

Food packaging during the COVID-19 pandemic: Consumer perceptions

Robert Kitz  | Tony Walker | Sylvain Charlebois  | Janet Music

Dalhousie University, Halifax, NS, Canada

Correspondence

Robert Kitz, Dalhousie University, Halifax, NS, Canada.

Email: robertkitz@dal.ca

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Abstract

While plastics play an important role in the safety, shelf-life, and affordability of many foods, their mismanagement as waste presents a serious environmental problem. In 2019, governments in Canada and globally were poised to take legislative action to curb the use of single-use plastics, with strong public support. However, the COVID-19 pandemic has since disrupted those initiatives as well as the public sentiment underlying them. The aim of our study is to measure changes in Canadian consumers' attitudes toward single-use plastic food packaging, from Summer 2019 to Summer 2020. The methodology relies on two, representative surveys of the Canadian population, carried out in May 2019 ($n = 1,094$) and in June 2020 ($n = 977$). Our measures explored potential impacts on consumer perceptions, driven both by new food safety concerns during the pandemic and also by increased price consciousness during a time of economic recession. We found that 55% of respondents were more concerned about food safety since COVID-19, and that 50% of respondents had become more price conscious when buying groceries. However, we found only a slight decline in motivation to reduce plastics – though with a sharper reduction among males. A stronger shift was seen in attitudes towards policy, where our results show a clear decline in support for tighter regulations or bans on single-use plastics, along with an increase in consumers' willingness to pay for biodegradable alternatives. These findings suggest a more difficult road ahead for legislative approaches, but also potential opportunities for market-based strategies and innovations in the food sector.

KEYWORDS

consumer responses, COVID-19 pandemic, food packaging, food safety crisis, single-use plastics

1 | INTRODUCTION

While its full implications remain to be seen, it is already clear that the COVID-19 pandemic has emerged as a major world event with far-reaching consequences. This crisis has suddenly and dramatically altered numerous aspects of our everyday lives and behaviours. For example, the mismanagement of personal protective equipment during the COVID-19 pandemic, along with increased use of single-use plastic grocery bags and other food packing, is resulting in widespread environmental pollution (Prata et al., 2020; Silva, Prata, Walker,

Campos, et al., 2020; Silva, Prata, Walker, Duarte, et al., 2020). As the ramifications of the virus, and the ensuing lockdowns, continue to unfold, two major areas of concern are the impact on food systems and the impact of mismanaged plastic food packaging on the environment (e.g. Cranfield, 2020; Degnarain, 2020; Galanakis, 2020; Pressman et al., 2020). At the intersection of these two areas is the issue of single-use plastic food packaging (Walker et al., 2021).

It is already known that COVID-19 is having a major impact both on consumer shopping habits and on dietary habits (Ammar et al., 2020; Sheth, 2020). Media reports also suggest that, during

the COVID-19 pandemic, consumers and policymakers have responded to an increased perception of food safety risk by increasing their reliance on single-use plastic food packaging (Bologaro, 2020; Canadian Grocer, 2020; Chua, 2020). Attitudes towards food packaging have major implications both for food policy and for environmental policy (Walker et al., 2021). If these consumer attitudes have shifted during the COVID-19 pandemic, such a finding has practical, short term implications for industry and policymakers, but also more general significance in contributing to our understanding of how consumers respond to crises.

The aim of our study is to measure changes in Canadian consumers' attitudes toward single-use plastic packaged foods, from Summer 2019 to Summer 2020. A survey of 1,014 Canadians from Summer 2019 found that most (93.7%) respondents were personally motivated to reduce consumption of single-use plastic food packaging (Walker et al., 2021). More specifically, we hope to determine what impact the COVID-19 pandemic has had on these attitudes, and to explore the determinants of these effects. The role of socio-demographic factors is explored, including gender, age, income, region, education, number of children and urban/rural differences. In addition, and drawing from previous literature on consumer responses to crises, we explore two potential mechanisms for the pandemic's impact on consumer attitudes: first, a potential increase in food safety concern (Nardi et al., 2020; Wilcock et al., 2004), and second, a potential increase in price consciousness (Hampson & McGoldrick, 2013, 2017).

2 | BACKGROUND AND DEVELOPMENT OF FRAMEWORK

While each crisis presents as a unique, 'Black Swan' type event, crises in general, are quite commonplace. Out of the array of past crises, of many distinct types, emerges a Literature of Crisis that constitutes a broad foundation for our understanding of any crisis (Prentice et al., 2020).

