Article

Identifying Consumer Mindsets Related to Sugars Consumption in Canadian Adults

Kátia Danielle Araújo Lourenço Viana [1] **, Sophia Davidov** [2] **, Olivia Morello** [2] **, Diana Mariela Puga Arguello** [2] **, Howard Moskowitz** [3] **and Nick Bellissimo** [2,*]

1 Department of Physiological Sciences, Federal University of Maranhão, 1966 Bacanga, Maranhão, São Luís 65080-805, Maranhão, Brazil
2 School of Nutrition, Toronto Metropolitan University, Toronto, ON M5B 2K3, Canada
3 Mind Genomics Associates, Inc., White Plains, NY 10605, USA
* Correspondence: nick.bellissimo@ryerson.ca; Tel.: +1-(416)-979-5000

Abstract: Little is known about the attitudes and perceptions towards dietary sugars in Canadian adults. The objective of this study was to use rule-developing experimentation (RDE) to identify consumer mindsets related to dietary sugars in 18–50-year-old Canadians. Following an isomorphic permuted experimental design, participants ($n = 269$) each rated a unique set of 24 scenarios, each consisting of a distinct mixture of two to four messages about dietary sugars on a 5-point scale. A regression model was created for each respondent, identifying the value that each respondent attributed to each of the 16 messages. K-means clustering revealed three distinct mindset groups as follows: "Sugars Beliefs" (MS1), "Trend Analysts" (MS2), and "Health Seekers" (MS3). In conclusion, this study found that RDE is a useful methodological approach for evaluating how consumers think about dietary sugars and revealed mindset-specific messages that matter most to people who differ in their attitudes toward sugars.

1. Introduction

The desire for sweet foods varies according to individual knowledge, attitudes, and eating habits [1,2]. Given the multitude of sugar types and sources [3], coupled with limited consumer knowledge around dietary guidelines for sugar intake, it is not surprising that consumers have a difficult time making evidence-based decisions around sugars consumption [4,5]. Total sugars consumption was estimated to be approximately 18% of total energy intake in Canadian adults in 2015 [6]. A report from Statistics Canada using data from 2015 suggested that the main source of sugars in Canadian diets was sugary beverages, accounting for 24% of total sugars consumption in adults [6]. Epidemiological and some experimental evidence has found that sugar consumption is associated with obesity, type 2 diabetes, cardiovascular disease, and metabolic syndrome [7–12]. When data from the 2004 Canadian Community Health Survey (CCHS) was compared to the 2015 data, there was a small decrease in daily intake of total sugars [6]. Findings from a survey conducted in 2020 of Americans aged 18–80 years suggested that respondents agreed that sugars consumption can negatively impact their health [13]. In addition, data from the 2017 Canada Food Study survey suggested that the majority of 16–30-year-old Canadians attempted to consume less sugar, and more consumers indicated attempts to consume less sugars (65.4%) in comparison to artificial (31.2%) or natural (24.0%) sweeteners [14]. The 2015 Tracking Nutrition Trends survey in adults aged $\geq$ 18 years found that most Canadians made an effort to consume less sugars in the 12 months prior and with increasing age were more likely to indicate attempts to consume less sugars [15].

The decline in sugars consumption may reflect the growing concerns around health risks related to sugars consumption. Tierney et al. [4] reported that limiting sugars intake

was considered an important factor in maintaining health. Another study in young adults found that providing sugars content on nutrition facts labels was identified as a strategy for reducing sugars intake [5]. Previous studies found that lower consumption of sugar-sweetened beverages was associated with higher levels of education [16], as well as a higher degree of knowledge regarding the negative health impacts of sugars [17,18]. Furthermore, consumers are acquiring their nutrition-related information from a large variety of sources. These include product labels [19] and internet-based sources, such as social media and scientific journals [20].

There are many barriers to understanding the thoughts, patterns, and behaviours of consumers, as they may be influenced by a range of factors from individual to environmental circumstances. Consumer behaviour concepts, such as the theory of reasoned action, have been established to help predict how individuals will behave based on their pre-existing beliefs and attitudes [21]. It is important to gain an understanding of consumer knowledge, attitudes, and beliefs about sugars to support evidence-based decision making for healthcare professionals who are committed to promoting more health-conscious food choices [22]. These findings may also be useful for market researchers and food product developers who are looking to cater to the interests and expectations of consumers. However, identifying the factors that influence consumers' food choices remains a challenge.

To address the foregoing challenges, rule-developing experimentation (RDE) [23] has been used to identify consumer preferences that emerge when respondents are presented with stimuli reflecting features of everyday life. RDE has been applied to different fields of research, including recent studies related to food, nutrition, and health [24–27]. The objective of the present study was to use RDE to identify consumer mindsets related to several aspects of dietary sugars, in the context of sugars-related beliefs and concerns, sources of sugars-related information, and knowledge of sugars consumption trends in 18–50-year-old Canadian adults.

2. Materials and Methods

This study protocol was approved by the Toronto Metropolitan University Research Ethics Board (#2021-104).

