both the low and high end of the intake distribution (54,57). A high GI was also found to be associated with an increased risk of type 2 DM (54,58). SSB consumption has been associated with a greater magnitude of weight gain and an increased risk for the development of Type 2 DM (59). However, an association was not found between sucrose intake and risk of DM (60) and a relationship was not found between GI or GL and Type 2 DM (61). To date the research has produced varying results on the role of GL and GI and risk of DM. Adequate dietary fiber intake and body weight regulation may play a more important role in decreasing the risk than either the quantity or quality of CHO in the diet.

Cardiovascular Disease

A high CHO, low fat diet has been recommended to those with cardiovascular disease but the GL and GI of CHO in the diet has also been investigated as a contributor to cardiovascular disease. The mechanism as to how this occurs is a high CHO (above 65%), low fat intake tends to increase plasma triacylglycerol and decrease HDL cholesterol concentrations especially when sugar intake is increased (62,63). This was the criterion for the upper limit for CHO Acceptable Macronutrient Distribution Range (AMDR) set by the Institute of Medicine (IOM) (62). Fructose is a concern because it contributes to hyper-triacylglycerolemia more than glucose or

starches because it is a better substrate for de novo lipogenesis because it enters the glycolysis cycle past phosphofructokinase by-passing this regulatory step (62).

The effects of GI and GL on blood lipids have varying results. An inverse association between fasting high density lipoprotein (HDL) cholesterol concentrations and dietary GI has been found (64-67), but limited or weak evidence of an inverse relationship between GI and total cholesterol, and GI on low density lipoprotein (LDL) and HDL cholesterol, triglycerides, fasting glucose, and insulin (64,68). A high sucrose, low fat, low energy diet did not adversely affect weight loss, metabolism, or plasma lipids (69). However, low GI diets changed total and LDL cholesterol concentrations but no difference of a low or high GI diet on HDL cholesterol (64,70). Results within the published literature vary so no definitive conclusions can be made on the relationship between CHO, or added sugars intake, and cardiovascular disease.

Cancer

The role of sugars in the development of certain types of cancer is likely to be indirectly related to body weight. Obesity related cancers and the dietary factors associated with obesity contribute to increasing the risk of developing certain types of cancer (54,71). The evidence linking high intakes of sucrose to colorectal cancer has been inconclusive, however the consumption of dietary fiber seems to have a protective effect against the development of colorectal cancer (24,54,71). Pancreatic cancer has been linked to hyperglycemia and hyperinsulinemia (72). Obesity and Type 2 DM increases the risk for this type of cancer possibly due to abnormal glucose tolerance and insulin resistance (72). However, an association was not found for added sugar consumption and risk for pancreatic cancer as evidence was inconclusive (72). Lactose intake and ovarian cancer have also been linked but the evidence was inconclusive (46,63).

There is uncertainty about contribution of added sugars to chronic diseases. More research is needed in these areas to come to definitive conclusions about the role added sugars play in DM, cardiovascular disease, and cancer.

2.3.3 Micronutrient Dilution

Sugar contributes energy to the diet but not micronutrients and the consumption of sugary foods is thought by some to be 'empty calories' and to effect micronutrient intakes. The concern over various micronutrients has led to examination of free sugars intake below 10% or greater that 25% of total energy. The difference in classifications of dietary sugars has made it difficult to make meaningful comparisons between studies (73,74).

Children, adolescents, and adults have lower intake of some micronutrients when consumption of free sugars is high (17,75-79). Associated with this is lower intake of fiber (77) and fruit and vegetables (76). Conversely, micronutrient deficiencies do not always occur when consumption of free sugars is high (73,80,81). An association of added sugars to vitamins, minerals, and food group servings in the USDA Food Guide Pyramid ranged from no association to a very small, but still statistically significant, positive or negative association depending on the outcome variable and age group (72). Inconsistencies were found and those statistically significant associations were so small it would be unlikely to have clinical relevance (72). The Dietary Reference Intakes (DRI) committee reports that although there is insufficient evidence to set a Tolerable Upper Intake Level (UL) for total or added sugars, they suggest a maximal intake of 25% or less of energy from added sugars based on the decreased intake of some micronutrients of American subpopulations exceeding this level (62). However, when micronutrient dilution did occur, it was usually in those who consumed very low energy intake

and energy was inadequate (73). When the impact of added sugars on micronutrient intakes was examined a modest effect overall was found (82).

In conclusion micronutrient dilution is more likely to occur when intakes of added sugars are extremely low when adequate micronutrient intake would be difficult to achieve. A diet high in added sugars alone would be difficult because the extreme taste of sugar limits how much is consumed.

2.3.4 Hyperactivity

Intake of added sugars has long been associated with behavioural problems in children. This is based on two theories; the first being an allergic reaction to refined sugar and the second a hypoglycaemic response (62,83). A hypoglycaemic response is thought to cause increased motor activity in children (83). There is conflicting evidence on the affect of sugars consumption on children's behaviour (84). Negative attributes such as hyperactivity, decreased attention span, and decreased cognitive performance in children was not evident in a meta-analysis (83,85). There are children who exhibit hyperactive behaviour; however, the change in behaviour could be a reaction to their surroundings or belief from parents expecting the change (85). In this case the behaviour caused the increased sugar intake rather than the opposite (83). Dietary differences between hyperactive and non-hyperactive boys have been explored but no difference in eating habits was found (86). Within both populations there appear to be some who exhibit individual sensitivities or reactions to food substances that may cause changes in behaviour and cognition (86). To date there is insufficient evidence to say that sugar intake has a negative impact on behaviour or cognitive performance in children and the DRI committee did

not find enough evidence to set a UL for sugar using altered behaviour as the endpoint criterion (62).

2.3.5 Dental Caries

Dietary sugars play a role in the incidence of dental caries. The breakdown of sucrose contributes to dental caries by feeding the microbes responsible for the formation of dental plaque, that serves as a reservoir enabling the plaque bacteria to adhere to the enamel surface, producing acids that wear away enamel (87-89). "The development of caries requires sugars and bacteria to occur but is influenced by the susceptibility of the tooth, the bacterial profile, quantity and quality of the saliva, and the time for which fermentable dietary carbohydrates are available for bacterial fermentation" (89). Although a positive, significant relationship of sugar quantity to dental caries has been found, there is not enough research to demonstrate a relationship but there is enough research to show a moderately significant relationship of sugar frequency to dental caries (87). High intakes of added sugars have been shown to increase the rate of caries in adults, adolescents, and children (90). However advances in oral health care and fluoridated drinking water and toothpaste have mitigated the impact of sugars intake on dental decay (84,90). Dental caries are preventable with proper oral hygiene however some people are more susceptible to caries due to saliva chemistry, enamel, and tooth make up.

Conclusion

The effect of sugars on health is controversial however the DRI committee has not found definitive conclusions to set a UL for sugar intake based on the notion of adverse health effects.

2.4 Dietary Guidelines for Intake of Total and Added Sugars:

Canada currently does not have dietary guidelines. The guidelines that would directly influence Canadian's food choices would be the joint guidelines published by the Institute of Medicine (IOM), the USDA, and Health Canada. The World Health Organization (WHO)/Food and Agriculture Organization (FAO) also produce dietary guidelines that may influence Canadian's food choices. Professional organizations make recommendations on intake of various macro and micronutrients in their respective dietary statements.

2.4.1 USDA/IOM/Health Canada Guidelines

The IOM (2002) established a Recommended Dietary Allowance (RDA) for CHOs of 130 grams per day for adults and children (91). This is based on the amount of sugar and starch required to supply the brain with adequate glucose to function and allows muscles to work under anaerobic conditions by supplying adequate muscle glycogen (91). The IOM's AMDR for CHOs is set at 45-65% of total calories (91). The DRI for added sugars intake was set at no more than 25% of total calories using the risk of micronutrient dilution as the end-point criterion (91). Based on U.S.A. data the median intake of CHO is approximately 220-330 grams per day for men and 180-230 grams per day for women, which is higher than the RDA but in order to meet energy needs while consuming acceptable intake levels of fat and protein an intake of CHO above 130 grams per day is necessary and is within the AMDR for CHO (91). A UL refers to the highest level of nutrient intake that is likely to pose no risk of adverse health effects for almost all individuals in the general population (91). A UL was not set for added sugars intake,

indicating a lack of evidence for adverse health effects of consuming added sugars above the recommended intake of 25% of total energy.

2.4.2 WHO/FAO Guidelines

In 2005, the WHO and FAO, carried out a Scientific Update, on key issues related to CHOs in human nutrition (92). The key issues identified were terminology and classification, measurement, physiology, CHOs and diseases (obesity, diabetes mellitus, cardiovascular diseases and cancer), and GI and GL (93). Specifically looking at the guidelines for sugar, the outcomes of the Scientific Update support the population nutrient intake goals on free sugars, that is, < 10% of total energy, that were recommended by the 2002 WHO/FAO Expert Consultation (4,5). This indicates that the research done between 2002 and 2005 did not show cause for change in the recommended intake of free sugars.

The suggested intake for free sugars is based on maximizing the intake of minimally processed CHOs and minimizing the intake of free sugars (92). At least 55% of energy from CHO from a variety of sources is recommended or 138 grams per 1000 kilocalories (92,93), which translates into an intake of 276 grams of CHO per day from a 2000 kcal diet. A 2000 kcal diet is the mean daily consumption by adults in the U.S.A. (1). They also recommend that beyond the minimum amount of 50 grams per day of CHO needed for adults to avoid ketosis, energy needs should be met by nutrient-dense CHO foods (93). It is recommended that excessive intakes of sugars should be avoided so that micronutrient density is not compromised (93). They report no evidence of a direct involvement of sucrose, other sugars and starch in the etiology of lifestyle-related diseases (93).

The variation between recommended intakes for added sugars is quite large, i.e., <10% versus <25% of total energy. Both recommendations are based on micronutrient dilution although the evidence for micronutrient dilution is unclear and could occur with both high and low levels of added sugars. It may be hard to meet the WHO/FAO recommendation of less than 10% of energy from added sugars while still meeting the recommended intake having at least 55% from CHO. The WHO/FAO recommendation of 55% falls within the AMDR of 45% to 65% recommended by the IOM but the RDA of 130 grams per day of CHO recommended by the IOM is 2.5 times more than the 50 grams per day recommended by the WHO/FAO. CHO food choice would need to be high quality whole foods to meet the WHO/FAO CHO goals while consuming less than 10% as added sugars.

2.4.3 Practical Tools

Practical tools available to consumers such as Eating Well with Canada's Food Guide (new version released in 2007), My Pyramid (new version released in 2008) and its replacement, My Plate (released in 2011) in the U.S.A. have been developed to guide food choice that is consistent with the DRI recommendations. Revisions have been made over the years to reflect changes in nutrition research.

Canada's Food Guide has revised the "other foods" category present in the 1992 version (previous version). It now includes a directional statement to help Canadian's choose foods to achieve and maintain a healthy body weight (94). The "other foods" category recognized foods and beverages that did not fit into the four food groups and were high in fat and/or sugar and/or sodium. It was recommended that consumption of these foods was to be limited. Examples of "other foods" are cookies, cakes, chips, and other snack or processed foods. The directional

statement in the new (2007) version states, “limit foods and beverages high in calories, fat, sugar, or salt (sodium) (2,94).

The DRI report does not specifically say that sugars need to be limited, only that they should not exceed 25% energy intake (91). Current intakes of added sugars in Canada are around 12 to 13% of energy intake (2), which is within the guidelines therefore the statements saying to limit foods with added sugars, is not supported by the evidence and recommendations in the DRI report on CHO.

The USDA equivalent food guide, MyPyramid, used the terms “essential” calories and “discretionary” calories. The recommendation was to eat foods that are nutrient dense, low-energy, lean, or low-fat forms of food without any added sugars (95). “Discretionary” calories are what are left over after the “essential” calories are consumed to meet recommended nutrient intake (95). They are also referred to as “added sugars or fat”, “extras”, or “luxury” foods (95). These statements are not consistent with the DRI report on CHO and the current added sugars intake in the U.S.A. is approximately 16% (2), which again is within the DRI recommendations. My Plate has a ‘foods to reduce’ section that makes the statement to drink water instead of sugary drinks (96).

2.5 Professional Organizations

Directional statements and recommendations on diet are made by professional organizations to help the public make healthy food choices to avoid chronic disease. Dietitians of Canada and the American Dietetic Association support the use of the Food Guide and My Pryamid or My Plate respectively for Canadians and Americans to make healthy food choices (97,98).

2.5.1 Diabetes

The Canadian Diabetes Association and the American Diabetes Association provide information on sugar consumption for those with diabetes. Both report that the total amount of carbohydrate and the rate of digestion are more important to blood glucose levels than the type of carbohydrate consumed; therefore, sugar can be consumed as part of a health diet for people with diabetes (51,53). This recommendation is supported by the literature from the review of the role of added sugars role in risk of diabetes.

2.5.2 Cardiovascular Disease

The Heart and Stroke Foundation of Canada suggests that intake of simple carbohydrates be reduced or eliminated from the diet (99). They recommend following Eating Well with Canada's Food Guide and encourage vegetable, fruit, whole grains and legumes with an emphasis on fiber intake (99). They report that simple CHO are found in most baked good, soft drinks, sugary cereals, white bread and white rice and suggest that these foods break down quickly, and make you hungry sooner (99). They have linked simple CHO with trans fat containing food such as cookies, candy, chocolate bars, French fries, doughnuts, and pastries that are unhealthy for the heart (99).

The American Heart Association recommends limiting sugars intake to <10% of total energy and by minimizing the intake of beverages and foods with added sugars in the context of maintaining a healthy body weight (100).

2.5.3 Cancer

The Canadian Cancer Society cautions consumers to reduce consumption of foods high in sugars as a means to control body weight because being overweight can put you at a higher risk for certain cancers (101). The American Cancer Society also supports the maintenance of a healthy body weight using the guidance that the healthiest way to reduce calories is to reduce intake of added sugars, saturated and trans fat, and alcohol which provide a lot of calories but few or no essential nutrients (102).

Conclusion

A recommendation for sugar consumption as a portion of total energy intake is made by each professional organizations without having done an evidence-based analysis. Research has been inconclusive regarding the consumption of free sugars and without a UL set based on adverse health effects their concern over the consumption of sugars in unsupported in the current literature.

2.6 Perceptions of Healthy Eating and Diet Behaviour

Little is known about consumer perception of what constitutes a healthy diet (43). A review of the literature completed in 2005 looked at the perceptions of healthy eating to identify the state of the knowledge and research gaps (103). One of the fundamental elements of perceived healthy eating was a diet that is low in fat, salt, and sugar (103), which were the "three most frequently mentioned components of food to be avoided for a diet to be perceived as healthy in all age groups" (103). The Tracking Nutrition Trends (TNT) surveys, completed by

the Canadian Council of Food and Nutrition (formerly National Institute of Nutrition) over 20 years, have identified that sugar has become a more important concern over time (6).