'A crisis can be understood as some unforeseen event that creates uncertainty, threatening daily routines and putting the accomplishment of certain personal ends to a risk' (Koos et al., 2017; Kutak, 1938). As Koos et al., (2017) argue, crises do not occur in a vacuum, but within a particular cultural, institutional, cultural, and social context. Crises act both on consumers and on institutional systems, where the consumers and the systems are themselves mutually related. Out of these inter-relations emerge a shift in attitudes, and a shift in consumption patterns. However, before considering the nature of the crisis and its effects, it is important to offer some background on the study subject: single-use plastic food packaging (Foroudi et al., 2020).

2.1 | Environmental impacts of plastic packaging

Plastic pollution – and particularly pollution resulting from single-use plastics packaging – is recognised as a significant environmental

threat (Schnurr, et al., 2018; UNEP, 2018). Even when waste streams are well-managed, global volumes of waste are a serious issue; greenhouse gas emissions from solid waste account for almost 5% of total global emissions (Hoorweg et al., 2013; Hoorweg & Perinaz, 2012; Walker & McKay, 2021). Further harm results when plastics leak out of that system (either through litter or through mismanagement), resulting in plastic pollution in the natural environment (Environment & Climate Change Canada, 2020; Walker, 2018; Xanthos & Walker, 2017). In particular, marine plastics are a major threat, and plastic packaging is identified as a major source of marine plastic pollution (Schnurr, et al., 2018). For this reason, national and international organisations, including the Government of Canada, have pursued a number of campaigns aiming to curb plastics waste (Government of Canada, 2019; UNEP, 2018; World Economic Forum, 2016).

At the same time, plastic food packaging performs an important role in ensuring an efficient and sustainable food production system. For many food products, the vast majority of their environmental impact is due to production, with packaging contributing a relatively minor impact (Barlow & Morgan, 2013). Food production is an extremely energy- and resource-intensive industry; plastic packaging has the potential to achieve a net positive environmental impact where it serves to curb food waste through improved preservation (Barlow & Morgan, 2013; Dilkes-Hoffman et al., 2018; Ingarao et al., 2017; Williams & Wikström, 2011). A full life cycle assessment of food products offers a complete picture of environmental impacts and their relative importance (Ahmad et al., 2019; Manfredi et al., 2015).

What life cycle assessments make clear is that generalisation about the role of packaging is not possible; results vary dramatically between food types (Heller et al., 2018). For example, where beef is packaged in plastics, the environmental footprint of the packaging is basically insignificant compared to the impact of beef production (Barlow & Morgan, 2013). But in contrast, for beverages or some types of produce (e.g. farmed spinach) the roles are reversed, and packaging provides the major environmental impact (Heller et al., 2018). Thus, the general policy goal may be to reduce plastics pollution (Schnurr, et al., 2018), but such a goal must be pursued holistically, and with sensitivity to the array of competing concerns. A single-minded focus on plastics reduction creates a real risk of adverse, unintended consequences (Abbott & Sumaila, 2019).

2.2 | Plastic packaging and food policy

Beyond its environmental impacts, plastic packaging plays an important role in the food system. The evolution of food packaging – and particularly of plastic food packaging – has played an instrumental role in the development of modern food supply systems and modern consumer expectations (Risch, 2009). Food affordability, food shelf-life, and food safety are all areas where plastic packaging currently plays a major role (Barlow & Morgan, 2013). In light of the COVID-19 pandemic, plastic's role as a guarantor of food safety is

emphasised. At present, expert advice suggests that the actual risk of food-borne transmission of COVID-19 is extremely low (Canadian Food Inspection Agency, 2020; Centers for Disease Control & Prevention, 2020; Desai & Aronoff, 2020). There is little rational basis for a strong impact on food packaging issues. But the subjective impact may still be strong, where consumer attitudes are easily driven by irrational influences (e.g. Miyata & Wakamatsu, 2016; Nardi et al., 2020).

Research shows that it is subjective knowledge and attitudes, rather than objective knowledge, that are the key determinants of consumer risk perception, and hence of consumer behaviour (Nardi et al., 2020; Verbeke, 2005; Wansink, 2004). Particularly in a crisis, consumers must make decisions on the basis of imperfect information, moderated by a range of contextual, demographic, and attitudinal factors (Schroeder, et al., 2007; Wansink, 2004). Subjective attitudes towards risk, coupled with subjective perceptions of the current risk, play a key role in differentiating between those who react strongly to a food scare versus those who 'just don't care' (Rieger et al., 2017; Turvey et al., 2010). In the absence of perfect information, a crucial determinant of risk perception is the degree of trust, both in institutions and in food sources (Charlebois et al., 2015; de Jonge et al., 2008; Verbeke, 2005). Food safety crises threaten to undermine this trust by exposing failures in the systems expected to guarantee consumer safety (Mossel et al., 1998; Wilcock et al., 2004).