2.1. Study Sample

Adults (*n* = 269) aged 18–50 years and residing in Canada were eligible to participate in the study. After providing consent, respondents were directed to an online platform (BimiLeap®) to complete the study. Eligible participants were invited to participate in the study through a recruiting service platform, Luc.id, Inc. (New Orleans, LA, USA). Luc.id, Inc. is a digital respondent recruiting service for individuals who have provided consent to participate in survey-based research.

2.2. Methods

The dependent variable is attitudes towards sugars on a 1–5 anchored scale (1 = does not describe me and does not describe others, 2 = does not describe me . . . but describes others, 3 = just don't know, 4 = describes me . . . but does not describe others, and 5 = describes me and describes others). The independent variables were four categories of messages related to sugars beliefs, concerns around sugars consumption, sources of information on sugars, and knowledge of sugars consumption trends. The independent variables resulted in 16 messages that were randomly mixed into 24 combinations by a permutation scheme [28]. These elements were presented to respondents as declarative statements that served as the test stimuli for the study. The four categories and 16 elements are presented in Table 1. Each respondent rated a unique set of 24 vignettes, and each vignette contained a combination of two to four elements, with up to one element from each category. The experimental design ensures that elements from the same category never appear in a vignette together.

Table 1. Experimental design categories and elements for sugars consumption stimuli presented to study participants.

Code	Elements
	Question 1: What are the sugars beliefs?
1A	Belief: Sugars are hidden in a lot of foods that you would not expect to find them in
1B	Belief: Honey and agave syrup are better for you than table sugar and high fructose corn syrup
1C	Belief: Limiting consumption of foods that are high in sugars leads to better health
1D	Belief: Other than providing energy, sugars have no other nutritional benefits
	Question 2: Why are people concerned about consuming sugars?
2A	Concern: Diets high in sugars contribute to the development of obesity and type 2 diabetes
2B	Concern: Consuming sugars negatively affects the gut microbiome
2C	Concern: Sugars can cause fatty liver disease
2D	Concern: Consumption of sugars contributes to the development of joint pain and inflammation
	Question 3: Where do people get their information on sugars?
3A	Source of information: Friends and family
3B	Source of information: Healthcare professional
3C	Source of information: Social media sites
3D	Source of information: Scientific journals and government websites
	Question 4: What are the trends in total sugars consumption over the last 20 years?
4A	Total sugars consumption: Dramatically increased over the past 20 years
4B	Total sugars consumption: Slightly increased over the past 20 years
4C	Total sugars consumption: Slightly decreased over the past 20 years
4D	Total sugars consumption: Has remained the same over the past 20 years

2.3. Statistical Analysis

Ordinary least squares (OLS) regression was used to analyze the data from each respondent. An additive constant and coefficient values for the 16 elements were determined, representing the level of interest toward the topic as a whole, and the level of interest toward each of the 16 elements, respectively [29]. A detailed description of the statistical analysis has been published previously by Bellissimo et al. [30].

To perform the OLS regression for "describes me", respondent ratings were transformed into a binary scale. Ratings of 4 or 5 were transformed into a value of 100 ('Top2') and classified as positive outcomes, while ratings of 1–3 were transformed into 0 and classified as negative outcomes. For "does not describe me", ratings of 1–2 were transformed into a value of 100 ('Bot2') and ratings of 3–5 were transformed into 0. After the transformation, a small random number between 0.01 and 0.1 was added to make the variable continuous. K-means clustering was used to create participant clusters based on similarities in the ratings of the 16 elements. The clusters (i.e., mindset segments) consist of respondents who exhibited similar patterns in their evaluation of the elements. Each mindset group was given a name based on the dominant characteristics in each segment.

Analyses based on age, gender, and the classification question, "Where do you stand on sugars consumption and health?" were also performed. The classification included the following options: (1) I don't consume a lot of sugars and know it's bad for me, (2) I don't consume a lot of sugars and don't think it's a problem, (3) I consume a lot of sugars and don't think it's a problem, and (4) I consume a lot of sugars and know it's bad for me. The purpose of the classification question was to analyze response patterns by participants'

self-reported stance on sugars consumption and health. Pearson chi-square tests were used to assess the distribution of age and gender across the mindset segments.

All analyses were conducted using SYSTAT version 13 (SPSS Inc., Palo Alto, CA, USA) and IBM SPSS Statistics 27 (IBM, New York, NY, USA). Statistical significance was defined as $p < 0.05$.

3. Results

3.1. Participant Characteristics

A total of 269 Canadians participated in this study ($n = 173$ females, $n = 96$ males) with a mean age of 35.2 ± 9.2 years. Furthermore, the majority of respondents were 35–44-years-old ($n = 111$).

3.2. Mindset Segments

K-means clustering revealed three distinct mindsets as follows: Mindset 1 (MS1)—"Sugars Beliefs", Mindset 2 (MS2)—"Trend Analysts", and Mindset 3 (MS3)—"Health Seekers" (Table 2).