The media have focused a lot of attention on sugars in the diet. The low-carbohydrate diet craze peaked in 2004 resulting in a lot of media attention about all carbohydrates, not just sugars, in the diet (104). From 2004 to 2007 there was an increase in media articles focused on the health benefits of low GI foods (103). The increase in attention is related to numerous scientific journal articles published on the potential benefits of a low-GI diet although there is not a strong scientific base to support the recommendation of a low-GI diet (104). High fructose corn syrup (HFCS) and SSB have also drawn a lot of media coverage beginning between 2002 and 2004 and then picking up again in 2007 when research studies associated HFCS and fructose with obesity (104). Within research and media tracking studies there appears to be an interconnection among nutrition research, dietary guidance, popular media articles, and consumer attitudes about sugars, health, and obesity (104).

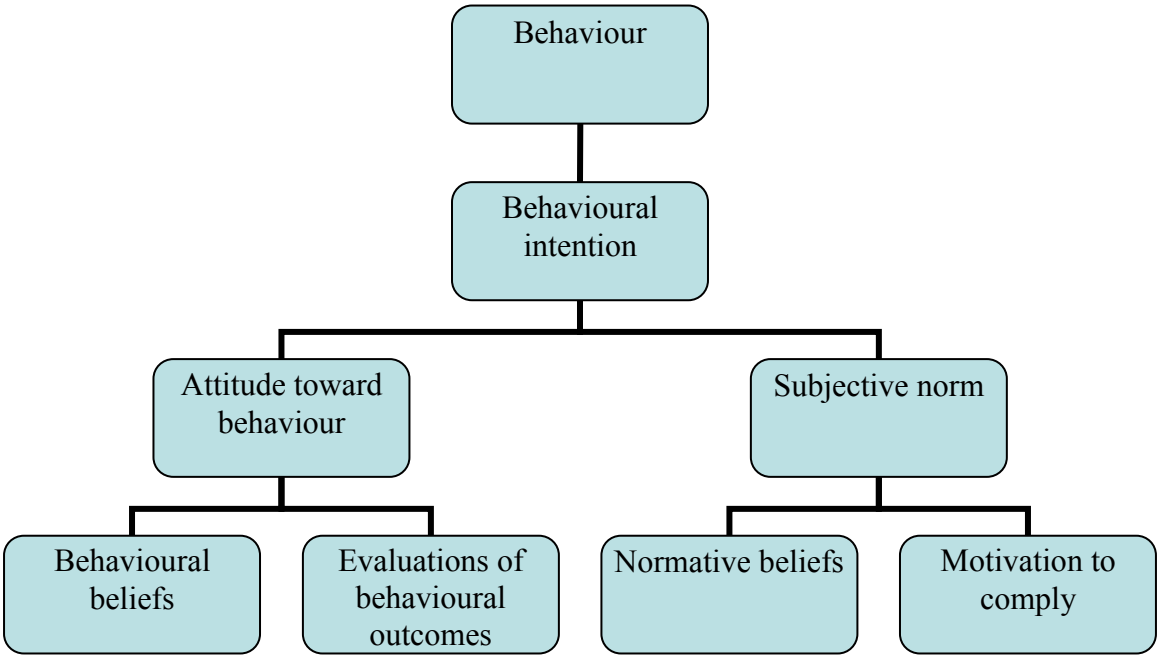
With the growth of nutrition related articles both on the Internet and in traditional sources, such as dietitian's columns in newspapers, access to information is readily available. In Canada, the use of the Internet as a source of food and nutrition information rose from 6% in 1997, to 51% in 2008 (6). In addition to it being a major source of information, 43% find the Internet to be a credible source of information (6). Advocacy groups such as the Center for Science in the Public Interest (CSPI) are also a key source of media stories on diet and health. The CSPI is a consumer advocacy organization whose twin missions are to conduct innovative research and advocacy programs in health and nutrition, and to provide consumers with current, useful information about their health and well-being (105).

2.7 Theoretical Framework

Many theories have been proposed to explain the complexity of food related behaviours. The Knowledge-Attitude-Behavior Model (KABM) assumes that new information about nutrition or health will lead to changes in attitudes, which in turn will result in improved dietary behavior or practices with the primary motivator being accumulation of knowledge (106,107). This model however does not explain the complex nature of behaviour or account for external influences.

The Theory of Reasoned Action (TRA) attempts to explain external influences on behaviour. This theory proposes that individual behaviour is driven by behavioural intentions, which are a function of attitude toward the behaviour and the subjective norms surrounding performance of the behaviour (108). Subjective norms are informed by the perception of whether the behaviour should be performed as interpreted through the actions/perceptions of a partner, family member or peer group. They are the beliefs about whether most people approve or disapprove of the behaviour (108). Attitude is shaped by the individual's beliefs about outcomes or attributes of performing the behavior (behavioral beliefs) weighted by evaluations of those outcomes or attributes
(108).

Figure 1. Model of the Theory of Reasoned Action (108)



The TRA has been popular in the field of consumer behaviour (109) and has been used successfully to predict and explain a wide range of health behaviours and intentions among others (108). Diet behaviours that the TRA has been used to predict include fat intake (110,111), salt intake (112), and milk consumption in women (113). The objective of this research was use the constructs of the Theory of Reasoned Action to explore the evolution of the relationship between knowledge, attitudes and behaviours of Canadian consumers toward dietary sugars, and to assess the key demographic predictors of sugar consumption attitudes and behaviours.

CHAPTER 3.0: METHODOLOGY

3.1 Background Information

The *Nutrition Information Service* of the Canadian Sugar Institute (CSI) is a national, non-profit organization whose role is to inform and educate Canadians about sugars and healthy eating, and to advocate for nutrition policies and recommendations that are based on reliable scientific research. They are also responsible for gathering information about Canadian opinions on sugar and disseminating that information to various opinion leaders (Ipsos ASI's Sugar Tracking Report, 2007). Since 1985, the CSI has been conducting research on tracking consumer behaviour, attitudes, and knowledge of sugar and sugar substitutes within the context of a number of health issues. The current wave of national tracking studies began in 1996 and was conducted in 1996, 1998, 2000, 2002, 2004, 2006, and 2007. Surveys were designed by the CSI and while some questions were added or removed from one survey year to the next a core group of questions were maintained throughout this wave of tracking. The advertising research company Ipsos ASI conducted all surveys on behalf of the CSI using the same methodology across survey years.

3.2 Research Design

3.2.1 Data Collection

Interviews were conducted by telephone, from Ipsos ASI's centralized interviewing facilities. All listed telephone numbers from within nine designated cities with populations over 100, 000 were randomized via a computer algorithm. In 2007, the most recent survey year, a total of 28, 141 calls were made in order to achieve 500 completed surveys. For 31% of all initial calls a viable contact was not reached for a variety of reasons, including no answer at the

number dialed and the number was not in service. Once a potential respondent answered the phone, 67% indicated at the point of initial contact, that they did not wish to participate in a survey. Other reasons for terminating contact with potential respondents include language difficulties, respondents not qualifying for the study, and respondent terminations part way through. Interviews lasted an average of 15 minutes and 45 seconds (Ipsos ASI's Sugar Tracking Report, 2007). See Appendix 1 for all call dispositions used by Ipsos ASI.

This research is based on the electronic data available for surveys completed in 1998, 2000, 2002, 2004, 2006, and 2007. The selected cities covered three regions including: Toronto, Ottawa, London (Ontario Region); Montreal, Quebec City, Sherbrooke (Quebec - French only Region); and Vancouver, Calgary, Winnipeg (Western Region). Sample size by year: 1998, n = 500; 2000, n = 300; 2002, n = 502; 2004, n = 553; 2006, n = 304; 2007, n = 500. A sampling error occurred in 2006, where interviews were conducted in all cities with a population over 100 000, rather than just within the nine designated cities. The sample size was therefore 304 after removing respondents residing in the non-designated cities. The survey was then repeated in 2007 to obtain the targeted sample size of 500 respondents. In 2000, a shorter version of the 1998 survey framework was conducted, which focused on low-carbohydrate diets, an emerging trend at that time. The sample size was also smaller in 2000, with only 300 respondents; however reasons for this are unknown as the report for the survey year did not specify if a sampling error had occurred. The methodology and timing of the fieldwork was consistent for all survey years. Research was conducted between September 24th and October 8th for trending purposes. Prior to production of final tabulations weighting adjustments were made based on latest Statistics Canada census data. This was done to reflect regional proportions and to

accurately proportion the population of each region's one million plus market versus smaller markets.

3.2.2 Sample

The sample was 80% female and 20% male respondents. Prior to 1996, tracking studies included only female respondents as they were the primary grocery shopper in the household however with traditional male and female roles changing the current tracking studies included 20% male respondents. Eligible participants had to be between the ages of 18 and 64 years of age. Potential subjects were excluded if they had a chronic disease that would impact on dietary intake. For example, subjects were excluded if they were diagnosed with the following medical conditions; heart or kidney ailments, diabetes, or muscular dystrophy. Also, potential subjects were not eligible if they were associated with various specified occupations such as a food manufacturer, food retailer, worked for a television or radio station, a newspaper or magazine, an advertising agency, or a marketing research company. This information was asked by the interviewer before administering the questionnaire.

3.2.3 Survey Tool

Table 1. Collaboration of questions from all questionnaire years

1a **1b**	I'd like to begin by asking you which food or drink products, if any, you personally consider particularly good for you? Could you tell me which food or drink products, if any, you personally consider particularly bad for you?
2	Now I'm going to read you a list of common food ingredients. For each one, I would like you to tell me *how important you feel it is to limit the amount of that ingredient that you eat in order to maintain good health.* Please use a six-point scale with "6" meaning that you feel it is very important to limit the amount you eat, and "1" meaning that you feel it is not at all important. Of course, you may choose any number in between.

2.1	Fat
2.2	Salt
2.3	Sugar
2.4	Sugar substitutes such as Equal, Sugar Twin, Nutrasweet, Splenda
2.5	Butter
2.6	Food additives or preservatives
2.7	Carbohydrates
3	Thinking for a moment specifically about sugar, what are the positive things that you can think of to say about sugar?
4a	Thinking for a moment now about sugar substitutes, such as Equal, Nutrasweet, Sugar Twin, and Splenda, what are the positive things that you can think of to say about sugar substitutes?
4b	What are the negative things, if any, you can think of to say about sugar substitutes?
5a	Now please think of all the ways in which you consume sugar, both by itself and in other foods, compared to how sugar was used in your household three years ago. Would you say that, overall, consumption of sugar in your household today has increased, decreased or remained the same?
5b	Would you say that it increased/decreased by a lot or a little?
5c	What would you say are the reasons for this?
6a	And now please think about all the ways in which you consume sugar substitutes, such as Equal, Nutrasweet, Sugar Twin, or Splenda, both by themselves and in other foods, compared to how sugar substitutes were used in your household three years ago. Compared to today, would you say that, overall, use of sugar substitutes in your household has increased, decreased, or remained the same?
6b	Would you say that it increased/decreased by a lot or a little?
6c	What would you say are the reasons for this?
7	I am going to read a list of statements about sugars and sugar substitutes. Would you please tell me how much you agree or disagree with each statement. Would you say you agree completely, agree somewhat, neither agree nor disagree, disagree somewhat, or disagree completely that…?
7.1	Sugar provides a quick energy boost but is followed by a low energy level
7.2	Sugar causes obesity
7.3	If I use sugar substitutes I will lose weight
7.4	I can control my weight through diet
7.5	Foods labeled 'no added sugar' are much lower in calories than the same food without this label
7.6	Too much sugar can cause diabetes
7.7	I am concerned about the hidden sugar in prepared foods
7.8	Sugar is a good source of energy
7.9	I worry about the amount of sugar my family consumes
7.10	Sugar causes hyperactivity in children
7.11	Sugar is a carbohydrate
7.12	It's more important to look for labels about fat than labels about sugar
7.13	Poor dental hygiene will do far more damage to your teeth than will sugar
7.14	Sugar has half the calories of fat

7.15	The body uses sugar from the sugar bowl in the same way it uses sugar in fresh fruit
7.16	Brown sugar is better for you than white sugar
7.17	Foods labeled 'sugar-free' are also calorie free
7.18	Food labeled 'no added sugar' are better for you
7.19	I can control my weight through regular physical activity
7.20	Foods that are labeled 'low fat' are usually high in sugar
7.21	Soft drinks contribute to weight gain
8a	How many calories do you think there are in a level teaspoon of sugar?
8b	And how many calories do you think there are in an equivalent amount of butter?
8c	How many calories per day would you think would be in a balanced diet for you, yourself, I mean?
9	Now I am going to read a few more statements about sugar and sugar substitutes. Would you please tell me how much you agree or disagree with each statement. Would you say you agree completely, agree somewhat, neither agree nor disagree, disagree somewhat, or disagree completely that…?
9.1	Sugar provides empty calories
9.2	The sugar that comes in fruit is better than regular sugar
9.3	Sugar makes a wider variety of healthy foods acceptable to children and adults alike
9.4	Sugar substitutes contain harmful chemicals
9.5	Canadians eat too much sugar
9.6	Sugar is better for you than sugar substitutes
9.7	Sugar is part of healthy eating
9.8	Sugar is safe
9.9	Sugar has its place in a balanced diet
9.10	I think too much fuss is being made about the possible harmful effects of sugar
9.11	Sugar is a natural product
9.12	Sugar is a primary cause of tooth decay
9.13	Sugar tastes better than sugar substitutes
9.14	Foods labeled 'no added sugar' are sugar free
10a	Do you have any children at home who are 12 years of age or less?
10b	I am also interested in how you feel about sugar and sugar substitutes consumed by your children aged 12 or younger. As you did before, please tell me whether you agree completely, agree somewhat, neither agree nor disagree, disagree somewhat, or disagree completely with each of these statements.
10b1	I feel sugar is better for my children than sugar substitutes
10b2	My children become hyperactive after they have eaten or drunk products containing sugar
10b3	Sugar in moderation is all right for children
10b4	I am concerned about sugar causing cavities in my children's teeth
10b5	I am concerned about sugar causing my children to put on too much weight
11	These next items should be interesting, as they are about more general issues and your "life style". Again, please tell me if you agree completely, agree somewhat, neither agree nor disagree, disagree somewhat, or disagree completely with the following statements.