Trust in food safety can be viewed as one of many antecedents to consumers' willingness to choose green alternatives versus plastic food packaging. Ketelsen et al., (2020) conducted a systematic review of studies relating to consumers' reactions to green packaging. Their review found that consumers support green packaging, but three important barriers prevent their actually choosing green packaged products: (a) consumers lack guidance to choose environmentally friendly packaging and are easily misled by design elements; (b) consumers lack knowledge to understand environmental benefits of different packaging options; and (c) consumers value other attributes such as price and product quality more highly than environmentally friendly packaging. Furthermore, most of the reviewed studies measured attitudes or intentions; an additional hurdle is the intention-behaviour gap, where intentions to act a certain way (i.e. to shop sustainably) fail to translate into real-world behavioural change (Sheeran & Webb, 2016).

2.3 | Crises and food consumer attitudes

2.3.1 | Food safety crises

Consumers have faced an array of food scares over the previous decades. In particular, food safety scares related to products of animal origin (i.e. meat, dairy, eggs) have been found to impact food safety risk perception (Mehroliya et al., 2020; Nardi et al., 2020).

Bovine spongiform encephalopathy (BSE) outbreaks have occurred in a number of nations – including Canada – with a significant

impact on consumer attitudes and behaviour. In Japan, a BSE outbreak was associated with a significant drop in beef demand, and an observed willingness to pay a greater than 50% premium for BSE-tested beef (McCluskey et al., 2005). In the UK, a BSE outbreak also produced a short-term drop in demand, and even four years after the outbreak a long-run reduction to the beef market of 4.5% (Burton & Young, 1996). In contrast, in Canada, BSE outbreaks in 2003 and 2005 were in fact associated with increased beef consumption in each year (Ding et al., 2013). Consumer willingness to continue consuming beef even in the face of a BSE crisis has been associated with a high level of trust in Canadian food safety institutions (Charlebois & Labrecque, 2007; Ding et al., 2013). However, it should also be noted that the aggregate increase in demand masks heterogeneity across several variables: demand for beef dropped in Ontario (a non-beef producing region) but not in Alberta (where beef is produced) (Maynard et al., 2008); demand dropped amongst households with lower initial beef expenditure shares (Ding et al., 2011); and demand dropped in households with different risk attitudes and perceptions. (Yang & Goddard, 2011) A further determinant of the impact of food scares, emphasised by much of the literature, is the role of communications and firms' crisis management as a means of mitigation (Jones & Davidson, 2014; Liao et al., 2020).

In 2012, Canada experienced its largest ever food recall following an *E. coli* outbreak in ground beef. Charlebois et al., (2015) found a short-term decrease in demand, but no significant long-term impact on either beef purchasing behaviour or trust in food safety. This is consistent with the findings on BSE in Canada and fits with findings in the USA that show heterogeneous responses to *E. Coli* recalls between regions, with demand declining in some but not all regions. (Shang & Tonsor, 2017) Taken together, these studies indicate that food safety scares can alter consumers' perceptions, but analysis must be specific to particular regional and demographic characteristics.

2.3.2 | Environmental crises

Environmental disasters are another category of crisis with the potential to affect food safety perceptions. Nuclear disasters are a well-studied example, where the threat of radioactive contamination may have a high impact on consumers. Grande et al. (1999) examined risks perceptions related to radioactivity from the Chernobyl disaster in both Scotland and Norway. They found that consumers perceived the risks, and altered their behaviour, in both Nations, but variably according to income, gender, education, and family size. However, the variables of education and family size had opposite effects between nations, with more educated Norwegians, and larger Norwegian households, taking more actions to reduce risk, while these factors have the opposite influence in Scotland. In both countries, women, older consumers, and low-income households exhibited higher rates of risk perception.

The Fukushima disaster provides a more recent, and well-studied example of another nuclear incident. Multiple studies have

examined the impact of the Fukushima meltdown on demand for the region's food products (Aruga, 2017; Ujiie, 2012; Wakamatsu & Miyata, 2017). Particularly for seafood, research shows a substantially reduced willingness to pay for food from the Fukushima region (Wakamatsu & Miyata, 2017). Miyata and Wakamatsu (2016) found that reputational damage could be partially mitigated through packaging and labelling strategies to reassure consumers of product's safety. Frank and Schvaneveldt (2014) offer an interpretation of consumer responses beyond simple avoidance; instead, they situate the question within a line of disaster sociology literature that emphasizes social resilience and altruism in the face of disasters. (Drury et al., 2009; Dube & Black, 2010; Levine & Thompson, 2004). Based on this literature, Frank and Schvaneveldt identified a relatively weak but still significant role for collective identity as a force to boost consumption of effected products, as a show of support for the Fukushima region.