Table 2. Ordinary least squares (OLS) regression and K-means clustering of sugars-related elements for "describes me" and "does not describe me" in Canadian adults aged 18–50 years.

	Describes Me [1]				Does Not Describe Me [1]			
	Total Panel	MS1: Sugars Beliefs	MS2: Trend Analysts	MS3: Health Seekers	Total Panel	MS1: Sugars Beliefs	MS2: Trend Analysts	MS3: Health Seekers
Sample Size	269	89	96	84	269	89	96	84
Additive Constant	57.6	60.5	65.3	46.7	14.5	13.5	14.2	15.9
Question 1: What are the sugar beliefs?								
Belief: Sugars are hidden in a lot of foods that you would not expect to find them in	−1.4	8.3 *	−10.7	−1.2	1.8	−3.6	5.5 *	3.9
Belief: Honey and agave syrup are better for you than table sugar and high fructose corn syrup	−1.6	9.0 *	−10.8	−2.7	1.4	−2.0	4.9 *	1.2
Belief: Limiting consumption of foods that are high in sugars leads to better health	−1.6	9.1 *	−10.1	−3.7	2.5	−5.3	6.6 *	6.2 *
Belief: Other than providing energy, sugars have no other nutritional benefits	−1.6	11.9	−11.9	−3.5	0.4	−5.6	5.3 *	1.2
Question 2: Why are people concerned about consuming sugars?								
Concern: Diets high in sugars contribute to the development of obesity and type 2 diabetes	−2.5	−12.3	−5.9	11.0 *	0.9	0.7	3.1	−1.4
Concern: Consuming sugars negatively affects the gut microbiome	−1.8	−7.0	−8.1	10.8 *	0.7	−1.8	6.1 *	−2.6
Concern: Sugars can cause fatty liver disease	−0.6	−11.7	−4.1	14.5 *	1.5	4.3	2.6	−2.8
Concern: Consumption of sugars contributes to the development of joint pain and inflammation	−1.6	−8.5	−9.3	15.7 *	−1.4	−1.4	2.0	−6.2

Table 2. *Cont*.

	Describes Me [1]				Does Not Describe Me [1]			
	Total Panel	MS1: Sugars Beliefs	MS2: Trend Analysts	MS3: Health Seekers	Total Panel	MS1: Sugars Beliefs	MS2: Trend Analysts	MS3: Health Seekers
Question 3: Where do people get their information on sugar?								
Source of information: Friends and family	0.7	−2.5	−0.2	5.6	0.0	4.0	−2.0	−1.9
Source of information: Healthcare professional	1.1	−7.3	1.9	9.2 *	−0.9	5.8 *	−3.4	−5.5
Source of information: Social media sites	−0.2	−3.3	−0.2	1.7	1.6	3.7	−0.7	2.8
Source of information: Scientific journals and government websites	−1.7	−7.7	0.8	1.6	1.6	5.0	−2.3	2.0
Question 4: What are the trends in total sugar consumption over the past 20 years?								
Total sugars consumption: Dramatically increased over the past 20 years	0.7	−3.6	11.0 *	−7.5	0.3	2.0	−7.0	6.9 *
Total sugars consumption: Slightly increased over the past 20 years	0.2	−2.5	6.0	−3.6	−0.1	2.2	−3.9	1.7
Total sugars consumption: Slightly decreased over the past 20 years	−1.8	−4.4	8.8 *	−12.2	0.0	−0.6	−4.3	6.2 *
Total sugars consumption: Has remained the same over the past 20 years	−0.1	−4.6	8.4 *	−5.3	−0.3	0.4	−4.4	3.3

[1] Results stratified by "describes me" and "does not describe me" for each mindset. * Coefficient values are statistically significant ($p < 0.05$).

Individuals in MS1 identified most strongly with elements describing beliefs about sugars, including: "Sugars are hidden in a lot of foods that you would not expect to find them in", "Honey and agave syrup are better for you than table sugar and high fructose corn syrup", and "Limiting consumption of foods that are high in sugars leads to better health". Additionally, respondents in MS1 did not recognize themselves as individuals who seek information about sugars from health professionals, scientific journals, or government websites (Table 2).

Respondents in MS2 were interested in messages that describe trends in sugars consumption. These individuals showed interest in contradictory messages about sugars consumption trends within the last 20 years, with beliefs ranging from a drastic increase to a slight decrease in consumption, as well as stabilization of consumption. Additional analyses revealed that MS2 individuals held the belief that a dramatic increase in total sugars consumption over the past 20 years is something that "describes everyone" (i.e., everyone believes that this is true). Conversely, respondents in MS2 did not agree that consuming sugars has a negative effect on the gut microbiome, nor did they agree that "Sugars are hidden in a lot of foods that you would not expect to find them in", "Honey and agave syrup are better for you than table sugar and high fructose corn syrup", "Limiting consumption of foods that are high in sugars leads to better health", or "Other than providing energy, sugars have no other nutritional benefits".