11.1	I try to eat natural foods most of the time
11.2	I make a point of choosing foods and beverages which contain little or no sugar
11.3	I eat a wide variety of foods in moderation so I don't have to worry about my sugar intake
11.4	Foods labeled "no added sugar" are better for you
12	Which of the following statements best describes your present situation? (one response only) a. I eat whatever I want and enjoy b. I watch what I eat for nutritional reasons but I'm not concerned about my weight c. I am watching the foods that I eat, because I am somewhat concerned about my weight, but I'm not actually on a specific weight reducing diet d. I am on a diet because I am actively trying to lose weight
13a	Which of these 3 statements do you most agree with? (one response only) a. I think sugar is basically good for you if eaten in moderation and should be included in your diet b. I don't think sugar is particularly good for you, but it doesn't do much harm eaten in moderation c. I think sugar is basically bad for you and should be avoided as much as possible
13b	And thinking about 'low-carbohydrate' diets, please tell me if you agree completely, agree somewhat, neither agree nor disagree, disagree somewhat, or disagree completely with the following statements as they relate to your understanding and perceptions of 'low-carbohydrate' diets.
13b1	Low-carbohydrate diets can be followed for an extended period of time
13b2	Low-carbohydrate diets are effective for losing weight
13b3	Low-carbohydrate diets will help people lose weight and keep it off
13b4	The principles of low-carbohydrate diets are consistent with your understanding of healthy eating
13b5	Low-carbohydrate diets are just a fad that will soon pass
13b6	Your attitudes toward sugar have changed since you became aware of low-carbohydrate diets
13b7	You have been reducing the amount of sugar you consume since you became aware of low-carbohydrate diets
18	And one final question on sugar. To help Canadians make healthy food choices, the government publishes Canada's Food Guide to Healthy Eating. Which of the following statements <u>best</u> describes the information in Canada's Food Guide about sugar? a. The use of sugar should be limited to reduce the risk of health problems b. Canadians should carefully monitor their use of sugar to avoid unnecessary calories c. Sugar is acceptable in moderation because it adds taste and enjoyment to a wide variety of foods d. Canada's Food Guide does not mention sugar
19a	Have you ever used the internet to seek out nutrition information for yourself or your household? Yes/No

19b	How likely are you to use the internet in the future, to seek out nutrition information for yourself or your family? Would you say you… a. Definitely will use the internet b. Probably will use the internet c. Might or might not use the internet d. Probably will not use the internet e. e. Definitely will not use the internet
98	Are you aware of any diets intended to help you lose weight, that are designed on the principle of reducing your carbohydrate intake. Yes/No
99a **99b**	I am going to read a list of different weight loss diet plans. Please tell me if you had ever heard of any of these diets before today, or not? And have you ever tried? 1. Sugar Busters! Cut Sugar to Trim Fat 2. Dr. Atkins' New Diet Revolution 3. The Carbohydrate Addict's Diet 4. Protein Power 5. Enter the Zone 6. Get Skinny on Fabulous Foods by Suzanne Somers 7. "Eat yourself Slim" by Michel Montignac 8. The Schwarzbein Principle

Red italicized questions are those included in the most recent questionnaire (2007). See Appendix 2 for the 2007 survey tool used by Ipsos ASI.

3.3 Ethical Considerations

The CSI has given consent to handle the data for the purposes of this research. Storage of the data is on a password protected computer and confidentiality will be maintained. Ipsos ASI obtained informed consent at the time the surveys were administered. All identification was removed prior to gaining access to the data therefore, the identities of the individuals have been kept confidential and private from our eyes and there is no way to identify responses or participation in the study with any individual. Information obtained from analyzing these data will in no way harm those individuals nor can it be traced back to them. Survey results will be kept for five years and after that point it will be destroyed. Ethical approval was provided by the

University Ethics Review Board of Mount Saint Vincent University (MSVU). See Appendix 3 for the MSVU Ethics Review Form.

3.4 Data Analysis

Since we did not have background information on how the questionnaire was originally constructed, the first step in the analysis was to assess internal consistency of the survey tool. The next step was to develop index scores as a measure of knowledge, attitudes and behaviours. The final step of the analysis used the index scores as continuous/dichotomous variables in multivariant/logistic regression to determine changes over time and to assess the key predictors of sugars consumption behaviour of Canadians.

3.4.1 Internal Consistency and Factor Analysis

Internal consistency was assessed using Crombach's alpha (α) with an acceptable alpha value between 0.6 and 0.8 (114). These cut-off values are based on the assumption that an alpha value above 0.8 indicates that responses of participants are too similar while an alpha value below 0.6 indicates that the response pattern is too random to be meaningful. Using the 51 questions included in the 1998 questionnaire as a reference point, the Crombach's alpha value was 0.617 indicating an acceptable level of internal consistency among respondents. A similar level of internal consistency was achieved in the questionnaires used in subsequent years. Open-ended questions were not included in the reliability analysis because the responses cannot be coded quantitatively (115). Reverse coding for questions framed to yield a negative response decreased the Crombach's alpha value suggesting that participants were not responding to the negative wording so this was not applied in the final analysis.

Table 2. Questions included in index scoring by questionnaire year

Index /domain grouping	1998	2000	2002	2004	2006/07
A	2.1	2.1	2.1	2.1	2.1
A	2.2	2.2	2.2	2.2	2.2
A	2.3	2.3	2.3	2.3	2.3
A	2.4	2.4	2.4	2.4	2.4
A	2.5	2.5	2.5	2.5	2.5
A	2.6	2.6	2.6		
A		2.7	2.7		
B	5a	5a	5a	5a	5a
B	6a	6a	6a	6a	6a
A	7.1		7.1		
A	7.2	7.2	7.2	7.2	7.2
A	7.3	7.3	7.3	7.3	7.3
A	7.4	7.4	7.4	7.4	7.4
K	7.5				
A	7.6	7.6	7.6	7.6	7.6
A	7.7				
K	7.8		7.8	7.8	7.8
A	7.9		7.9	NA	
A	7.10	7.10	7.10	7.10	7.10
K	7.11	7.11	7.11	7.11	7.11
A	7.12	7.12	7.12	7.12	7.12
K	7.13		7.13		
K	7.14	7.14	7.14	7.14	7.14
K	7.15		7.15		
A	7.16				
K	7.17				
K		7.18	7.18	7.18	7.18
A			7.19	7.19	7.19
K			7.20		
A			7.21	7.21	7.21
A	9.1	9.1	9.1	9.1	9.1
A	9.2	9.2	9.2	NA	
A	9.3		9.3	NA	
A	9.4		9.4	NA	
A	9.5	9.5	9.5	9.5	9.5
A	9.6	9.6	9.6	9.6	9.6
A	9.7	9.7	9.7	9.7	9.7
A	9.8	9.8	9.8	NA	

K	9.9	9.9	9.9	9.9	9.9
A	9.10				
K	9.11		9.11	9.11	9.11
K	9.12	9.12	9.12	9.12	9.12
A	9.13		9.13	9.13	9.13
K	9.14				
A	10b1		10b1	10b1	10b1
A	10b2				
A	10b3		10b3	NA	
A	10b4				
A	10b5	10b5	10b5	10b5	10b5
B	11.1				
B	11.2	11.2	11.2	11.2	11.2
B	11.3				
A	11.4				
B	12	12	12	12	12
A	13a	13a	13a	13a	13a
K		13b1			
A		13b2		13b2	13b2
A		13b3		13b3	13b3
K		13b4			
A		13b5		NA	
A		13b6			
B		13b7			
K	18c		18c	18c	18c

A=Attitude; B=Behaviour; K=Knowledge

Factor analysis with varimax rotation with removal of items with a correlation of <0.35 (116), was used to determine the thematic constructs embedded in the attitudinal questions (Table 3). The emerging themes were: (1) importance of limiting food ingredients; (2) negative associations of sugar consumption; (3) general attitudes towards sugar consumption; (4) positive associations of sugar consumption; and (5) controlling weight though diet. It is important to note that Question 10b1 through 10b5 that asked about sugars consumption in children had a poor response rate. These questions remained in the analysis as it was felt that refusing to answer, or not knowing the answer, was still a relevant response and it may indicate that respondents need more knowledge or direction on acceptable sugar consumption for their children.

Table 3. Five Factor Analysis – Attitude Variables

Factors	1998	2000	2002	2004	2006	2007
Limiting food ingredients	2.1,2.2,2.3,2.5,2.6	2.1,2.2,2.3,2.4,2.5, 2.6	2.1,2.2,2.3 ,2.4,2.5, 2.6	2.1,2.2,2.3, 2.4,2.5	2.1,2.2, 2.3,2.4, 2.5	2.1,2.2,2.3
Negative association of sugar consumption	10b1,10b2,10b3, 10b4,10b5	9.7,9.8, 13a	10b1,10b3 ,10b5	10b1,10b5	10b1, 10b5	10b1,10b5
General attitudes to sugar consumption	7.9,7.12, 9.3,9.6,9.7,9.8,9.10,13a	2.7,7.2,7.3,7.6,7.10 ,10b5	7.2,7.4,7.6 ,7.9,7.10, 7.12,7.19, 7.21	7.2,7.3,7.4,7.6,7.10 ,7.19, 7.21	7.2,7.6, 7.10, 7.21,9.1, 9.5,13a	7.2,7.6, 7.10,7.21, 9.1,9.5, 13a
Positive association of sugar consumption	2.4,7.10, 7.16,9.1, 9.2,9.4,9.5,9.13	9.6,13b2, 13b3,13b5,13b6	9.3,9.7,9.8 ,13a	13b2,13b3	13b2,13b3	7.3,7.4, 7.12,7.19, 13b2,13b3
Controlling weight through diet	7.2,7.3,7.4	7.12,9.2, 9.5	9.1,9.4,9.5 ,9.6,9.13	9.6,9.7, 9.13,13a	7.3,9.6, 9.7,9.13	2.4,9.6,9.7,9.13
Removed	7.1,7.6, 7.7,11.4	7.4,9.1	2.7,7.1,7.3 ,9.2	7.12,9.1,9 .5	7.4,7.12, 7.19	2.5

3.4.2 Index Scores

To develop the index scores, questions were grouped into domains corresponding to knowledge, attitude, and behaviour. The first column of Table 2 shows the grouping of questions for each domain identified as knowledge (K), attitude (A) and behaviour (B). Attitudinal questions were differentiated from knowledge questions by the way the question was worded (117). For example, if a comparison was being made it was labeled an attitude question because it was eliciting personal opinion. On the other hand, if the question used "is a" or "has" in the wording, it was labeled as a knowledge question because it was assessing the persons knowledge or awareness about a particular attribute of dietary sugars (115). If a question asked about consumption of dietary sugars or dieting behaviour it was labeled as a behaviour question.

Questions were removed from index scoring if the question was open-ended because the responses could not be coded quantitatively.

Participants provided answers using a five or six point Likert scale ranging from completely disagree to completely agree. Separate index scores were developed for knowledge, attitude and behavioural domains along a continuum of responses: attitudes were scored as positive, neutral or negative; knowledge was scored as low, average or high; and behaviours were scored as favourable, neutral or unfavourable. Attitude was rated as positive if a respondent answered positively towards dietary sugars consumption; knowledge was rated high by a correct response; and behaviour was rated as favourable if a respondent was likely to consume dietary sugars.

In order to assign a numerical value to the index score, a value of three, two, or one was applied respectively to each category of attitude, knowledge, and behaviour. For example, if a participant answered completely agree and somewhat agree to a knowledge question and this was the correct response, the reply was coded as a three. If the respondent gave a neutral answer, neither agree nor disagree, the reply was coded with a two. If the respondent answered somewhat disagree or completely disagree and this was an incorrect response, the reply was coded with a value of one. If the respondent refused to answer or did not know the answer it was coded with a value of nine, which was subsequently coded as a neutral value of two since the respondent did not 'guess' and this was a conservative option that would not influence the score (118). The scores to each question were summed to provide a final index score. Because the number of questions in each domain differed by year, the total index score was scaled in proportion to the year with the fewest questions. The highest possible knowledge, attitude and behaviour scores were 21, 69, and 12 respectively.

3.4.3 Socio-demographic Variables

Table 4 shows the socio-demographic characteristics of survey participants. Categories were collapsed to make groups that were approximately equal in size. The category with the largest number of respondents before categories were collapsed was identified as the reference category, except for age, education level, and household size. For these categories the middle age category was chosen, having a high school education was considered as the standard level of education, and a four person household was considered the standard family size.

Table 4. Socio-demographic characteristics of survey participants

Variable	**Categories**	**n**	**Percent (%)**
Gender	Female*	2124	79.8
	Male	536	20.2
Employment Status	Employed*	1911	71.8
	Unemployed	744	28.2
Children aged 12 and under in household	Yes	920	34.6
	No*	1740	65.4
Household size	1 person	372	14.0
	2 people	800	30.1
	3 people	575	21.6
	4 people*	590	22.2
	5 or more people	317	11.9
Education level	< Grade 12	165	6.2
	High school graduate*	558	21.0
	Any college	752	28.3
	Any university	1162	43.7
Income level	Low - <$30,000	430	16.2
	Middle - $30,000 – 59,999	667	25.1
	High - >$60,000*	966	36.3
Age	18-34 years	836	31.4
	35-44 years*	802	30.2
	> 45 years	1022	38.4
Region	English Canada*	1838	69.1

	Quebec	822	30.9
Year	1998*	500	18.8
	2000	301	11.3
	2002	502	18.9
	2004	553	20.8
	2006	304	11.4
	2007	500	18.8

* Reference category

3.4.4 Statistical analysis

Total behaviour, knowledge, and attitude scores were calculated for each survey year then scaled to a value out of 12, 21, and 69 respectively for each domain. The questionnaire results by year were merged into one dataset. Data analysis included descriptive statistics with median, mean and standard deviation, tests for normality, Tukey's multiple range T tests, Analysis of Variance (ANOVA), linear regression and logistic regression using SPSS (Version 15, 2006, New Jersey, U.S.A.) ($p<0.05$) (119). The Enter, Forward, Backward, and Stepwise selection methods were used, starting with all predictor variables in the model. Non-significant predictor variables were removed one at a time until the model included only those variables that were statistically significant. For the socio-demographic variables, each category, with the exception of the reference category, was included in the model. For linear regression, the behaviour and attitude scores were treated as continuous variables using the scaled values. For logistic regression dummy variables were created. This was done by dichotomizing the behaviour and attitude domains into unfavourable/favourable behaviour and poor/positive attitude. The median values of the scaled scores were used to dichotomize.

CHAPTER 4.0: RESULTS

4.1 The Questionnaire

The first step in the analysis was to assess the internal reliability and thematic constructs contained in the questionnaire. For this the 1998 survey year was used as the reference. This step was done for two reasons. First, we had no background information on what the original intent was or how the questionnaire was originally constructed. Second, the number of questions has changed over the years with questions being both added and removed. Internal reliability tests were satisfactory and remained relatively consistent across survey years suggesting the questionnaire is performing as intended. Five thematic constructs were identified within the attitudinal questions asked in the questionnaire in 1998 and these remained intact in the most recent (2006/2007) version of the questionnaire. Open ended questions were not included in the analysis because they could not be coded. This is not to imply that the information is not useful, just that it did not fit the intent of the analysis conducted. The CSI removed the open ended questions in the 2006/07 questionnaires suggesting these questions did not provide information that would be of value to them moving forward. The only open ended questions that remain in the 2006/07 questionnaire are the questions that ask about the calorie content of sugar, butter, and a balanced diet. Rewording these questions so they could be answered on a Likert scale would allow for them to be included in the index scoring in the future.

4.2 Index Scores

The development of index scores for knowledge, attitude, and behaviour provided a summary measure and allowed for the construction of continuous and categorical variables,

which were then used in more complex regression analysis to show relationships between predictor variables.

The distribution of scores was normal in each year of the knowledge and attitude domains. The mean and median values were equal or almost equal to one another and therefore the mean values were reported. Within the behavioural domain the mean and median were not equal in 1998, 2000, 2004, and 2007. In these years the distributions were slightly skewed. The distribution was positively skewed in 1998 (Median, 9.3), negatively skewed in 2000 (Median, 8.0), positively skewed in 2004 (Median, 8.0), and positively skewed in 2007 (Median, 7.0). Median scores show a larger change in behaviour from 1998 to 2007. The median score was higher than the mean in 1998 and less than the mean in 2007. Mean scores were reported and will be discussed because they were the more conservative value.