2.3.3 | Economic crises

Economic crises are a distinct type of crisis, with another set of implications for food consumers. The COVID-19 pandemic is unfolding as both a health crisis, and an economic crisis. As of June 2020, the IMF projects a -4.9% contraction in global GDP including a -8% contraction in developed economies (IMF, 2020). In Canada, the Parliamentary Budget Officer projects a -6.8% contraction in national GDP (Parliamentary Budget Officer, 2020). It is the worst recession since the Great Depression, and far more severe than the Global Financial Crisis of 2008 (Gopinath, 2020). At the same time that the economy is cratering, consumers face uncertainty about the path of food prices.

It does not appear that the early stages of the pandemic have led to a sharp price shock in food prices (Cranfield, 2020). Nevertheless, food prices have been facing upward pressures over recent years, even apart from COVID-19, and it is important to recognize that even relatively stable price levels represent a year over year increase higher than any other major category of goods (Charlebois et al., 2020; Statistics Canada, 2020). In a generally deflationary environment, 2%-4% food inflation stands out as a sizable increase, even if it falls short of worst-case scenario spikes. Furthermore, researchers voice significant uncertainty over the medium- and long-term trends. Deaton and Deaton (2020), along with Cranfield (2020), cite key factors that could lead to substantial increases in the cost of food, including the additional costs of operating within new safety regulations, along with disruptions to international trade, supply chains, and labour supply.

A recent precedent for these dynamics can be found in the aftermath of the 2008 Financial Crisis, where global food prices experienced a sharp spike even as general inflation was extremely low (Rollin, 2015). A major concern during periods of food inflation is the impact on food security (Headey, 2013). Beyond the question of food security, researchers can ask what the effects on consumer preferences and attitudes are – particularly when food inflation is

higher among some food types than among others. A UK study by Griffith et al. (2015) found that changes in the relative prices of food following the financial crisis, led to substitution effects in purchasing behaviour (as expected). Further, researchers in both Spain and the United States have found that unemployment leads to a drop in food expenditure as households seek to economize (Aguar & Hurst, 2005; Antelo et al., 2017). Antelo et al., (2017) find that this effect is exaggerated during times of economic crisis. With high unemployment and volatile food prices, we should therefore expect shifts in consumer food demand.

Furthermore, studies indicate that consumers become more price conscious during an economic crisis (Hampson & McGoldrick, 2013, 2017; Steenkamp & Maydeu-Olivares, 2015). This entails a shift away from premium items such as Fair Trade products (Bondy & Talwar, 2011), along with an increase in purchases from private labels (Lamey et al., 2007). Hampson and McGoldrick (2017) argue that reductions in financial well-being are only one driver in increased price-consciousness; consumers also respond to shifts in social norms. COVID-19 presents a novel instance where widespread financial precarity arrives at the same moment as numerous widespread shifts in norms, behaviours, and environmental cues. As Cranfield (2020) notes, the actual path of consumer demand for food will be shaped by simultaneous shifts in preferences, behaviours, and attitudes. Sarmiento et al., (2019) conducted qualitative interviews with Portuguese consumers during a recessionary period to identify a different set of shopping strategies consisting of: (a) more organisation and planned behaviour; (b) going shopping more frequently; (c) reducing stocking behaviour, and (d) avoiding wasting. It remains to be seen, how these general tendencies of behaviour during a recession, will interact with the wide range of other behavioural changes brought on by the COVID-19 pandemic. It is suggested that increased price consciousness should translate into a decrease in willingness to pay for green packaging.

2.3.4 | Single-use plastics and COVID-19

Several studies have already highlighted the importance of reducing our dependence on single-use plastics despite the COVID-19 pandemic (Grodzińska-jurczak et al., 2020; Parashar & Hait, 2020; Prata et al., 2020; Silva, Prata, Walker, Campos, et al., 2020; Silva, Prata, Walker, Duarte, et al., 2020). Before the COVID-19 pandemic swept the world, many countries were already adopting aggressive reforms to reduce the amount of plastic waste generated in the food industry (Adam et al., 2020; Bezerra et al., 2021; Clayton et al., 2020; Schnurr et al., 2020; Xanthos & Walker, 2017). Much attention has already been given to how perceptions would impact policies and strategies looking at eliminating plastics (Walker et al., 2021). However, the COVID-19 pandemic has increased the use of single-use plastic used for take-out and fast food and even reversal of some policies to ban plastic bags (Prata et al., 2020; Silva, Prata, Walker, Campos, et al., 2020; Silva, Prata, Walker, Duarte, et al., 2020). Thus, the

COVID-19 pandemic offered an opportunity to challenge the level of some of our commitments to eliminating plastics in the food industry (Hale & Song, 2020).