As "Health Seekers", people in MS3 agreed that "Diets high in sugars contribute to the development of obesity and type 2 diabetes", "Consuming sugars negatively affects the gut microbiome", "Sugars can cause fatty liver disease", "Consumption of sugars contributes to the development of joint pain and inflammation", and their main source of information should come from healthcare professionals. Respondents in MS3 did

not agree that "Limiting consumption of foods that are high in sugars leads to better health" and, unlike respondents in MS2, they were not interested in messages about sugars consumption trends.

3.3. Sugars Consumption Elements Stratified by Sociodemographic Characteristics

Analyses by age group revealed that older adults (45–50 y) were concerned about the negative impacts of sugars consumption on health, particularly related to the relationship between sugars consumption and the development of fatty liver disease ($p < 0.05$). Furthermore, unlike younger age groups (18–44 y), participants between 45 and 50 years of age believed that total sugars consumption has increased dramatically over the last 20 years. Adults within the most prevalent age group in this study (35–44 years old, $n = 111$) were more interested in seeking information about sugars using social media sites compared to other age groups (Table 3).

Table 3. Ordinary least squares (OLS) regression of sugars-related elements stratified by age group and gender in Canadian adults aged 18–50 years.

| | Age (Years) | | | | Gender | | | |
| | | | | | Describes Me [1] | | Does Not Describe Me [1] | |
	18–24	25–34	35–44	45–50	Males	Females	Males	Females
Sample Size	49	70	111	39	96	173	96	173
Additive Constant	34.0	28.0	24.1	18.1	63.0	54.4	9.3	17.6
Question 1: What are the sugar beliefs?								
Belief: Sugars are hidden in a lot of foods that you would not expect to find them in	4.2	−1.0	−2.9	−0.4	−4.2	0.2	5.9 *	−0.5
Belief: Honey and agave syrup are better for you than table sugar and high fructose corn syrup	0.6	−3.8	−1.5	0.8	−3.5	−0.2	5.4 *	−1.2
Belief: Limiting consumption of foods that are high in sugars leads to better health	2.3	−1.9	−4.6	−3.4	−2.8	−0.9	6.2 *	0.3
Belief: Other than providing energy, sugars have no other nutritional benefits	2.0	0.1	−3.6	5.0	−4.4	0.2	3.7	−1.6
Question 2: Why are people concerned about consuming sugars?								
Concern: Diets high in sugars contribute to the development of obesity and type 2 diabetes	−6.0	1.3	−0.8	5.6	−2.3	−2.8	1.0	0.9
Concern: Consuming sugars negatively affects the gut microbiome	−3.1	0.3	0.1	5.3	−4.8	−0.0	2.5	−0.4
Concern: Sugars can cause fatty liver disease	−2.4	2.8	0.9	9.1 *	−0.6	−0.7	1.2	1.7
Concern: Consumption of sugars contributes to the development of joint pain and inflammation	−2.8	0.4	1.9	5.2	−6.9	1.2	1.4	−3.0
Question 3: Where do people get their information on sugar?								
Source of information: Friends and family	−2.7	−1.9	1.8	5.4	2.9	−0.4	−0.0	0.0
Source of information: Healthcare professional	−4.7	2.6	4.4	2.5	−0.6	2.1	1.7	−2.5
Source of information: Social media sites	−1.3	−1.4	6.1 *	0.6	−4.3	2.0	3.9	0.3
Source of information: Scientific journals and government websites	−2.1	−1.1	4.2	0.8	−3.8	−0.5	1.4	1.6

Table 3. *Cont.*

	Age (Years)				Gender			
					Describes Me [1]		Does Not Describe Me [1]	
	18–24	25–34	35–44	45–50	Males	Females	Males	Females
Question 4: What are the trends in total sugar consumption over the past 20 years?								
Total sugars consumption: Dramatically increased over the past 20 years	−3.9	4.7	4.0	9.0 *	−4.0	3.4	3.7	1.7
Total sugars consumption: Slightly increased over the past 20 years	−4.0	1.2	1.6	−0.6	−0.4	0.8	3.0	1.9
Total sugars consumption: Slightly decreased over the past 20 years	−8.4	3.2	−1.7	−1.7	−4.6	−0.0	3.5	−2.0
Total sugars consumption: Has remained the same over the past 20 years	−8.7	−0.1	−0.5	1.2	−5.0	2.8	3.3	−2.4

[1] Results stratified by "describes me" and "does not describe me" for each mindset. * Coefficient values are statistically significant ($p < 0.05$).

Males and females differed in their responses to sugars-related beliefs. Males did not describe themselves as consumers who believe or are interested in messages like "Sugars are hidden in a lot of foods that you would not expect to find them in", "Honey and agave syrup are better for you than table sugar and high fructose corn syrup", and "Limiting consumption of foods that are high in sugars leads to better health" (Table 3). Finally, chi-square analyses revealed no statistically significant association between age group ($X^2 = 5.394$, $p = 0.494$) or gender ($X^2 = 4.123$, $p = 0.127$) and mindset segment membership.