Table 5. Changes in knowledge, attitude and behaviour index scores of Canadian consumers between 1998 and 2007

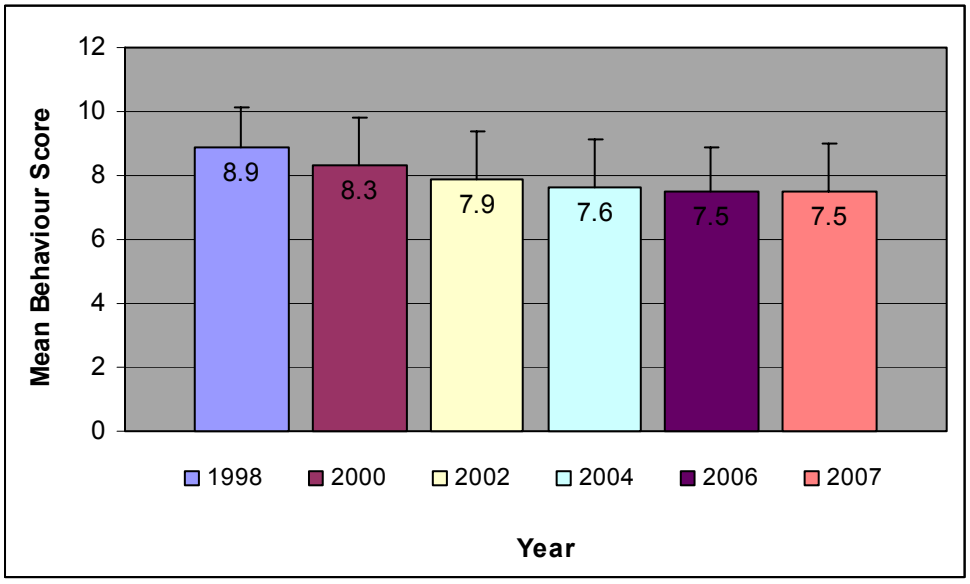
Year	N	Knowledge[+]	Attitude[#]	Behaviour[@]
		Index Score (Scaled Score)		
1998	500	$14.9^{a} \pm 2.0$	$46.1^{ac} \pm 5.2$	$8.9^{a} \pm 1.2$
2000	301	$14.1^{b} \pm 2.4$	$44.6^{b} \pm 5.6$	$8.3^{b} \pm 1.5$
2002	502	$14.4^{ab} \pm 2.0$	$46.8^{c} \pm 4.5$	$7.9^{c} \pm 1.5$
2004	553	$14.8^{a} \pm 2.2$	$46.2^{ac} \pm 4.9$	$7.6^{d} \pm 1.5$
2006	304	$14.3^{b} \pm 2.3$	$45.6^{a} \pm 4.9$	$7.5^{d} \pm 1.4$
2007	500	$14.2^{b} \pm 2.3$	$45.4^{ab} \pm 4.9$	$7.5^{d} \pm 1.5$

Mean $\pm$ SD. Values not sharing a common superscript are significantly different (Tukey's HSD) $p < 0.05$.
[+] Maximum possible score = 21; [#] Maximum possible score = 69; [@] Maximum possible score = 12.

Tukey's multiple range T-test results showed temporal changes in mean behaviour scores over the time span of data collection (Table 5). Behaviour score declined significantly in each year from 1998 to 2004 then behaviour scores leveled out and remained unchanged from 2004 to 2007. Mean scores in 1998, 2000, and 2002 were statistically different from all survey years.

Mean scores in 2004, 2006 and 2007 were not different from one another but they were all statistically different from the survey years earlier in the decade. From 1998 to 2007, the mean behaviour score decreased by 15.7% meaning that consumer's behaviour had become increasingly more negative as respondents adopted ways to decrease sugars consumption and dieting behaviours (Figure 1). The largest decrease occurred between 1998 and 2000. When expressed as a percentage of the maximum possible score, the mean score decreased from 75% of the maximum in 1998 to 62% of the maximum in 2007.

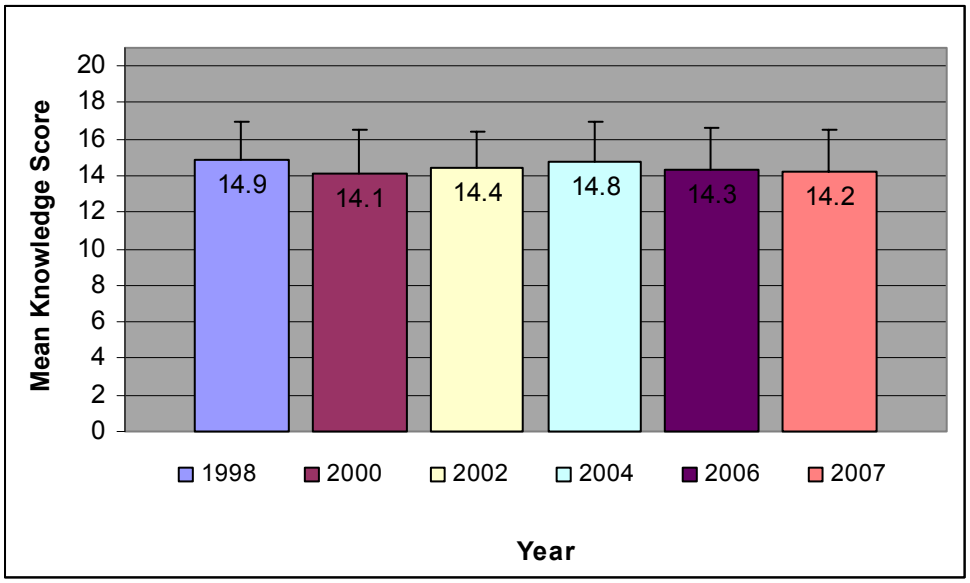
Figure 2. Temporal changes in sugars consumption behaviour



F-value = 73.7, p-value = .000

In contrast to the behaviour score which showed a distinct downward trend over time, the mean knowledge score of the nutritional value of dietary sugars remained fairly constant during the data collection period (Figure 2). When examined for differences

Figure 3. Temporal changes in the knowledge of the nutritional value of sugars

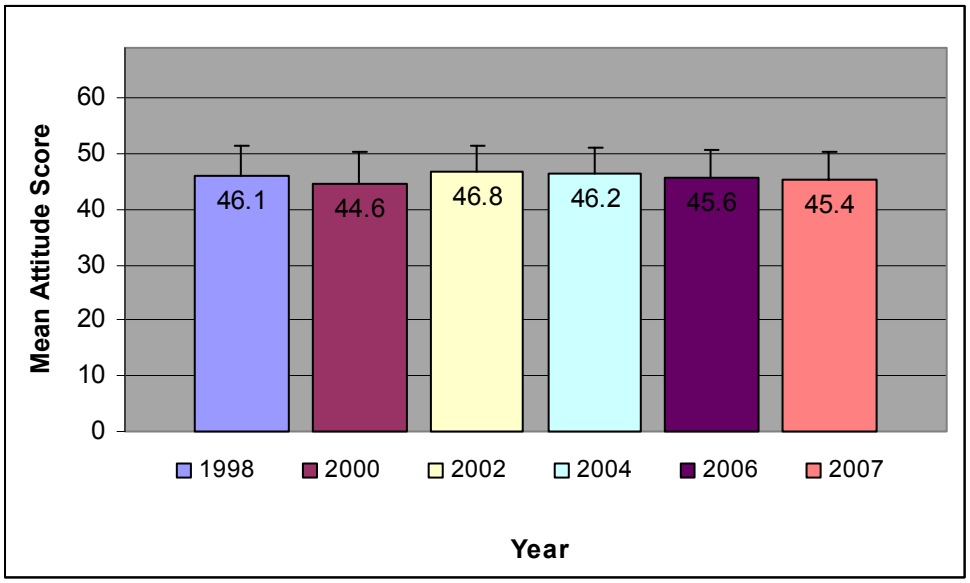


F-value = 9.1, p-value = .000

across years, the mean knowledge score was highest in 1998 and 2004 when compared to 2000, 2002, 2006 and 2007; however, the magnitude of the differences was small. Tukey's multiple range T-test showed temporal changes in mean consumer knowledge (Table 5). Mean scores in 1998 and 2004 were statistically different from mean scores in 2000, 2006, and 2007.

Similar to the trend in the knowledge score, the mean attitude score was fairly constant across the data collection period (Figure 3). Tukey's multiple range T-test showed temporal changes in mean consumer attitude (Table 5). Again, while the difference was statistically significant, the magnitude was small. Mean attitude score was highest in 2002 and lowest in 2000 and 2007.

Figure 4. Temporal changes in attitudes toward sugars consumption



F-value = 9.8, p-value = .000

4.3 Socio-demographic Predictors of Sugar Consumption Behaviour

Regression analysis was done to determine the predictors of sugars consumption using the behaviour score and the attitude score as dependent variables. For both linear and logistic regression, the independent variables included attitude score, knowledge score, and the socio-demographic categories listed in Table 4.

4.3.1 Linear Regression

Linear regression analysis, with behaviour score as the dependent variable, was done with each independent variable entered in the model. Regression analysis indicated that sugars consumption behaviour was impacted by attitude toward sugars, survey year, gender, income, household size, age, and region (Table 6).

Table 6. Predictors of sugar consumption behaviour by Canadian consumers

	Unstandardized Coefficients	Standardized Coefficients	95% Confidence Interval
	β	β	Lower-Upper
Constant (Behaviour)	4.511		3.925 - 5.098
Attitude Index Score	0.097	0.316*	0.086 - 0.109
Knowledge Index Score	-0.013	-0.018	-0.039 - 0.013
2000	-0.536	-0.110*	-0.731 - -0.341
2002	-1.115	-0.283*	-1.283 - -0.947
2004	-1.324	-0.349*	-1.488 - -1.160
2006	-1.332	-0.275*	-1.527 - -1.138
2007	-1.322	-0.335*	-1.491 - -1.153
Male	0.540	0.140*	0.410 - 0.669
Unemployed	-0.081	-0.024	-0.197 - 0.035
Children < 12 years	0.003	0.001	-0.141 - 0.148
Low Income	0.182	0.043*	0.026 - 0.338
Middle Income	0.084	0.024	-0.042 - 0.211
Education < Grade 12	0.144	0.023	-0.092 - 0.381
Education - College	-0.095	-0.028	-0.242 - 0.052
Education - University	-0.135	-0.043	-0.272 - 0.002
Household size - 1	0.061	0.014	-0.141 - 0.262
Household size - 2	-0.024	-0.007	-0.191 - 0.143
Household size - 3	0.057	0.015	-0.101 - 0.214
Household size > 5	0.231	0.049*	0.047 - 0.415
Age 18-34 years	0.106	0.032	-0.028 - 0.239
Age > 45 years	-0.154	-0.049*	-0.291 - -0.017
Region - Quebec	0.192	0.058*	0.074 - 0.310

* p-value < 0.05; Model ($F_{22,2636}$=39.590, p=.000, Adjusted R^2=0.242)

The regression equation for sugars consumption behaviour is:

Behaviour Index Score = 4.511 + 0.097(Attitude Index Score) +0.540(Male) + 0.043(Low Income) + 0.049(Household Size > 5) + 0.058(Quebec Resident) – 0.154(Age > 45 years) – 0.536(2000) – 1.115(2002) – 1.324(2004) – 1.332(2006) – 1.322(2007)

Overall, the strongest negative predictor of sugar consumption behaviour was time and the strongest positive predictor was having a positive attitude toward dietary sugars. The standardized coefficient beta (β) was larger for the survey years and attitude compared to the other significant predictors. Other factors having a positive effect on sugars consumption

behaviour, albeit a modest input, were being male, having a low income, living in larger households (greater than five people), and being a resident of Quebec. Sugars consumption behaviour became more negative with increased age (respondents over the age of 45). Knowledge of the nutritional value of sugars, employment status, presence of children under twelve in the household, and education level did not significantly impact on behaviour. The final regression model accounted for ~24% of the variance in sugars consumption behaviour (adjusted $R^2 = 0.242$).

When linear regression was repeated using the attitude score as the dependent variable, the knowledge index score was the most important positive predictor while being a resident of Quebec was the most important negative predicator (Table 7). The β values for knowledge score and residing in Quebec were stronger compared to the other predictors in the model. Other positive but less robust predictors were survey year 2002, being male, being unemployed, and being from a younger age group. Time, with the exception of survey year 2002, did not have a significant impact on attitude. Survey year 2002 had the highest attitude score which would explain why it is significant in the model. Income, presence of children under twelve in the household, household size, and education level were the other variables that did not have a significant impact on attitude. The regression model accounted for ~20% of the variance in attitude towards sugars consumption (adjusted $R^2 = 0.204$).

Table 7. Predictors of attitude toward sugar consumption by Canadian consumers

	Unstandardized Coefficients	Standardized Coefficients	95% Confidence Interval
	β	β	Lower-Upper
Constant (Attitude)	34.607		33.169 – 36.044
Knowledge Index Score	0.792	0.348*	0.712 - 0.872
2000	-0.529	-0.033	-1.179 – 0.120
2002	1.054	0.082*	0.498 – 1.611
2004	0.063	0.005	-0.482 – 0.609
2006	0.042	0.003	-0.604 – 0.689
2007	-0.165	-0.013	-0.728 – 0.398
Male	0.732	0.059*	0.302 - 1.163
Unemployed	0.664	0.061*	0.278 - 1.050
Children < 12 years	-0.020	-0.002	-0.502 - 0.462
Low Income	-0.285	-0.021	-0.802 - 0.233
Middle Income	-0.287	-0.025	-0.708 - 0.135
Education < Grade 12	-0.429	-0.021	-1.215 - 0.357
Education - College	-0.196	-0.018	-0.684 - 0.292
Education - University	-0.060	-0.006	-0.516 - 0.396
Household size - 1	-0.646	-0.045	-1.317 - 0.024
Household size - 2	-0.459	-0.042	-1.015 - 0.097
Household size - 3	-0.104	-0.009	-0.628 - 0.420
Household size > 5	-0.255	-0.016	-0.868 - 0.359
Age 18-34 years	0.704	0.065*	0.260 - 1.148
Age > 45 years	-0.102	-0.010	-0.559 - 0.354
Region - Quebec	-1.958	-0.181*	-2.344 - -1.571

* p-value < 0.05; Model ($F_{21,2638}$=33.438, p=.000, Adjusted R^2=.204)

The regression equation for attitude towards sugars consumption is:

Attitude Index Score = 34.607 + 0.792(Knowledge Score) +0.732(Male) + 0.664(Unemployed) + 0.704(Age 18-34) + 1.054(2002) – 1.958(Quebec Region).

4.3.2 Logistic Regression

While linear regression looks at the full spectrum of behaviours/attitudes, logistics regression was done to assess the predictors of unfavourable versus favourable sugar consumption behaviours and poor versus positive attitude.

When this analysis was done using unfavourable behaviours as the dependent variable, time was the strongest positive predictor of an unfavourable behavior (Table 8). The likelihood of having an unfavourable behaviour was more than 9 times greater in 2007 than it was in 1998. Being in an older age group (>45 years) was the only other positive predictor of an unfavourable behaviour with a 1.4 (odds ratio) fold greater chance of having an unfavourable behaviour if you were older. The attitude index score, being male, and living in a larger household (>5 people) were weaker negative predictors of an unfavourable behaviour. This inverse relationship implies that these variables are more predictive of a favourable rather than unfavourable behaviour. The knowledge index score, employment status, presence of children twelve and under in the household, income, education level, and region did not have a significant impact on an unfavourable behaviour.