2.4 | Conceptual framework

Drawing on this literature of both food safety and economic crises, we develop the following framework to guide the development of the survey instrument and conceptual analysis. The framework hypothesizes two distinct mechanisms, each mediated by demographic factors, by which the COVID-19 pandemic may impact consumer attitudes towards single-use plastics food packaging. First, the pandemic may undermine trust in food systems through an increase in food safety concern, driving consumers to re-assess plastics as a guarantor of food safety. Second, the financial recession may increase consumer's price consciousness, undermining their perceptions of the value for money offered by alternative biodegradable packaging options.

3 | METHODOLOGY

3.1 | Participants

The study relies on data collected from two separate public opinion surveys. The first survey was conducted in May 2019, as an exploratory study of Canadian consumers' attitudes towards single-use plastic food packaging, and potential policies to mitigate plastics pollution (Walker et al., 2021). A voluntary survey was conducted across Canada, in collaboration with Angus Reid, using the Qualtrics online survey platform. Angus Reid is a well-established field house in Canada and is a member of the Canadian Marketing Association. The survey was available in both English and French, across all regions of the country. All respondents were required to have lived in Canada for at least 12 months and to be at least 18 years of age. Survey results were weighted by age and gender in each region, to correct for any sampling bias and non-response bias. 1,112 responses were collected. Incomplete responses were removed as were those of respondents who completed the survey in under 3 min; this yielded 1,094 valid responses.

The second, follow-up survey was conducted in June 2020. Again the survey was conducted through the Qualtrics platform, in collaboration with Angus Reid, and offered across the country in both English and French. Both surveys have similar demographic guidelines. As in the previous survey, all respondents were required to have lived in Canada for at least 12 months and to be at least 18 years of age. Survey results were weighted by age and gender in each region, to correct for any sampling bias and non-response bias. A total of 1,084 responses were collected. Incomplete responses were removed, as were those of respondents who completed the survey in under 3 min; this yielded 977 valid responses.

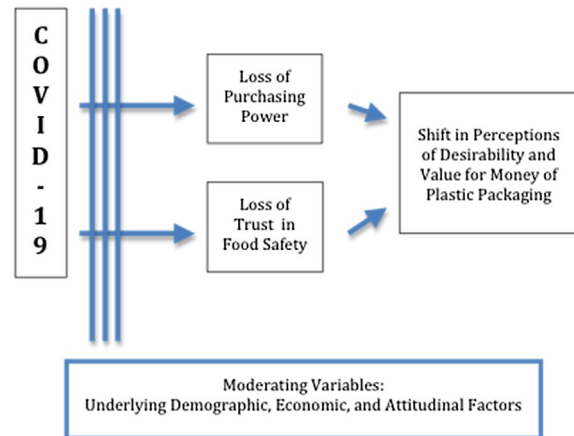


FIGURE 1 Conceptual framework of the study

3.2 | Measures

A conceptual framework was developed, to guide the study and serve as analytical tool (Figure 1). From this, a quantitative survey was developed using a series of statements and 5-point Likert scale (1 Strongly agree, 2 Somewhat Agree, 3 Neither Agree nor Disagree, 4 Somewhat Disagree, 5 Strongly disagree). The non-cross-sectional survey was divided into three parts. First, the socio-economic determinants of respondents were collected (i.e. age, gender, income, education, region and marital status...). Second, the survey measured changes in attitude toward plastic packaging by gauging consumers' commitment to plastics reduction, support for plastics bans, willingness to pay for biodegradable alternatives, and reported change in plastics purchasing behaviour since the onset of the COVID-19 pandemic. Finally, the survey sought to investigate the two prongs of the conceptual framework: changes in purchasing power and price consciousness, and changes in food safety concern.