When presented with messages related to total sugars consumption trends, people who believed that sugars consumption has increased dramatically over the past 20 years also believed that "Sugars are hidden in a lot of foods that you would not expect to find them in". When asked, "Where do you stand on sugars consumption and health?", 29%, 21%, 21%, and 29% of respondents said, "I don't consume a lot of sugars and know it's bad for me, "I don't consume a lot of sugars and don't think it's a problem", "I consume a lot of sugars and don't think it's a problem", and "I consume a lot of sugars and know it's bad for me", respectively. However, none of the study elements were significant and did not differ among groups ($p > 0.05$; data not shown).

4. Discussions

This is the first study in Canadian adults to evaluate consumer mindsets related to dietary sugars using RDE, although previous research has been carried out on related topics using different methods [4,5,14]. The present study identified the messages that generated interest from respondents and revealed three distinct mindsets. MS1 showed interest in the following sugars beliefs from this study: "Sugars are hidden in a lot of foods that you would not expect to find them in", "Honey and agave syrup are better for you than table sugar and high fructose corn syrup", and "Limiting consumption of foods that are high in sugars leads to better health". Positive or negative beliefs can be perpetuated due to several factors and may lead to confirmation bias, which occurs when individuals pay selective attention to information or interpret evidence in ways that are partial to existing beliefs [31]. In this study, it was observed that participants in MS1—"Sugars Beliefs" do not recognize themselves as people who seek information on sugars from credible sources. Combined, these findings may suggest that individuals in MS1 hold strong beliefs about sugars consumption that may not be easily influenced by credible or evidence-based sources of information.

Interest in the message "Sugars are hidden in a lot of foods that you would not expect to find them in" aligns with a self-reported practice among consumers regarding seeking

nutritional information on food labels [4,32]. Although consumer understanding of and use of food labels varies, sugars content is among the most sought-after information on food labels [4]. In 2016, as a way to establish new mechanisms for more conscious food choices, the Food and Drug Administration in the United States required food manufacturers to implement "added sugar" information on labels as a subcomponent of total sugar content [33]. Based on this implementation, a recent study aimed to evaluate whether American adult consumers wanted to access or avoid the added sugars content information on labels and found that participants showed interest in accessing label information for added sugars [34]. Similarly, findings from this study suggest that consumers in MS1 may be interested in or familiar with seeking information about sugars content given that they believe sugars are "hidden in a lot of foods".

Based on reports from the Canadian Community Health Survey (CCHS—Nutrition), there was a reduction in total sugars intake from all foods and beverages in the Canadian population between 2004 and 2015 (mean daily intake: 93.0 g vs. 85.0 g/day) in adults aged 19 years and older [6,35]. Canadian consumers in MS2—"Trends Analysts" showed interest in messages about sugars consumption trends over the last 20 years, and despite the downward trend, this group believes that total sugars consumption has dramatically increased over the past 20 years. It is likely that social (e.g., family, friends) and environmental (e.g., food availability) influences, increased marketing on labels [36], and health policy strategies aimed at improving diet quality (e.g., food guides, front-of-package labeling, and various forms of taxation) contribute greatly to consumers' constant exposure to messages about sugars. This stimulates consumers' interest in messages about sugars, although they may not always seek reliable sources of information.

In general, Canadians describe their health and eating habits as good or excellent and report that they are striving to improve the quality of their diet by increasing the consumption of foods considered as "healthy" while reducing the consumption of some food components, including sugars [15,37]. This evidence corroborates the findings of the present study with respect to Canadians in MS3—"Health Seekers", who identified with messages related to sugars consumption and its health implications, such as: "Diets high in sugars contribute to the development of obesity and type 2 diabetes", "Consuming sugars negatively affects the gut microbiome", "Sugars can cause fatty liver disease", and "Consumption of sugars contributes to the development of joint pain and inflammation". This group also seeks advice from health professionals regarding sugars. Canadians generally consider the government/professional associations, family physicians, and dietitians to be the most reliable sources of information on food and nutrition [15]. However, many use the internet (e.g., social media, websites without specific qualifications) to seek out health information [20]. These findings may have important implications for healthcare professionals as those who identify with the health implications of sugars consumption also tended to seek information from health professionals. Targeted messaging to improve understanding about the health implications of sugars consumption may, in turn, also encourage individuals to seek advice and information from these professionals, who can provide evidence-based information to consumers about sugars.

We found that there was general agreement with the message, "I consume a lot of sugar and I know it's bad for me" across each mindset segment. Factors such as knowledge, attitudes, and habits can influence eating behaviours. However, it is also clear that even those who can identify foods that may reflect negatively on their health still encounter barriers that prevent them from translating their knowledge into habitual behaviours. Several studies that analyzed data from the CCHS found that ultra-processed foods are widely consumed among Canadians [38–40]; however, Canadians have also reported difficulty accessing healthy foods [37]. Individuals may have knowledge about the health effects and recommendations regarding sugars consumption, but not be able to implement those behaviours due to systematic or economic barriers in their environment. In addition to the food environment, attitudes towards sugars consumption (e.g., preferences, motivations to

eat, and amount of food eaten) can be driven by how these foods resonate emotionally [41]. Emotional responses towards sugars may influence beliefs and consumption patterns.