Table 8. Predictors of unfavorable sugar consumption behaviour by Canadian consumers

	β	Exp(β)	95% Confidence Interval
			Lower - Upper
Constant	5.087	161.983*	
2000	0.928	2.528*	1.826 - 3.501
2002	2.062	7.861*	5.844 - 10.574
2004	2.396	10.983*	8.124 - 14.850
2006	2.518	12.399*	8.567 - 17.944
2007	2.262	9.599*	7.049 - 13.071
Attitude Index Score	-0.128	0.880*	0.861 - 0.899
Knowledge Index Score	-0.014	0.558	0.942 - 1.033
Male	-0.709	0.492*	0.393 - 0.616
Unemployed	0.153	1.016	0.786 - 1.313
Children < 12 years	0.016	1.021	0.790 - 1.319
Low Income	-0.218	0.804	0.613 - 1.054
Middle Income	-0.115	0.891	0.712 - 1.115
Education < Grade 12	-0.369	0.692	0.459 - 1.042
Education - College	0.112	1.119	0.864 - 1.449
Education - University	0.183	1.200	0.943 - 1.528
Household size - 1	-0.149	0.862	0.601 - 1.237
Household size - 2	-0.156	0.855	0.634 - 1.155
Household size - 3	-0.201	0.818	0.619 - 1.082
Household size > 5	-0.403	0.668*	0.483 - 0.925
Age 18-34 years	-0.121	0.886	0.703 - 1.116
Age > 45 years	0.368	1.445*	1.129 - 1.849
Region - Quebec	0.003	1.003	0.813 - 1.239

* p-value < 0.05; Model Summary: -2 Log likelihood 2808.822; Cox & Snell R Square 0.231; Nagelkerke R Square 0.315

The regression equation for unfavourable sugars consumption behaviour is:

Unfavorable Behaviour = 5.087 + 0.928(2000) + 2.062(2002) + 2.396(2004) + 2.518(2006) + 2.262(2007) + 0.368 (Age >45 years) - 0.128(Attitude Index Score) – 0.709(Male) – 0.403(Household size >5)

When the logistic regression was repeated using favourable behaviour, as expected, the same predictor variables had a significant impact but the direction of effect was different. The attitude index score, being male, and living in a large household (>5 people) had a greater positive impact on a favourable behaviour than they had as negative predictors of an unfavourable behaviour. Time also significantly impacted on a favourable behaviour, however

as a weaker negative predictor. This inverse relationship implies time is a better predictor of an unfavourable behaviour which was shown in the logistic regression model in Table 8. Being in an older age group (>45 years) was also a negative predictor of a favourable behaviour but did not have the same impact as it did as a positive predictor of unfavourable behaviour.

Table 9. Predictors of favorable sugar consumption behaviour by Canadian consumers

	β	**Exp(β)**	**95% Confidence Interval**
			Lower - Upper
Constant	-5.087	0.006*	
2000	-0.928	0.396*	0.286 - 0.548
2002	-2.062	0.127*	0.095 - 0.171
2004	-2.396	0.091*	0.067 - 0.123
2006	-2.518	0.081*	0.056 - 0.117
2007	-2.262	0.104*	0.077 - 0.142
Attitude Index Score	0.128	1.137*	1.113 - 1.162
Knowledge Index Score	0.014	1.014	0.968 - 1.062
Male	0.709	2.032*	1.624 - 2.543
Unemployed	-0.153	0.858	0.698 - 1.055
Children < 12 years	-0.016	0.984	0.762 - 1.272
Low Income	0.218	1.244	0.949 - 1.631
Middle Income	0.115	1.122	0.897 - 1.404
Education < Grade 12	0.369	1.446	0.959 - 2.180
Education - College	-0.112	0.894	0.690 - 1.157
Education - University	-0.183	0.833	0.654 - 1.060
Household size - 1	0.149	1.160	0.809 - 1.664
Household size - 2	0.156	1.169	0.866 - 1.578
Household size - 3	0.201	1.222	0.924 - 1.616
Household size > 5	0.403	1.496*	1.081 - 2.070
Age 18-34 years	0.121	1.129	0.896 - 1.422
Age > 45 years	-0.368	0.692*	0.541 - 0.886
Region - Quebec	-0.003	0.997	0.807 - 1.231

* p-value < 0.05; Model Summary: -2 Log likelihood 2808.822; Cox & Snell R Square 0.231; Nagelkerke R Square 0.315

The regression equation for favourable sugar consumption behaviour is:

Favorable Behaviour = -5.087 + 0.709(Male) + 0.403(Household Size > 5) + 0.128(Attitude Index Score) – 0.928(2000) – 2.062(2002) – 2.396(2004) – 2.518(2006) – 2.262(2007) – 0.368(Age > 45 years)

Favourable behaviour was not significantly impacted by employment status, presence of children twelve and under in the household, income, education level, or region. Regression results for unfavourable and favourable behaviour were complementary to one another with the same predictor variables however, the magnitude and direction of the influence was different. For the most part, linear and logistic regression results show behaviour as being significantly impacted by the same variables. However, while being a resident of Quebec and having a low income were significant predictors of the behaviour score when expressed as a continuous variable, they were not predictive of either unfavourable/favourable behaviour.

When attitude was dichotomized into positive/poor attitude, being a resident of Quebec had greater than a 2-fold (odds ratio) greater likelihood of having a poor attitude (Table 10). Survey year 2007 was the only other positive predictor of a poor attitude with a 1.3 (odds ratio) greater likelihood. The knowledge index score, being male, being unemployed, and of a younger age (18-34 years) were weaker negative predictors of a poor attitude and therefore more predictive of having a positive attitude. All other survey years, the presence of children twelve and under in the household, income, education level, and household size were not predictive of a poor attitude.

Table 10. Predictors of poor attitude toward sugar consumption by Canadian consumers

	β	Exp(β)	95% Confidence Interval
			Lower - Upper
Constant	4.165	64.386*	
2000	0.216	1.241	0.904 - 1.704
2002	-0.255	0.775	0.593 - 1.013
2004	0.146	1.157	0.890 - 1.503
2006	0.169	1.184	0.865 - 1.622
2007	0.276	1.317*	1.003 - 1.730
Knowledge Index Score	-0.288	0.750*	0.719 - 0.782
Male	-0.306	0.737*	0.599 - 0.906
Unemployed	-0.296	0.744*	0.616 - 0.898
Children < 12 years	-0.003	0.997	0.791 - 1.257
Low Income	0.165	1.179	0.918 - 1.516
Middle Income	0.145	1.156	0.942 - 1.418
Education < Grade 12	0.280	1.323	0.892 - 1.963
Education - College	0.157	1.170	0.925 - 1.481
Education - University	-0.046	0.955	0.767 - 1.190
Household size - 1	0.146	1.158	0.837 - 1.601
Household size - 2	0.083	1.086	0.830 - 1.420
Household size - 3	0.009	1.009	0.784 - 1.299
Household size > 5	0.071	1.074	0.798 - 1.444
Age 18-34 years	-0.243	0.784*	0.633 - 0.971
Age > 45 years	0.060	1.062	0.851 - 1.325
Region - Quebec	0.777	2.176*	1.800 - 2.631

* p-value < 0.05; Model Summary: -2 Log likelihood 3275.566; Cox & Snell R Square 0.141; Nagelkerke R Square 0.188

The regression equation for poor attitude is:

Poor Attitude = 4.165 + 0.276 (2007) + 0.777(Quebec Resident) – 0.288(Knowledge Index Score) – 0.306(Male) – 0.296(Unemployed) – 0.243(Age 18-34 years)

When predictors of a positive attitude were assessed, the knowledge index score, being male, being unemployed, and being younger were positive predictors with each having ~1.3 odds likelihood (Table 11). Weaker negative predictors were survey year 2007 and being a resident of Quebec. These variables, as was shown in Table 10, are more predictive of a poor attitude.

Table 11. Predictors of positive attitude toward sugar consumption by Canadian consumers

	β	Exp(β)	95% CI
			Lower - Upper
Constant	-4.165	0.016*	
2000	-0.216	0.806	0.587 - 1.107
2002	0.255	1.290	0.987 - 1.686
2004	-0.146	0.865	0.666 - 1.123
2006	-0.169	0.844	0.616 - 1.156
2007	-0.276	0.759*	0.578 - 0.997
Knowledge Index Score	0.288	1.333*	1.279 - 1.390
Male	0.306	1.357*	1.103 - 1.670
Unemployed	0.296	1.345*	1.114 - 1.623
Children < 12 years	0.003	1.003	0.795 - 1.265
Low Income	-0.165	0.848	0.660 - 1.090
Middle Income	-0.145	0.865	0.705 - 1.061
Education < Grade 12	-0.280	0.756	0.510 - 1.122
Education - College	-0.157	0.854	0.675 - 1.081
Education - University	0.046	1.047	0.841 - 1.304
Household size - 1	-0.146	0.864	0.625 - 1.195
Household size - 2	-0.083	0.921	0.704 - 1.204
Household size - 3	-0.009	0.991	0.770 - 1.275
Household size > 5	-0.071	0.932	0.693 - 1.253
Age 18-34 years	0.243	1.275*	1.030 - 1.579
Age > 45 years	-0.060	0.942	0.754 - 1.175
Region – Quebec	-0.777	0.460*	0.380 - 0.556

* p-value < 0.05; Model Summary: -2 Log likelihood 3275.566; Cox & Snell R Square 0.141; Nagelkerke R Square 0.188

The regression equation for positive attitude is:

Positive Attitude = -4.165 + 0.288(Knowledge Index Score) + 0.306(Male) + 0.296(Unemployed) + 0.243(Age 18-34 years) – 0.276(2007) – 0.777(Quebec Resident)

All other survey years, the presence of children twelve and under in the household, income, education level, and household size did not have a significant impact on a positive attitude. Regression results for both poor and positive attitude have the same predictor variables but the direction and magnitude of the impact are different. Linear and logistic regression results show attitude as being impacted by the same variables. The only discrepancy is with the time sensitive variables. Survey year 2002 was the only significant survey year that had an impact on attitude

score but when attitude was dichotomized as poor/positive attitude, survey year 2007 had significant impact. Looking at the attitude scores in those years survey year 2002 had the highest attitude score and survey year 2007 had the second lowest attitude score.

CHAPTER 5.0: DISCUSSION

Little is known about Canadian consumer's attitudes and behaviours towards sugar consumption. Access to the Sugar Tracking Study database provided a unique opportunity to explore Canadian consumer's attitudes and behaviours towards sugars consumption. Ipsos ASI prepared a Sugar Tracking Report for the CSI with information on how survey participants responded from one year to the next however this information in unable detect temporal changes or explore relationships with socio-demographic variables. In order to utilize the information contained in the database, and take the analysis further than Ipsos ASI had, index scores were developed for behaviour, attitude, and knowledge. This provided a means to measure behaviour, attitude, and knowledge quantitatively within the questionnaire and a means to explore the relationship between them. These types of variables can be used in statistical tests to determine if relationships exist between variables and if changes in responses are statistically different.

Canadians food choices are driven by taste, nutrition, cost, healthfulness, and convenience in that order (6). Socio-demographics play a role in the perceived health risk/benefit of their food consumption behaviours. Food selection behaviours are linked to socio-demographic characteristics of individuals and the households they live in. Socioeconomic status (SES)/income (103,120-123), age (103,121-124), gender (121-124), education level (121-124), employment status (121-123), and household size/composition (121-124) have a role in dietary behaviour. Women, university graduates, older individuals and residents of British Columbia (BC) place more importance on nutrition (6).

Consumer behaviours toward sugars consumption have become more negative over the data collection period. In contrast to the behaviour score, attitude and knowledge scores remained fairly constant across the years of data collection. The behaviour index score

decreased in each data collection period which would indicate that more consumers are taking steps to limit sugars intake in their diet and/or are practicing dieting bahaviours. From 1998 to 2007 there was a 13% decrease in mean behaviour scores and the likelihood of having an unfavourable behaviour was more than 9 times greater in 2007 than it was in 1998. Attitude toward dietary sugars was an important predictor of the behaviour index score and an unfavourable/favourable behaviour. If an individual had a positive attitude toward dietary sugars, they were less likely to engage in behaviours to limit sugars intake indicating that they believed the desirability of consuming sugar outweighed any consequences (124). With attitude scores remaining fairly stable, the temporal changes in behaviour score may be related to external influences such as changing subjective norms (108) that may be shaped by media messages and changing public health policy. Media messages may act directly by changing the beliefs of whether most people approve or disapprove of consumption of sugars, while changing public health policy may indirectly impact the beliefs about consumption of sugars by changing normative beliefs (108).

Having a positive attitude towards dietary sugars positively impacted on behaviour score. Other predictors that showed a consistent positive relationship toward sugars consumption behaviour were being young, male, having a low income, and living in a large household. These demographic groups attach less importance to the perceived health properties of a food, had a positive attitude and were less likely to practice behaviours to limit sugars intake (121-124). Having a low income or living in a larger household would have an effect on availability/accessibility of products and therefore food dollars would have to stretch further and impact on food choice (123). Men and younger individuals tend to worry less about what they eat (120,125) and place less importance on nutrition (6), which could explain why these

individuals have positive consumption behaviours towards sugars consumption. The presence of children twelve and under in the household did not have an impact on behaviour index score which indicates that household size rather than composition is more important to sugars consumption behaviour.

Predictors of attitudes toward sugars consumption differed from predictors of behaviour. The most notable difference was the role of knowledge as a determinant of attitudes but not of sugars consumption behaviour. This dissociation between knowledge and behavior is consistent with the TRA (108) and suggests that education alone is unlikely to impact sugars consumption behaviour. The scientific evidence for the link between the knowledge and behaviour in the KAB model is also weak (107).

There was the lack of an effect of time on attitudes toward sugars consumption. This can be related to an individual's beliefs, as the TRA asserts, having a strong impact on attitude (108). Beliefs can sometimes be hard to change explaining why attitude has remained fairly constant. Individual beliefs would develop throughout a person lifetime and be based on experiences and an accumulation of knowledge based on the outcomes of performing certain behaviours. This could mean that attitudes may be hard to change if the person's beliefs are very strong and past experiences outweigh the gain in new knowledge. The TRA could explain why attitude and knowledge remained fairly constant throughout the data collection period.

In addition to attitude and subjective norms, response to elements in the environment that hinder ability to act due to the cost of food, food preferences, and perceptions of risk must also be considered. Consistent with this, low income and being unemployed were predictors of a positive attitude toward dietary sugars. Because foods with higher sugar content are typically lower in price (123), these foods may be viewed more positively since they already make up a

larger part of daily food choices. The TNT surveys report that lower income groups placed a higher importance on cost and convenience or ease of preparation than those with a higher income (6).