3.3 | Statistical analysis

Exploratory data analysis was completed using SPSS version 26. Weights for the data were developed according to Statistics Canada Census Profile 2016 and applied to correct for any sampling deficiencies in age and gender within each region. The same approach was followed for both surveys. As data were not normally distributed, ranked-based nonparametric tests were used to determine differences between groups. As such, differences in medians were measured with Kruskal-Wallis H tests to determine significance between subgroups, age (18–23, 24–38, 39–53, 54–72, 73+), region (British Columbia; Prairies (Alberta, Saskatchewan, and Manitoba); Ontario; Quebec; Atlantic Provinces (New Brunswick, Prince Edward Island, Nova Scotia, and Newfoundland and Labrador); and Northern Territories (Yukon, Northwest Territories, and Nunavut)) income (<\$40,000, \$40,000–\$79,999, \$80,000–\$149,999, \$150,000+) and education (high school diploma, undergraduate degree, college

diploma, graduate degree or doctorate, other). To facilitate comparisons between time-points, all subgroups used in 2020 are identical to those used in 2019. A Mann–Whitney U-test was used to determine differences in scores by gender.

Two-way ANOVA was used to determine the interaction effect of Year and Gender across measures, where it was observed that male and female opinions appeared to be diverging on a number of issues. The main purpose of an ANOVA is to test if two or more groups differ from each other significantly in one or more characteristics. The use of ANOVA is predicated on the type of data we collected and requires a nominal or categorical scale for the independent variables – other multivariate tests (e.g. regression analysis) require a continuous-level scale. In this data, we collected categorical data therefore the ANOVA is appropriate. Where we tested using one-way ANOVA on one independent variable, and a two-way ANOVA with two variables. While rank-based nonparametric tests were preferred for the group comparisons, it was decided that this analysis could give a sufficient approximation of interaction effects, while avoiding the considerable complexity of nonparametric alternatives. A Spearman's Rank Order Correlation was performed to test for a correlation between price consciousness and increased plastics purchases, and between increased concern for food safety and increased plastics purchases.

4 | RESULTS

Findings of the two surveys present interesting results. This is likely the first study that we are aware of in Canada that seeks to measure the impact of COVID-19 on consumer's attitudes towards food

packaging. More importantly, however, this research looks beyond our present moment to better understand, generally, the question of how consumers view single-use plastics and how consumers respond to crisis situations. For this section, we first look at change in perceptions overall, then look at how the COVID-19 pandemic impacted perceptions. Finally, we present results related to food safety concerns and price consciousness.

4.1 | Measurements of change

A Mann–Whitney U test was used to compare median values between 2019 and 2020 for questions common to both data sets. Where a significant difference was found, the percentages of respondents selecting either 'somewhat agree' or 'strongly agree' were computed in order to produce an intuitive indicator of support for each statement (see Table 1, Figures 2-4).

4.2 | Impact of the COVID-19 pandemic

In addition to longitudinal measures based on the 2019 baseline, specific questions were added to the 2020 survey to query perceptions of the COVID-19 pandemic and its impacts. Aggregate measures are shown below (Table 2, and Figures 5-7).

For each question, a Kruskal–Wallis H Test was applied to measure differences in medians between demographic groups. Appendix A1 shows a full table of values; notable, selected results are displayed below.

TABLE 1 Year over year comparisons, 2019 versus 2020: Mann–Whitney U test comparisons of medians; percentage of responses selecting 'Strongly Agree' or 'Somewhat Agree'

Question	Mann–Whitney U	Test statistic	p (Asymp. Sig)	S/S agree, 2019	S/S agree, 2020
<i>Change in attitudes towards plastic packaging, year over year</i>					
'I consider environmental impacts caused by single-use plastic food packaging to be important'	554,024.5	554,024.5	.003	91%	87%
'I actively shop for non-plastic packaging goods while grocery shopping'	510,794.5	510,794.5	.46	58%	60%
<i>Change in attitudes towards plastics policies, year over year</i>					
'Regulations to reduce consumption of single-use plastic packaging for food should be strengthened in Canada'	576,847	576,847	<.001	90%	79%
'I am willing to pay more for an item containing biodegradable packaging'	427,624	427,624	<.001	40%	55%
'I would accept paying a government tax to disincentivize consumption of single-use plastic food packaging'	475,960	475,960	.005	33%	41%
'I support a ban of all single-use plastics used for food packaging'	682,944	682,944	<.001	72%	58%

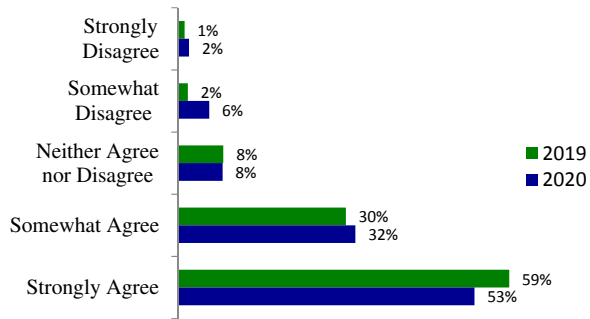


FIGURE 2 Comparison of Responses, 2019–2020: 'I am personally motivated to reduce the amount of single-use plastic food packaging because of its environmental impacts'