In the present study, we stratified the results by age group as it was important to consider the influence of age on nutrition knowledge, sugar beliefs, and sugars consumption trends. Our study found that adults between the ages of 45 and 50 years were concerned about some of the potential negative health impacts of sugars consumption. This is in line with a previous study that reported Canadian adults between the ages of 35 and 65 years consumed significantly less total sugars in comparison to younger adults aged 18–34 years [42]. Together, these findings support the notion that negative attitudes towards sugars may influence consumption, and that this relationship appears to grow stronger with age. The findings in the present study may also be, in part, due to a stronger interest in health or concerns about avoiding disease, as the susceptibility to disease often increases with age [43].

The present study has some limitations. The 16 elements tested in this study reflected the researchers' choices of everyday stimuli related to sugars consumption. However, not all predictors of sugars consumption were assessed. While this study provides an assessment of attributes related to overall sugars consumption, it did not address sugars consumption in its entirety. Findings from our study may be used to promote future work that could aim to explore beliefs about specific sources of sugars and food product categories. This exploration, paired with findings from this study, could provide a greater understanding of consumer beliefs about specific sugars and provide useful evidence for healthcare professionals and food product developers. While we collected some demographic information from participants, we were limited by the type of demographic data we could collect. Furthermore, we did not collect dietary intake data on the frequency of sugar consumption or other nutrients. Given the use of online surveys involving self-identified panelists and the cross-sectional study design, this sample may not be representative of the general population.

5. Conclusions

This study found that RDE is a useful methodological approach for evaluating how consumers think about dietary sugars that reveals mindset-specific messages that matter most to people who differ in their attitudes toward sugars. Future studies should continue to explore other beliefs, behaviours, and important topic areas regarding sugars consumption to gain a greater understanding of emerging mindsets in the Canadian population.