Cultural values appear to impact attitudes and behaviours toward sugars consumption. French Canadians presented a paradox in that they were more likely to have a negative attitude and a positive behaviour suggesting they consume foods they enjoy even though there may be negative consequences. For residents of Quebec, the subjective norms, whether it is the disapproval of dieting in this culture, outweighs attitude when it comes to sugar consumption behaviour. This cultural group may also place a greater importance on taste and the enjoyment of food. The 2008 TNT survey reports residents of Quebec were the least likely (44%) to say nutrition is very important, however in 1989 they were the most likely (65%) to say nutrition is very important (6). This is an interesting trend and it may be related to the positive impact being a resident of Quebec had on sugars consumption behaviour. Being a resident of Quebec was a predictor in the model for the behaviour index scores however it was not a predictor in the model for both an unfavourable or favourable behaviour. It was also a predictor in the model for the attitude index scores and for a poor and positive attitude. This would suggest that being a resident of Quebec has a stronger impact on attitude than it does on behaviour.

English Canadians were more likely to have negative food consumption behaviour and a positive attitude. This contradiction suggests that action and belief are disassociated within these cultural groups. Subjective norms also outweigh attitude for English Canadians, however subjective norms in this case could be the influence or acceptance of dieting behaviours within this culture.

Media messages that have positioned added sugars as playing a role in obesity and chronic disease (104) may be impacting on sugars consumption behaviour. The popularity of low carbohydrate diets early in the decade also shed a negative light on consumption of all carbohydrates, not just added sugars (104). This may have caused a change in the behavioural belief associated with sugar consumption (108). Public policies such as food labeling (120,125) could also play a role in changing consumer behaviours by changing the evaluations of behavioural outcomes (108). Sugars are identified on the Nutrition Facts Panel and nutrient claims are used to help consumers make healthier food choices (126). The nutrient claims for sugars would be "free", "low", or "reduced" which indicates this is a nutrient that should be avoided or limited. The value attached to these claims by the consumer could influence behaviour (108). Consumer use of food package labels has gone up10% from 2004 to 2008 however nutrient or health claims was not what most label readers look for (6). The implementation of school food policies to remove foods with added sugars (127) and statements in Canada's Food Guide to limit foods and beverages that are high in sugar (94) may also impact on changing subjective norms or directly impact on attitude by changing their overall evaluation of the behaviour (108). Although Canadian consumers report unfavourable behaviour toward sugars intake, we do not know if this translates into reduced intake as this information is not available. Based on sugars availability data from Statistics Canada, sugars intake has not changed during this time interval (13); however, availability data are a very crude measure of consumption (7,8).

Participants may be responding to the changing beliefs and behaviours of the people around them, indirect measures within the TRA that impacts on behaviour (108). They are motivated to comply with others (108). An example of this would be someone who does not

think they need to lose weight begins to follow a low carbohydrate diet because their friends or family are following the diet and their behaviours were influential. In this case their attitude towards carbohydrates did not change but their dieting behaviour did. Normative beliefs, the belief about whether each referent approves or disapproves of the behaviour, might also be changing (108). An example of this would be someone that is out to eat with friends and does not order dessert because their friends did not order dessert. Their attitude towards dessert did not change but their behaviour has changed by adapting to match those around them.

The sample consisted of respondents residing in large urban cities. This may have an affect on the results because income tends to be higher in urban areas. Since all participants were from large urban cities it would be useful to include ethnicity as a socio-demographic variable. Females are dominant in the sample therefore results may be different if the proportion of male respondents was higher. We may not have seen the same change in behaviour index score since being male positively impacted on behaviour index score.

CHAPTER 6.0: CONCLUSION

The results of the Sugar Tracking Study show behaviour towards sugars consumption has changed among Canadians from 1998 to 2007. More Canadians are reducing sugars intake in 2007 then they were in 1998. Regression models accounted for accounted for ~24% and ~20% of the variance in behaviour and attitude index scores respectively. It is suggested that changing subjective norms such as media messages and public health policy may account for the remainder of the variance in behaviour score and could explain the changes in behaviour index score without the change in attitude index score.

CHAPTER 7.0: LIMITATIONS

Some assumptions had to be made about the questionnaire since the original questions were not designed to be used in the way we have for the purposes of these analyses. Since we did not know how the questions were intended to be formatted we made a distinction between the questions that were attitudinal and those that were knowledge or awareness. While we feel confident in the way questions have been assigned to domains, the number of questions is variable within domains and across years. A limitation of the questionnaire is the questions in the behavioural domain are, to a large extent, underrepresented in the total number of questions. This is a concern since this is the key dependent variable in the regression analysis. Another concern is that the attitudinal questions out-weigh the other domains significantly. One way to even out the domains, if not to add questions, would be to reword some attitudinal questions to make them behavioural or knowledge/awareness type questions. This would keep the survey at a reasonable length in terms of time to complete as longer surveys may turn away potential respondents.

Another limitation of the Sugar Tracking Study is that although the sample was randomly selected only larger urban areas were surveyed. The characteristics of the population surveyed (Table 4) showed a higher proportion of respondents as employed females with at least some university/college education, living in 2 person households. A higher proportion of respondents report a higher income, which is considered high relative to Statistics Canada cut-offs, but not high relative to an urban population. Surveying smaller cities/towns and rural areas would expand the population characteristics and be more representative of the Canadian population.

CHAPTER 8.0: RECOMMENDATIONS

A suggestion to the CSI would be to continue with the version of the survey used in 2006/07 (Table 2) for future surveys. While questions may be added as new issues emerge, this core group of questions should be retained so that comparisons can continue to be made across years. In future, if more questions are added to the questionnaire, the scoring scheme would be more robust if behavioural questions were added. From a research perspective this would strengthen the results.

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APPENDIX 1 Call Disposition from Ipsos ASI

Call Dispositions Available

Tip-code	Call Disposition	Definition	Times Called?
1	Do Not Call - Refusal	Respondent hung up or refused to do the study	Only once
2	Cell phone	Respondent was called on their cell phone	Only once
10	Out of area long distance	The wrong area code may be attached to the number. This sometimes occurs when new area codes are introduced where there is an overlap during the updating period.	Only once
11	Disconnected number not-in-service	Number is not in service	Only once
12	Abandoned interview		
13	Business number	For evening studies where we are using RDD sample, we do not want to speak with businesses	Only once
14	French language barrier	Respondent speaks only French	Only once
15	English language barrier	Respondent speaks English but not well enough to communicate or for French / Spanish-language studies Respondent only speaks English	Only once
16	Spanish language barrier	Respondent speaks only Spanish	Only once
17	Oriental language barrier	Respondent speaks only an Asian language	Only once
18	Unknown language barrier	Respondent speaks only a language which is unknown to the Interviewer	Only once
19	Illness / incapable / deaf	Respondent is ill, incapable or deaf to the point where they cannot communicate properly with the Interviewer	Only once
20	General incapable		
21	Eligible respondent not available	This is an appointment. The respondent who qualifies for the study is not available	Respondent is called back based on a scheduled

			appointment time
22	**Stop**	This is an interview where only part of the survey was collected. In this case, the respondent could not finish the interview at that time and an appointment was set at their convenience to finish the survey.	Respondent is called back based on a scheduled appointment time
23	**Specified appointment**	This is a specified appointment made with the respondent who qualifies for the study.	Respondent is called back based on a scheduled appointment time.
24	**Household refusal**	Respondent hung up or refused to do the study	Only once
25	**Qualified respondent refusal**	The person who qualifies for the study refuses to participate in the survey	Only once
26	**Refused before qualifying**	Respondent refuses before qualifying for the study	Only once
27	**Refused after qualifying**	Respondent refuses after qualifying for the study	Only once
28	**Refusal part-way through**	This is considered a terminated interview where the respondent begins to do the survey but then decides they do not want to complete it and do not want to be called back	Only once
29	**Over quota**	Respondent agrees to do the study and qualifies but is unable to participate because the quota cell they fall into is full	Only once
30	**Appropriate gender unavailable**	Where there are gender quotas, the introduction will instruct the Interviewer to ask for a male or female depending on how the gender quota is falling out. If the gender we are looking for does not live in that household, the household will disqualify since the appropriate gender is not available.	Only once
31	**No one 18 +**	There is no adult 18 years of age or older living in the household	Only once
32	**Occupation**	Respondent is disqualified due to their occupation	Only once
33	**Not reached at home**	Respondent disqualifies because the number at which we reached them is not their home number	Only once
34	**Disqualified by client specifications**		Only once

to 39			
47 to 54	**Disqualified by client specifications**		Only once
40	**Yes**	Yes = complete (a completed survey)	Only once
41	**Busy**	Number dialed is busy. This is treated as a normal busy number and put into 'qbusy'	These numbers are called back every 15 to 35 minutes (up to 3 times per shift)
42	**Fax / modem number**	Fax number	These numbers are called back 24 hours later and if they are still a fax / modem the 2nd time, they are assigned a disposition of 'dead', not to be retried
43	**No answer**	No one answered the telephone	These numbers are called every 2 ½ hours (up to 3 times per shift)
44	**Answering machine**	An answering machine was reached (we do not leave a message)	These numbers are called every 2 ½ hours (up to 3 times per shift)
45	**Changed number**	Person who answers the phone give us a different number with which to reach the Respondent	The Interviewer can set up a specific date and time to call the Respondent back
46	**Left 1-800 number**	For daytime studies we leave a toll free number so the Respondent can call us back at their convenience	The Interviewer can set up a specific date and time to cal

			the respondent back. Standards call back time is 2 days.
201	**Dialer - busy**	Number dialed was busy. This is treated as a normal busy number and put into 'qbusy'.	These numbers are called back every 15 to 35 minutes (up to 3 times per shift)
202	**Dialer – no answer**	No answer	These numbers are called every 2 ½ hours (up to 3 times per shift)
205	**Dialer – modem tone**	Fax number	These numbers are called back 24 hours later and if they are still a fax / modem the 2nd time, they are assigned a disposition of 'dead', not to be retried
206	**Dialer – nuisance hang-up**	Over dialing occurred and no Interviewer was available to respond to the call. This is treated as a hang up and we call the number back the next day.	These numbers are called up to 3 times a shift starting the next day
207	**Dialer – bad number syntax**	Number could not be dialed and it was moved to a 'dead' queue by the system	Only once
208	**Dialer - incomplete**	Number could not be dialed and it was moved into a 'dead' queue by the system	Only once
210	**Dialer – site congestion**	The dialer has been requested by SMS to dial more numbers than it had physical phone lines	Numbers are called back during the same shift if possible or the next day
211	**Dialer – site out of service**	Number not in service	Only once
212	**Dialer – new number dropped**	Number has been changed and it is moved to a 'dead' queue	Only once
221	**Dialer – unknown error**	Number could not be dialed and it was moved into a 'dead' queue by the system	Only once

APPENDIX 2 2007 Survey Tool used by Ipsos ASI

E-SPEC # TR06-1540602 (60-6077-44)
To be in field: September 17, 2007

SUGAR TRACKING QUESTIONNAIRE

Good afternoon / evening. My name is _____ from IPSOS Reid, a market research company. Today we are conducting a survey about food and nutrition and we would like to include the opinions of someone in your household.

A. Are you the person who does most of the food shopping in your household? **(If 'no' ask to speak to that person, reintroduce yourself if necessary)**.

Yes
No

[DO NOT ACCEPT DK / REF. IF NO ASK QA1; OTHERWISE, SKIP TO QB.]

A1. May I please speak to the person who does most of the food shopping in your household? **(Do not read list)**

Yes, coming to the phone
No, not available
No, refused

[IF 'YES, COMING TO THE PHONE', RETURN TO INTRODUCTION. IF 'NO NOT AVAILABLE', ARRANGE CALLBACK. IF 'NO, REFUSED', THANK AND TERMINATE. DK/REF NOT ALLOWED.]

B. We are interested in knowing whether you or anyone in your household suffers from any of the following medical conditions. **(Read list)**

[DO NOT RANDOMIZE LIST]
Heart ailment
Kidney ailment
Diabetes
Muscular dystrophy

Yes
No

[IF YES TO QB FOR ANY AILMENT, ASK QBi FOR EACH AILMENT, OTHERWISE CONTINUE. DO NOT ACCEPT DK.]

Bi. Would that be yourself or another household member who suffers from **[insert MEDICAL CONDITION from QB]**?

Yourself
Other person

[IF ANY "YOURSELF" OR ANY REFUSALS THANK AND TERMINATE; OTHERWISE, CONTINUE. DO NOT ACCEPT DK]
[MP]

C. Do you or does anyone in your household work for any of the following types of companies…? **(Read list)**

A food manufacturer
A food retailer
A TV or radio station
A newspaper or magazine
An advertising agency
A marketing research company

Yes
No

[IF ANY YES, DK, OR REF THANK AND TERMINATE; OTHERWISE, CONTINUE.]

D. In which of these age categories should I check you? **(Read list)**

Less than 18 years
18 to 24 years
25 to 34 years
35 to 44 years
45 to 54 years
55 to 64 years
Over 64 years

[IF LESS THAN 18 YEARS OR OVER 64 YEARS, DK, OR REF, THANK AND TERMINATE, OTHERWISE CONTINUE]

E. **[RECORD SEX OF RESPONDENT]** (DO NOT READ QUESTION)

Male
Female

2. Now I'm going to read you a list of common food ingredients. For each one, I would like you to tell me how important you feel it is to limit the amount of that ingredient that you eat in order to maintain good health. Please use a six-point scale with "6" meaning that you feel it is very

important to limit the amount you eat, and "1" meaning that you feel it is not at all important. Of course, you may choose any number in between. So, what number would you say indicates how important or unimportant it is for good health to limit…?

[DO NOT RANDOMIZE LIST]
Fat
Salt
Sugar
Sugar substitutes such as Equal, Sugar Twin, Nutrasweet, Splenda
Carbohydrates

[RECORD NUMBER: RANGE 1-6]

5a. Now please think of all the ways in which you consume sugar, both by itself and in other foods, compared to how sugar was used in your household three years ago. Would you say that, overall, consumption of sugar in your household today has increased, decreased or remained the same? **(Do not read list)**

Increased
Decreased
Remained the same
DO NOT USE SUGAR

6a. And now please think about all the ways in which you consume sugar substitutes, such as Equal, Nutrasweet, Sugar Twin, or Splenda, both by themselves and in other foods, compared to how sugar substitutes were used in your household three years ago. Compared to today, would you say that, overall, use of sugar substitutes in your household has increased, decreased, or remained the same? **(Do not read list)**

Increased
Decreased
Remained the same
DO NOT USE SUGAR SUBSTITUTES

7. I am going to read a list of statements about sugars and sugar substitutes. Would you please tell me how much you agree or disagree with each statement. Would you say you agree completely, agree somewhat, neither agree nor disagree, disagree somewhat, or disagree completely that…? **(Read list)**

[DO NOT RANDOMIZE STATEMENT LIST]
Sugar causes obesity
If I use sugar substitutes I will lose weight
I can control my weight through diet
Too much sugar can cause diabetes
Sugar is a good source of energy
Sugar causes hyperactivity in children

Sugar is a carbohydrate
It's more important to look for labels about fat than labels about sugar
Sugar has half the calories of fat
I can control my weight through regular physical activity
Soft drinks contribute to weight gain.