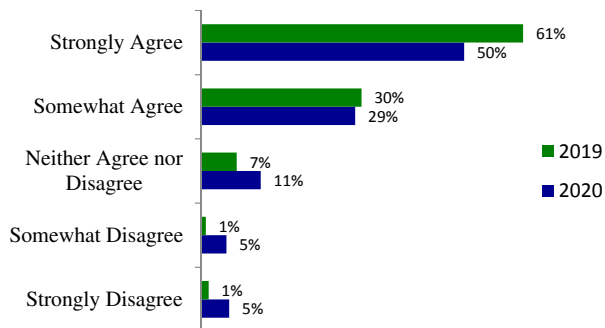


FIGURE 3 Comparison of Responses, 2019–2020: 'Regulations to reduce consumption of single-use plastic packaging for food should be strengthened in Canada'

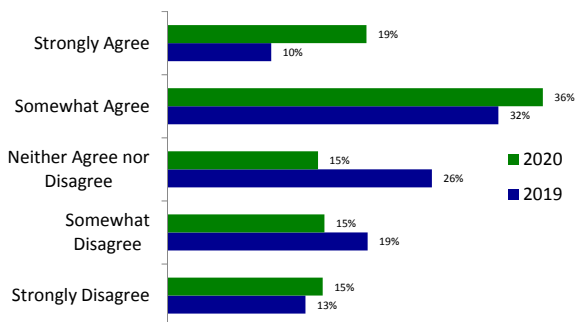


FIGURE 4 Comparison of Responses, 2019–2020: 'I am willing to pay more for an item containing biodegradable packaging'

4.3 | Importance of new safety concerns since the COVID-19 pandemic

For the Question 'Since the beginning of the COVID-19 pandemic, I have been more concerned about the safety of my food' we compared responses across regions:

A Kruskal–Wallis test was conducted to determine if there were differences in rates of increased food safety concern between regions. Distributions of scores were not similar for all groups,

as assessed by visual inspection of a boxplot. Scores were statistically significantly different between the different age groups, $\chi^2(5) = 19.140, p = .002$. Subsequently, pairwise comparisons were performed using Dunn's (1964) procedure with a Bonferroni correction for multiple comparisons. This post hoc analysis revealed statistically significant differences in scores between the regions Prairies (592.93) and Atlantic (460.87) ($p = .011$); Prairies (592.93) and Quebec (509.17) ($p = .038$); and Prairies (592.93) and Ontario (511.21) ($p < .001$); but not between any other pairs.

For the Question: 'How important are each of the following factors in influencing your decision of whether or not to purchase food items packaged in single-use plastics? – New safety concerns during the COVID-19 pandemic' we compared response between genders and across age groups:

A Mann–Whitney U test was run to determine if there were differences in the importance of new safety concerns between males and females. Distributions of scores for males and females were not similar, as assessed by visual inspection. Scores for males (mean rank = 480.32) were statistically significantly lower than for females (mean rank = 565.11), $U = 158,646, p < .001$.

A Kruskal–Wallis test was conducted to determine if there were differences in the importance of new safety concerns between age groups. Distributions of scores were not similar for all groups, as assessed by visual inspection of a boxplot. Scores were statistically significantly different between the different age groups, $\chi^2(4) = 36.816, p < .001$. Subsequently, pairwise comparisons were performed using Dunn's (1964) procedure with a Bonferroni correction for multiple comparisons. This post hoc analysis revealed statistically significant differences in scores between the age groups: 18–25 (421.77) and 74+ (584.32) ($p = .02$); 18–25 (421.77) and 55–73 (591.91) ($p < .001$); 26–39 (487.54) and 55–73 (591.91) ($p < .001$); and 40–54 (493.41) and 55–73 (591.91) ($p = .001$) but not between any other pairs.

4.4 | Increased price consciousness since COVID-19

For the Question 'Since the beginning of the COVID-19 pandemic, I have been more price conscious when shopping for groceries' we compare responses across Income groups and CERB receipt:

A Kruskal–Wallis test was conducted to determine if there were differences in increased price consciousness between income groups. Distributions of scores were similar for all groups, as assessed by visual inspection of a boxplot. Scores were statistically significantly different between the different age groups, $\chi^2(3) = 62.470, p < .001$. Subsequently, pairwise comparisons were performed using Dunn's (1964) procedure with a Bonferroni correction for multiple comparisons. This post hoc analysis revealed statistically significant differences in scores between all pairwise comparisons except for incomes less than \$39,999 and incomes \$40,000–\$79,999.