References

1. Gupta, A.; Smithers, L.G.; Harford, J.; Merlin, T.; Braunack-Mayer, A. Determinants of knowledge and attitudes about sugar and the association of knowledge and attitudes with sugar intake among adults: A systematic review. *Appetite* **2018**, *126*, 185–194. [CrossRef]
2. Tan, S.Y.; Tucker, R.M. Sweet Taste as a Predictor of Dietary Intake: A Systematic Review. *Nutrients* **2019**, *11*, 94. [CrossRef]
3. Bernstein, J.T.; Schermel, A.; Mills, C.M.; L'Abbe, M.R. Total and Free Sugar Content of Canadian Prepackaged Foods and Beverages. *Nutrients* **2016**, *8*, 582. [CrossRef] [PubMed]
4. Tierney, M.; Gallagher, A.M.; Giotis, E.S.; Pentieva, K. An Online Survey on Consumer Knowledge and Understanding of Added Sugars. *Nutrients* **2017**, *9*, 37. [CrossRef] [PubMed]
5. Prada, M.; Godinho, C.A.; Garrido, M.V.; Rodrigues, D.L.; Coelho, I.; Lopes, D. A qualitative study about college students' attitudes, knowledge and perceptions regarding sugar intake. *Appetite* **2021**, *159*, 105059. [CrossRef]
6. Langlois, K.; Garriguet, D.; Gonzalez, A.; Sinclair, S.; Colapinto, C.K. Change in total sugars consumption among Canadian children and adults. *Health Rep.* **2019**, *30*, 10–19. [PubMed]
7. Yin, J.; Zhu, Y.; Malik, V.; Li, X.; Peng, X.; Zhang, F.F.; Shan, Z.; Liu, L. Intake of Sugar-Sweetened and Low-Calorie Sweetened Beverages and Risk of Cardiovascular Disease: A Meta-Analysis and Systematic Review. *Adv. Nutr.* **2021**, *12*, 89–101. [CrossRef]
8. Te Morenga, L.A.; Howatson, A.J.; Jones, R.M.; Mann, J. Dietary sugars and cardiometabolic risk: Systematic review and meta-analyses of randomized controlled trials of the effects on blood pressure and lipids. *Am. J. Clin. Nutr.* **2014**, *100*, 65–79. [CrossRef] [PubMed]
9. Te Morenga, L.; Mallard, S.; Mann, J. Dietary sugars and body weight: Systematic review and meta-analyses of randomised controlled trials and cohort studies. *Br. Med. J.* **2013**, *346*, e7492. [CrossRef]
10. Stanhope, K.L. Sugar consumption, metabolic disease and obesity: The state of the controversy. *Crit. Rev. Clin. Lab. Sci.* **2016**, *53*, 52–67. [CrossRef]
11. Imamura, F.; O'Connor, L.; Ye, Z.; Mursu, J.; Hayashino, Y.; Bhupathiraju, S.N.; Forouhi, N.G. Consumption of sugar sweetened beverages, artificially sweetened beverages, and fruit juice and incidence of type 2 diabetes: Systematic review, meta-analysis, and estimation of population attributable fraction. *Br. Med. J.* **2015**, *351*, h3576. [CrossRef] [PubMed]
12. Janzi, S.; Ramne, S.; González-Padilla, E.; Johnson, L.; Sonestedt, E. Associations Between Added Sugar Intake and Risk of Four Different Cardiovascular Diseases in a Swedish Population-Based Prospective Cohort Study. *Front. Nutr.* **2020**, *7*, 603653. [CrossRef]
13. International Food Information Council. *2020 Food and Health Survey*; Food Insight: Durham, NC, USA, 2020. Available online: https://foodinsight.org/wp-content/uploads/2020/06/IFIC-Food-and-Health-Survey-2020.pdf (accessed on 1 May 2022).
14. Goodman, S.P.; Vanderlee, L.P.; Jones, A.P.; White, C.M.; Hammond, D.P. Perceived Healthiness of Sweeteners among Young Adults in Canada. *Can. J. Diet Pract. Res.* **2021**, *82*, 90–94. [CrossRef] [PubMed]
15. Canadian Foundation of Dietetic Research. *Tracking Nutrition Trends (TNT) Canada's Longest-Standing Consumer-Focused Nutrition Research Poll*; CFDR: Toronto, ON, Canada, 2015; Available online: https://www.cfdr.ca/Sharing/Tracking-Nutrition-Trends.aspx (accessed on 1 May 2022).
16. Gase, L.N.; Robles, B.; Barragan, N.C.; Kuo, T. Relationship Between Nutritional Knowledge and the Amount of Sugar-Sweetened Beverages Consumed in Los Angeles County. *Health Educ. Behav.* **2014**, *41*, 431–439. [CrossRef] [PubMed]
17. Hattersley, L.; Irwin, M.; King, L.; Allman-Farinelli, M. Determinants and patterns of soft drink consumption in young adults: A qualitative analysis. *Public Health Nutr.* **2009**, *12*, 1816–1822. [CrossRef]
18. Huffman, L.; West, D.S. Readiness to change sugar sweetened beverage intake among college students. *Eat. Behav.* **2007**, *8*, 10–14. [CrossRef]
19. Wills, J.M.; Schmidt, D.B.; Pillo-Blocka, F.; Cairns, G. Exploring global consumer attitudes toward nutrition information on food labels. *Nutr. Rev.* **2009**, *67* (Suppl. 1), S102–S106. [CrossRef]
20. Wang, Y.F.; Bellissimo, N.; Kitts, D.D.; O'Brien, H.T.; David Ma, W.L.; Suh, M.; Luhovyy, B.; DiAngelo, C.; Pasut, L.; Marsden, S.; et al. Knowledge and Perceptions of Carbohydrates among Nutrition-Major and Nutrition-Elective Undergraduate Students in Canada. *J. Am. Coll. Nutr.* **2021**, *40*, 164–171. [CrossRef]
21. Montano, D.; Kasprzyk, D. Theory of Reasoned Action, Theory of Planned Behaviour, and the Integrated Behavioral Model. In *Health Behavior Theory, Research and Practice*, 5th ed.; Glanz, K., Rimer, B., Viswanath, K., Eds.; Jossey-Bass: San Francisco, CA, USA, 2015.
22. Pinheiro, R.M.; Castro, G.C.D.; Silva, H.H.; Nunes, J.M.G. *Comportamento do Consumidor e Pesquisa de Mercado*, 3rd ed.; Publicações Fundação Getúlio Vargas (FGV) management, serie marketing; Fundação Getúlio Vargas (FGV): Rio de Janeiro, Brazil, 2006.
23. Moskowitz, H.R. 'Mind genomics': The experimental, inductive science of the ordinary, and its application to aspects of food and feeding. *Physiol. Behav.* **2012**, *107*, 606–613. [CrossRef]
24. Saluo, A.A.; Moskowtiz, H.R.; Gere, A.; Papajogji, P.; Lieberman, L.E.; Feurwerker, D. Linking Food Endorsement Labels & Messaging to Perceived Price and Emotions. A Mind Genomics Exploration. *Adv. Nutri. Food Sci.* **2019**. *ANAFS-152*. Available online: https://kosmospublishers.com/linking-food-endorsement-labels-messaging-to-perceived-price-and-emotions-a-mind-genomics-exploration/ (accessed on 1 May 2022).
25. Harizi, A.; Trebicka, B.; Tartaraj, A. A Mind Genomics Cartography of Shopping Behavior for Food Products During the Covid-19 Pandemic. *Eur. J. Med. Nat. Sci.* **2020**, *4*, 25–33. [CrossRef]

26. Gere, A.; Harizi, A.; Bellissimo, N.; Roberts, D.; Moskowitz, H. Creating a Mind Genomics Wiki for Non-Meat Analogs. *Sustainability* **2020**, *12*, 5352. [CrossRef]