Agree Completely
Agree Somewhat
Neither Agree nor Disagree
Disagree Somewhat
Disagree Completely

[SP PER STATEMENT]

8a. How many calories do you think there are in a level teaspoon of sugar? **(If respondent asks, say "that is equivalent to 5 ml." If respondent says 'don't know' ask: "what is your best guess?")**

[RANGE ALLOW 1-9999]

8b. And how many calories do you think there are in an equivalent amount of butter? **(If respondent asks, say "that is equivalent to 5 ml." If respondent says 'don't know' ask: "what is your best guess?")**

[RANGE ALLOW 1-9999]

8c. How many calories per day would you think would be in a balanced diet for you, yourself, I mean? **(If respondent asks, say "that is equivalent to 5 ml." If respondent says 'don't know' ask: "what is your best guess?")**

[RANGE ALLOW 1-99999]

9. Now I am going to read a few more statements about sugar and sugar substitutes. Would you please tell me how much you agree or disagree with each statement. Would you say you agree completely, agree somewhat, neither agree nor disagree, disagree somewhat, or disagree completely that…?

[DO NOT RANDOMIZE STATEMENTS]
Sugar provides empty calories
Canadians eat too much sugar
Sugar is better for you than sugar substitutes
Sugar is part of healthy eating
Sugar has its place in a balanced diet
Sugar is a natural product
Sugar is a primary cause of tooth decay
Sugar tastes better than sugar substitutes

I make a point of choosing foods and beverages which contain little or no sugar
Foods labeled "no added sugar" are better for you

Agree Completely
Agree Somewhat
Neither Agree nor Disagree
Disagree Somewhat
Disagree Completely

[SP PER STATEMENT]

10a. Do you have any children at home who are 12 years of age or less?

Yes
No

[IF YES ASK Q10b; OTHERWISE, SKIP TO Q12. DO NOT ALLOW DK.]

10b. I am also interested in how you feel about sugar and sugar substitutes consumed by your children aged 12 or younger. As you did before, please tell me whether you agree completely, agree somewhat, neither agree nor disagree, disagree somewhat, or disagree completely with each of these statements. **(Read list)**

[DO NOT RANDOMIZE]
I feel sugar is better for my children than sugar substitutes
I am concerned about sugar causing my children to put on too much weight

Agree Completely
Agree Somewhat
Neither Agree nor Disagree
Disagree Somewhat
Disagree Completely

[SP PER STATEMENT]

12. Which of the following statements best describes your present situation? **(Read list)**

[DO NOT RANDOMIZE STATEMENT LIST]
I eat whatever I want and enjoy
I watch what I eat for nutritional reasons but I'm not concerned about my weight
I am watching the foods that I eat, because I am somewhat concerned about my weight, but I'm not actually on a specific weight reducing diet
I am on a diet because I am actively trying to lose weight

[SP]

13a. Which of these 3 statements do you most agree with? **(Read list)**

[DO NOT RANDOMIZE STATEMENT LIST]
I think sugar is basically good for you if eaten in moderation and should be included in your diet
I don't think sugar is particularly good for you, but it doesn't do much harm eaten in moderation
I think sugar is basically bad for you and should be avoided as much as possible

[SP]

13b. Thinking now about 'low-carbohydrate' or 'low-carb' diets (such as Atkins, South Beach, Montignac, etc.), please tell me if you agree completely, agree somewhat, neither agree nor disagree, disagree somewhat, or disagree completely with the following statements as they relate to your understanding and perceptions of 'low carbohydrate' diets. **(Read list)**

[DO NOT RANDOMIZE STATEMENT LIST]
Low-carbohydrate diets are effective for losing weight
Low-carbohydrate diets will help people lose weight and keep it off

Agree Completely
Agree Somewhat
Neither Agree nor Disagree
Disagree Somewhat
Disagree Completely

I have one more question about sugar but first I'd like to ask a few questions for classification purposes:

14a. Including yourself, how many people in total live in your household?

[ENTER NUMBER: 1-15]

[IF '1'/REF, SKIP TO Q15a. DO NOT ALLOW DK.]

14b. Please tell me how many members of your household, including yourself, fall into each of the following age groups: **(Responses must equal total number asked in previous question.)**

Adults 18 and over
Teenagers 13 - 17
Children 5 - 12
Children under 5

[ENTER NUMBER: TOTAL MUST EQUAL RESPONSE FROM 14a.]

[IF ANY DK / REF, CONTINUE TO Q15a]

15a. Do you personally work outside the home or not?

Yes
No

[IF YES ASK 15b; IF NO ASK 15c; OTHERWISE, SKIP TO Q16. DO NOT ALLOW DK]

15b. Would that be… **(Read list)**

[DO NOT RANDOMIZE LIST]
Full time, that is, 30 hours per week or more or,
Part-time, that is, less than 30 hours per week

[DO NOT ALLOW DK]

15c. Are you… **(Read list)**

[DO NOT RANDOMIZE LIST]
Retired / Pensioned
Student
Unemployed
Homemaker

[DO NOT ALLOW DK]

16. And what was the last year of formal education that you completed? **(Read list as necessary)**

Elementary / public school
Partial high school
Graduated high school
Partial Community College or technical school
Graduated Community college or technical school
Partial university
Graduated university

[DO NOT ALLOW DK]

17. What was the total income of your household before taxes in 2006? **(Read list as necessary)**

Under $20 000 per year
$20 000 to $29 999 per year
$30 000 to $39 999 per year
$40 000 to $49 999 per year
$50 000 to $59 999 per year
$60 000 to $69 999 per year
$70 000 or more per year

[SP]

18c. And one final question on sugar. To help Canadians make healthy food choices, the government publishes Canada's Food Guide to Healthy Eating. Which of the following statements best describes the information in Canada's Food Guide about sugar? **(Read statements)**

The use of sugar should be limited to reduce the risk of health problems
Canadians should carefully monitor their use of sugar to avoid unnecessary calories
Sugar is acceptable in moderation because it adds taste and enjoyment to a wide variety of foods
Canada's Food Guide does not mention sugar

[SP]

APPENDIX 3 MSVU Ethics Review Form

MSVU Ethics Review Application Form

Directions: All proposals submitted for review must have this cover sheet. You must include all relevant supporting documentation in final form (e.g. surveys, interview questions, informed consent forms). To facilitate the referencing of reviewers' comments on the submission, please ensure that the pages are appropriately numbered and that changes made to the proposal are clearly indicated when re-submission is required. Please forward the required number of copies to the Chair, University Review Ethics Board, located in the Research and International Office (RIO).

Note: If you are not sure that your research project requires ethics review, please consult with the Research Office before submitting an application.

The Number of Copies required:

Two copies – if the proposal is an Honours Thesis, Directed/Independent Study, or Class Project that has received departmental REB approval and does not exceed minimum risk.
Three copies – for all other proposals that do not exceed minimum risk.
Eight copies – for all proposals that exceed minimum risk.

Note – to complete this form click on the shaded box once to begin data entry

General Information

Date: October 22, 2009
Name of person(s) submitting application: Erin Horne
Title of project: Historical Trends in Attitudes, Knowledge and Behaviours Amongst Canadian Consumers: Analysis of Sugar Tracking Studies from 1998-2007
Department(s): Applied Human Nutrition
E-mail addresses: erin.horne@msvu.ca
Student: Erin Horne Supervisor: Dr. Theresa Glanville

Category of Researcher:

☐ Faculty
X Graduate Student - Program of Study/Degree MSc.AHN
Please specify: Graduate Project, Thesis or Independent Study? Thesis
☐ Honours Student
☐ Other (please specify):

Category of Research:

X Minimal Risk - Expedited Review
☐ Exceeds Minimal Risk
☐ Re-review

This project is currently under review by: ☐

Or

This project has already been reviewed by (**attach relevant documentation**):

☐ External agency / specify: ☐

☐ MSVU Committee on Research and Publications

☐ Thesis Committee (**NOTE**: A copy of the thesis proposal acceptance must be attached to your ethics application prior to review)

☐ Departmental Research Ethics Board

☐ Third party: (e.g., school board, hospital, etc.)

Specify and attach a copy of the approval (s) ☐

Funding/Sponsorship

Has this project received funding (internal or external): x Yes or ☐ No

If yes, please indicate the source of funding: Canadian Sugar Institute

Agreement: I/we have read the MSVU University Research Ethics Board (UREB) Instructions for Completion and Submission of Ethics Protocol Review, the MSVU Senate Policy on Ethical Conduct for Research Involving Humans, and the Tri-Council Policy Statement on the Conduct of Research Involving Humans and agree to comply with the policies and procedures outlined therein. In the case of student research, as Faculty Supervisor, my signature indicates that I have read and approved the application and proposal, deem the project valid and worthwhile, and agree to provide continuing and thorough supervision of the student(s). I/we have read and will make every effort to meet the requirements of the Tri-Council Policy Statement on Ethical Conduct for Research Involving Humans.

Signatures:

For Faculty/Staff Research Projects:

Signature(s) of investigator(s): Date:

For Students or Thesis Research Projects:

Signature(s) of student investigator(s): Date:

Signature(s) of Faculty Supervisor(s) Date:

A. Summary of Proposed Research

Describe the purpose of the research (maximum 500 words). Include enough background information to enable the UREB to understand the rationale for the study. This should be an overview of the proposed research and the purpose of the research: what are you doing and why?

Sucrose, also known as sugar, is a disaccharide that is found naturally in most fruits and vegetables. Added sugar, derived from either sugar cane or sugar beet, is an important constituent of many foods consumed by Canadians and has a role in the context of the total diet. Sugar is an important source of food energy contributing four kilocalories per gram and is required for optimal brain and body functions.

Despite the important role sugar plays as a dietary constituent, public perception is largely negative with consumption being blamed for the obesity epidemic, behavioural problems in children, dental caries, and increased disease risk. To a large extent, the media rather than scientific evidence have shaped these negative perceptions. There is controversy within lay and scientific literature on recommendations for sugar consumption and the role sugar plays in human health. However, media reports the research they see as popular even if evidence is lacking. A review of the literature on the role of sugars in human health, the guidelines for sugars consumption, sugars consumption in Canada, and the perceptions and attitudes of sugars consumption of Canadian's was done.

The literature has shown conflicting results for the role on sugars in human health. Consumption of sugars and risk for obesity has been controversial in the literature. High intakes of added sugars may be representative of a particular lifestyle that includes excessive energy consumption and a lack of physical activity resulting in weight gain. Obesity may be a common link for increased risk of developing chronic diseases. A diet high in added sugars could potentially contribute to an increased risk of developing diabetes, cardiovascular disease, and cancer by contributing to excess energy intake and being overweight and obese puts stress on

metabolic functions responsible for blood sugar and blood lipid control. Sugars alone however, have not been found to increase the risk for diabetes, cardiovascular disease, and cancer based on current research findings. Micronutrient dilution at moderate levels of added sugar intake has had controversial results and is more likely to occur at low levels than at high levels of consumption. Hyperactivity and sugars consumption in children has been disproved and dental caries can be preventable in most cases with proper dental hygiene.

National and international dietary guidelines have been developed to help the public choose foods to achieve optimal health. The guidelines that would directly influence Canadian's food choices would be the joint guidelines published by the Institute of Medicine (IOM), the United States Department of Agriculture (USDA), and Health Canada and the WHO/FAO guidelines. Professional organizations reflect these recommendations in their respective dietary statements. The guidelines for added sugars intake and the evidence behind the recommendations have been reviewed as well as the practical tools that reflect the guidelines and selected professional association guidelines.

Sugar consumption in Canada is estimated at 12-13% of total energy intake which falls within the recommended guidelines. We know little about the perceptions of Canadian consumers toward sugar consumption. General attitudes and knowledge of sugar in relation to other common food ingredients, the attitudes of sugar consumption on health, and the attitudes of sugar consumption in children are unknown. The Canadian Sugar Institute has conducted a tracking survey on a regular basis over the past decade. However, little has been done to analyze these data in order to present an historical overview of changing perceptions of Canadians.

Research Objectives

(1) Have the attitudes, knowledge, behaviors of sugar consumption changed among Canadians?

(2) Can predictors of attitudes of sugar consumption in the Canadian population be developed from the Sugar Tracking Studies?

B. Special Considerations

1. If the context of the research is "non-traditional" or specialized in any way (e.g., research in another culture, research with hard-to-access groups, research with mature minors, research with persons with special needs), describe the information that the UREB needs to keep in mind when reviewing this application.
2. Research with vulnerable persons
    a. One of the guiding ethical principles of The Tri-Council Policy on Conducting Research Involving Humans is respect for *vulnerable persons* who are "those whose diminished competence and/or decision making capacity make them vulnerable". Competence refers to "the ability of prospective subjects to give informed consent in accord with their own fundamental values".
    b. The Tri-Council Policy specifies that in regard to competence, researchers "must comply with all applicable legislative requirements". In Nova Scotia, the age of majority is nineteen. If research is undertaken with *mature minors* (i.e., adolescents under the age of majority but otherwise deemed competent to give informed consent), the researcher(s) must provide a detailed rationale explaining why parental/guardian consent is not needed.
    c. The researcher(s) should pay scrupulous attention to the possibility that a subject may be vulnerable as a result of a special need (e.g., difficulty reading print text). The researcher(s) should make all reasonable efforts to insure that subjects with special needs are respected and, to the extent possible, accommodated.
3. If the research project is but one component of a larger non-research study (e.g., international development project), describe briefly the larger context of the project.

N/A

C. Research Approach or Method

1. Describe your research method. How will you collect the data?
2. Describe/identify your participants.
3. Describe the procedure(s) for recruiting participants.
4. Outline any particular incentives you are using for participation (e.g., payment).

Ipsos ASI collected data from six surveys conducted by telephone interviews from Ipsos ASI's centralized interviewing facilities. Methodology was consistent for surveys administered in 1998, 2000, 2002, 2004, 2006, and 2007. Five hundred completed interviews from nine cities of a population greater than 100,000 were conducted. Quotas were used to ensure 80% female respondents and 20% male respondents. Age quotas for respondents were set at 18-64 years of age. The sample was randomly drawn from the 9 designated cities in 3 regions. Prior to final tabulations weighting adjustments were made to reflect regional proportions based on Statistics Canada census data.

D. Debriefing (if applicable) - Describe debriefing procedures

Debriefing occurs at the end of a study when the researcher provides participants with additional information. Debriefing is usually thought of in the context where the researcher uses deception in a study and therefore at the end of the procedure discloses to participants the nature of the deception and explains the rationale for its necessity. Participants at this point should be given the opportunity to withdraw their data from the study if possible. However, debriefing is also necessary to alleviate any potential negative effects of a procedure. For example, if the researcher believes that answering a certain type of question may cause distress in some participants, the researcher needs to help the participant deal with the distress. If the researcher is not qualified to deal with the negative consequences, is concerned the participants will not disclose the negative consequences, or that the negative consequences may occur at a later time after the procedure, the researcher needs to provide *all* participants with contact information for sources that can aid the participants.

E. Third Party Permission

1. If you are using data provided by outside agencies, explain how you will establish agency consent.
2. If data will be collected offsite (e.g., school boards, community agencies, etc.), describe how you will establish consent of third parties. Final approval is contingent upon the researcher's formal confirmation that third party permission has been granted.

The Canadian Sugar Institute has given consent to handle the data obtained from the Sugar Tracking Study Surveys for the purposes of this research. Ipsos ASI the Advertising Research Company conducted all surveys on behalf of the Canadian Sugar Institute. See appendix for confirmation letter from the Canadian Sugar Institute to conduct this research and consent to use the data obtained from the Sugar Tracking Studies.

F. Research Surveys, Questionnaires, Instruments, Etc.

1. Append of all documents in final form.
2. Indicate the sources of questions (e.g. public domain; developed by the researcher; etc.) and the relationship to the purpose of the study.
3. For instruments under copyright, the onus is on researcher(s) to obtain permission for use.

Six surveys developed by the Canadian Sugar Institute for the Sugar Tracking Studies were used. Methodology was consistent for surveys administered in 1998, 2000, 2002, 2004, 2006, 2007. See appendix for a sample of the questionnaire.

G. Risks

Minimal risk is defined as: "if potential subjects can reasonably be expected to regard the probability and magnitude of possible harms implied by participation to be no greater than those encountered in everyday life."

1. Specify and describe any potential risks to participants, making special note of situations that exceed minimal risk.
2. If there is the potential to incur risk, outline the safeguards that you will put in place to protect participants.

3. Please pay special attention to situations in which the researcher may have dual relationships with participants (e.g., professors using their own students as participants; counsellors whose clients may also be their research participants).

There are no risks to participants of the surveys as identification was removed prior to gaining access to the data therefore there is no way of identifying any individual with a specific response or participation in the study.

H. Free and Informed Consent

1. Informed Consent Forms must be placed on departmental letterhead and must address the points below.
2. Written informed consent is normally expected. If you believe written consent is impossible or unwarranted, explain why.
3. These items need to be explicit in the Informed Consent Form. These are:
    a. The identity of the researcher(s) and contact information, and supervisor information (if applicable);
    b. An invitation to participate;
    c. A statement of the research purpose;
    d. A description of the tasks to be performed and the expected time commitment;
    e. A description of foreseeable harm and benefits, including limitations to confidentiality
    f. Confirmation that prospective participants may decline participation or withdraw at any time without penalty;
    g. *An arm's length* contact in case of questions about the conduct of the research: "If you have questions about how this study is being conducted and wish to speak with someone who is not directly involved in the study, you may contact the Chair of the University Research Ethics Board (UREB) c/o MSVU Research and International Office, at 457-6350 or via e-mail at research@msvu.ca."
4. Please note that the consent of the participants shall not be conditional upon or include any statement to the effect that, by consenting, participants waive any legal rights.
5. If participants are a captive/vulnerable population, participants must be assured that non-participation will not affect their primary care in any way. For example, students must be assured that refusing to respond to a survey will not affect them academically. When it is not clear that potential participants have the capacity to provide informed consent, or if the research participants are from a population recognized as having diminished capacity to provide informed consent (e.g. children, adults with mental disabilities), informed consent must be obtained from an individual who bears responsibility for decisions concerning the well-being of the participant (e.g. parent, guardian, care-giver). When the participant is able to provide assent for the research (i.e. express their willingness to participate at the time of conducting the research), this should also be sought.
6. If participants are being photographed; videotaped and/or voice recorded, separate letters of consent must be attached to the Informed Consent Form.
7. Researcher(s) should provide a description of the criteria that they will use to judge assent/dissent of a participant in the protocol that they submit for review.
8. Parental consent is required for persons under the age of majority.
    a. Consent of both the child and the parent(s) are required in research studies where children are minors but are 7 years or older.

b. With children under 7, consent of the parent(s) only is necessary for the child's participation in research.

9. Attach the Informed Consent Form(s) to the application.

Please note that if you provide the above information in a *separate* information letter or introduction letter, it must be repeated exactly the same in the Informed Consent Form.

Describe how you will obtain Informed Consent:

Informed consent was obtained at the time of survey administration by Ipsos ASI.

Checklist for Informed Consent (On Letterhead)

✓ Introduction
✓ Invitation
✓ Research Purpose
✓ Researcher Identity
✓ Tasks Outlined
✓ Time Commitment
✓ Harms/Benefits
✓ Decline Participation
✓ Withdrawal Anytime
✓ Arm's Length Contact (UREB Chair)
✓ Special Population
✓ Obtaining Consent
✓ Signature area
✓ Special Consent for Audio
✓ Separate Consent for Photographs, Video

I. Privacy, Confidentiality, Anonymity

1. How will anonymity and/or confidentiality be maintained?
   - while collecting data (please identify situations in which confidentiality cannot be guaranteed (e.g. abuse; self-harm; etc);
   - after data collection (i.e. storage, disposal of raw data);
   - on resulting publications.
2. If you are utilizing secondary data, state its original source and confirm that the data does not allow for identification of participants.

The Canadian Sugar Institute has given consent to handle the data for the purposes of this research. Storage of the data will be on a password protected computer and confidentiality will be maintained. Ipsos ASI obtained informed consent at the time the surveys were administered. All identification was removed prior to gaining access to the data therefore, the identities of the individuals have been kept confidential and private from our eyes and there is no way to identify responses or participation in the study with any individual. Information obtained from analyzing this data will in no way harm those individuals nor can it be traced back to them. Records of the data will be kept for five years and after that point it will be destroyed.

J. Dissemination of Results

Describe how participants will be informed of the results of the study.

Presentation of results at the Dietitian's of Canada Annual Conference in May 2010.
Submission of research findings to a peer-reviewed journal.

APPENDIX 4 Distribution of Index Scoring

Figure 1. Distrubution of scaled behaviour index scores for all survey years

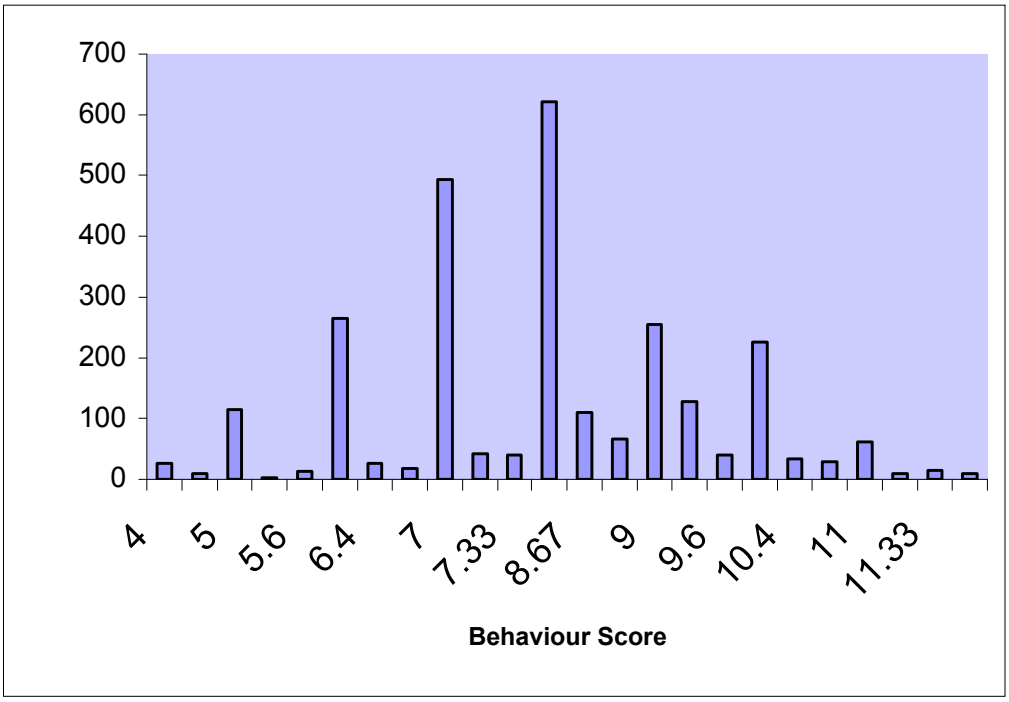


Figure 2. Distribution of scaled knowledge index scores for all survey years

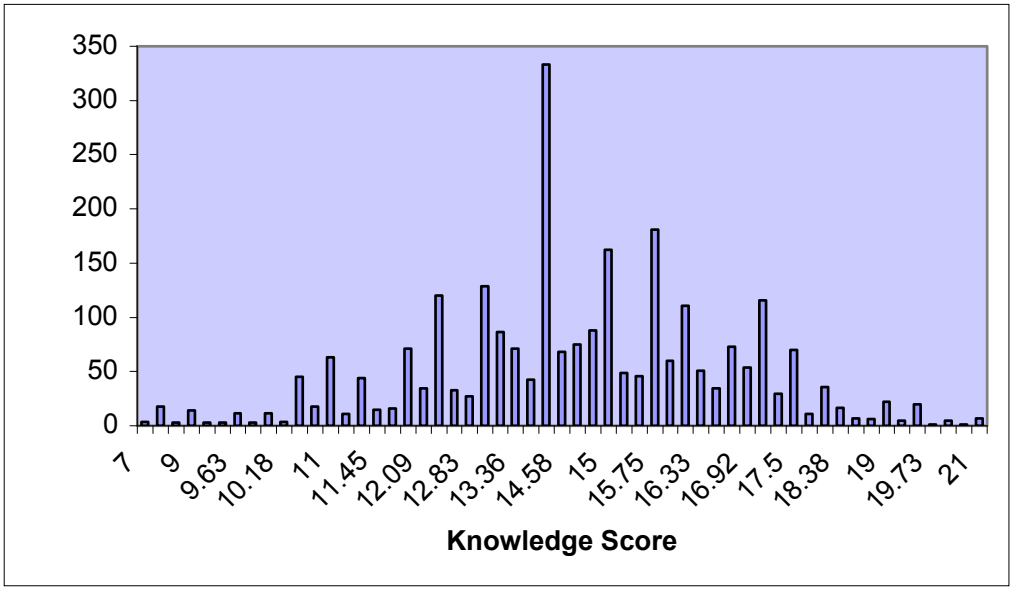
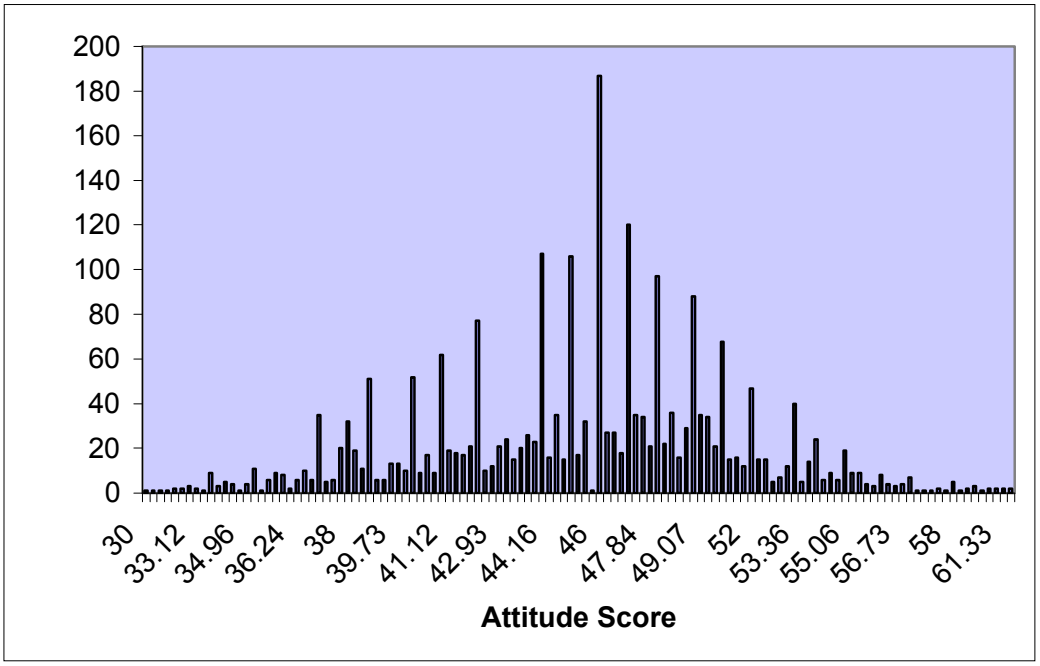


Figure 3. Distribution of scaled attitude index scores for all survey years



APPENDIX 5 Abstract submitted to the Canadian Public Health Association

Title: Knowledge, Attitudes, and Behaviours of Canadian Consumers toward Dietary Sugar

Introduction: Sugars, whether intrinsic or added, contribute to the functional properties of food by influencing taste, colour, texture and stability. Because sugars consumption contributes to total energy intake and glycemic load, research has examined the relationship to chronic disease outcomes. The Dietary Reference Intake Macronutrient Panel concluded that the evidence linking sugars intake to risk of obesity, cancer, diabetes and hyerlipidemia was insufficient to set a Tolerable Upper Level for total sugars intake. Despite the uncertainty, media messages often focus on negative aspects of sugars intake especially intake of added sugars.

Objective: The objective of this research was to assess the perceptions of Canadian consumers toward dietary sugar.

Methods: A 33-item questionnaire was administered by telephone to consumers residing in central and western urban locations of Canada biennially between 1998 and 2006 and in 2007. Index scores were developed to provide a summative measure of knowledge, attitudes and behaviours.

Results: In 2006 (n=304), the median index scores were: knowledge - 18 (range 11-26; maximum score=27; correct response); attitude - 32 (range 22-50; maximum score=60; positive attitude); and behaviour - 7 (range 4-11; maximum score=12; taking no steps to limit sugar intake). Typically consumers indicated they were limiting sugar intake for health and for weight control.

Conclusions: Consumers were knowledgeable about sugar yet have mixed perceptions regarding its role in health and whether intake should be limited. Future analysis will focus on predictors of sugar intake and the temporal changes in consumers' perceptions over the time frame of data collection.

APPENDIX 6 Abstract submitted to the Dietitians of Canada

Knowledge, attitudes, and behaviours of Canadian consumers toward dietary sugars

N.T. Glanville, E. Horne, Department of Applied Human Nutrition, Mount Saint Vincent University, Halifax, NS. [R]*

Sugars, whether intrinsic or added, contribute to the functional properties of food including taste, colour, texture, and stability. Although sugars consumption contributes to energy intake and glycemic load, the Dietary Reference Intake Macronutrient Panel concluded that the evidence linking sugars intake to risk of obesity, cancer, diabetes and hyperlipidemia was insufficient to set a Tolerable Upper Level. Despite this uncertainty, media messages often focus on negative aspects of sugars intake especially consumption of added sugars. **Objectives:** The Canadian Sugar Institute commissioned a national research firm to survey consumers' perceptions of sugars from 1998 to 2007. The objective of this research is to analyze this database for temporal trends and predictors of consumer perceptions of sugars intake. **Methods:** A 33-item questionnaire was administered by telephone to consumers residing in central and western urban locations of Canada biennially between 1998 and 2006 and in 2007. Questions were grouped into categories, assessed for internal consistency, and index scores were developed to provide a summative measure of knowledge, attitudes and behaviours. **Results:** Using 2006 as a reference year (n=304), the median index scores were: knowledge - 18 (range 11-26; maximum score=27; correct response); attitude - 32 (range 22-50; maximum score=60; positive attitude); and behaviour - 7 (range 4-11; maximum score=12; taking no steps to limit sugars intake). Typically consumers indicated they were limiting sugars intake for health and for weight control. I**mplications & Conclusions:** Preliminary analysis indicates that consumers were generally knowledgeable about dietary sugars yet had mixed perceptions regarding its role in health and whether intake should be limited.