27. Moskowitz, H.; Gere, A.; Roberts, D.; Nagarajan, D.; Harizi, A. Cultured Meat: A Mind Genomics Cartography of a Technology in its Infancy. *Edelweiss Food Sci. Technol.* **2020**, *1*, 38–44. [CrossRef]

28. Gofman, A.; Moskowitz, H.R. Improving customers targeting with short intervention testing. *Int. J. Innov. Manag.* **2010**, *14*, 435–448. [CrossRef]

29. Zemel, R.; Choudhuri, S.G.; Gere, A.; Upreti, H.; Deite, Y.; Papajorgi, P.; Moskowitz, H. Mind, consumers, and dairy: Applying artifical intelligence, mind genomics, and predictive viewpoint typing. In *Current Issues and Challeneges in the Dairy Industry*, 1st ed.; Ibrahim, S.A., Zimmerman, T., Gyawali, R., Eds.; IntechOpen: London, UK, 2020; pp. 59–77.

30. Bellissimo, N.; Gabay, G.; Gere, A.; Kucab, M.; Moskowitz, H. Containing COVID-19 by Matching Messages on Social Distancing to Emergent Mindsets-The Case of North America. *Int. J. Environ. Res. Public Health* **2020**, *17*, 8096. [CrossRef] [PubMed]

31. Nickerson, R.S. Confirmation bias: A ubiquitous phenomenon in many guises. *Rev. Gen. Psychol.* **1998**, *2*, 175–220. [CrossRef]

32. Cowburn, G.; Stockley, L. Consumer understanding and use of nutrition labelling: A systematic review. *Public Health Nutr.* **2005**, *8*, 21–28. [CrossRef]

33. Anon; United States, Food and Drug Administration. *Division of Field Investigations. Guide to Nutritional Labeling and Education Act (NLEA) Requirements [1994]*; AGRIS: Rome, Italy, 1996. Available online: https://agris.fao.org/agris-search/search.do?recordID=US9604625 (accessed on 1 May 2022).

34. Kim, E.J.; Ellison, B.; McFadden, B.; Prescott, M.P. Consumers' decisions to access or avoid added sugars information on the updated Nutrition Facts label. *PLoS ONE* **2021**, *16*, e0249355. [CrossRef] [PubMed]

35. Langlois, K.; Garriguet, D. Sugar consumption among Canadians of all ages. *Health Rep.* **2011**, *22*, 23–27. [PubMed]

36. Franco-Arellano, B.; Kim, M.A.; Vandevijvere, S.; Bernstein, J.T.; Labonté, M.-È.; Mulligan, C.; L'Abbé, M.R. Assessment of Packaged Foods and Beverages Carrying Nutrition Marketing against Canada's Food Guide Recommendations. *Nutrients* **2019**, *11*, 411. [CrossRef]

37. Schermel, A.; Mendoza, J.; Henson, S.; Dukeshire, S.; Pasut, L.; Emrich, T.E.; Lou, W.; Qi, Y.; L'Abbé, M.R. Canadians' perceptions of food, diet, and health–a national survey. *PLoS ONE* **2014**, *9*, e86000. [CrossRef] [PubMed]

38. Nardocci, M.; Polsky, J.Y.; Moubarac, J.-C. Consumption of ultra-processed foods is associated with obesity, diabetes and hypertension in Canadian adults. *Can. J. Public Health* **2020**, *112*, 421–429. [CrossRef] [PubMed]

39. Nardocci, M.; Leclerc, B.-S.; Louzada, M.-L.; Monteiro, C.A.; Batal, M.; Moubarac, J.-C. Consumption of ultra-processed foods and obesity in Canada. *Can. J. Public Health* **2018**, *110*, 4–14. [CrossRef] [PubMed]

40. Moubarac, J.-C.; Batal, M.; Louzada, M.L.; Martinez Steele, E.; Monteiro, C.A. Consumption of ultra-processed foods predicts diet quality in Canada. *Appetite* **2017**, *108*, 512–520. [CrossRef] [PubMed]

41. Jiang, Y.; King, J.M.; Prinyawiwatkul, W. A review of measurement and relationships between food, eating behavior and emotion. *Trends Food Sci. Technol.* **2014**, *36*, 15–28. [CrossRef]

42. Bergeron, A.; Labonté, M.-È.; Brassard, D.; Bédard, A.; Laramée, C.; Robitaille, J.; Desroches, S.; Provencher, V.; Couillard, C.; Vohl, M.-C.; et al. Intakes of Total, Free, and Naturally Occurring Sugars in the French-Speaking Adult Population of the Province of Québec, Canada: The PREDISE Study. *Nutrients* **2019**, *11*, 2317. [CrossRef] [PubMed]

43. World Health Organization. *Risk Factors of Ill Health among Older People*; Fact Sheets: San Diego, CA, USA, 2011. Available online: https://www.who.int/europe/news-room/fact-sheets/item/risk-factors-of-ill-health-among-older-people (accessed on 1 May 2022).