A Kruskal–Wallis test was conducted to determine if there were differences in rates of increased price conscious, between recipients

TABLE 2 2020 Survey questions: impacts of the COVID-19 pandemic (+/-3.2 percentage points, 19 times out of 20)

Question	Agree (%) (somewhat/strongly)	Neither agree nor disagree	Disagree (%) (somewhat/strongly)
'Since the beginning of the COVID-19 pandemic, I have been more concerned about the safety of my food'	55% (34/22)	22%	23% (13/10)
'Since the beginning of the COVID-19 pandemic, I have been more price conscious when shopping for groceries'	50% (29/21)	29%	20% (13/7)
'Since the beginning of the COVID-19 pandemic, I feel that I have purchased more foods packaged in single-use plastics'	30% (22/8)	54%	16% (13/4)
'I believe that any new regulations on single-use packaging in Canada should wait until after the COVID-19 pandemic is fully resolved'	52% (26/24)	20%	28%(17/12)
Respondents ranking of the importance of new safety concerns during COVID-19, to their decision to purchase plastics packaged foods	Very/Extremely Important 40% (21/19)	Moderately Important 18%	Not at All/Slightly Important 41% (16/25)
'Since the beginning of the COVID-19 pandemic, my trust in the ability of the Canadian food system to ensure the safety of my food is:'	Increased (Somewhat/Strongly) 22% (18/4)	Neither Increased nor Decreased 65%	Decreased (Somewhat/Slightly) 14% (12/2)

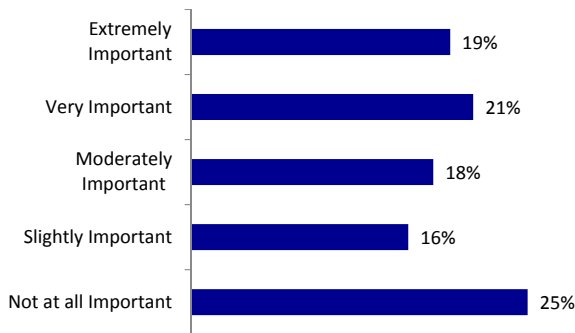


FIGURE 5 Respondents ranking of the importance of new safety concerns during COVID-19, to their decision to purchase plastics packaged foods

and non-recipients of CERB. Distributions of scores were not similar for all groups, as assessed by visual inspection of a boxplot. Scores were statistically significantly different between the different age groups, $\chi^2(e) = 14.590, p = .002$. Subsequently, pairwise comparisons were performed using Dunn's (1964) procedure with a Bonferroni correction for multiple comparisons. This post hoc analysis revealed statistically significant differences in scores between those receiving CERB (450.00) and those who had never received CERB (540.29) ($p = .007$) but not between any other pairs.

4.5 | Two-way ANOVA analysis: the interaction of year and gender variables

In several measures, it is observed that there is a divergence between male and female responses between 2019 and 2020. A

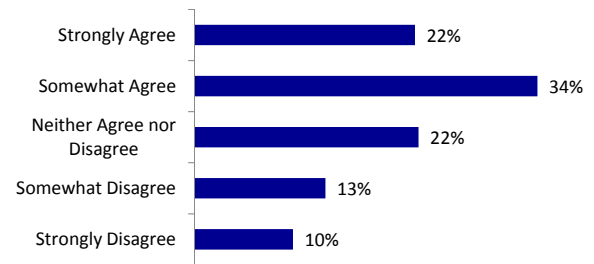


FIGURE 6 Responses to the 2020 Survey: 'Since the beginning of the COVID-19 pandemic, I have been more concerned about the safety of my food'

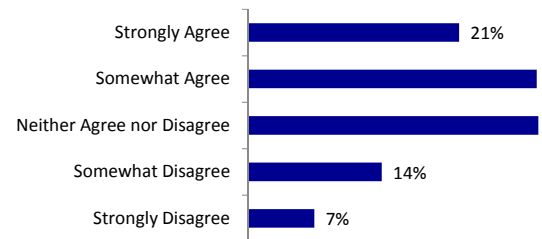


FIGURE 7 Responses to the 2020 Survey: 'Since the beginning of the COVID-19 pandemic, I have been more price conscious when shopping for groceries'

two-way ANOVA with interaction analysis was performed to observe the different trends in male and female opinion over the study period. Table 3 below displays values for interaction effects in repeated questions.

These results show that, while both men's and women's opinions changed from 2019 to 2020, they did not change to the same extent.

TABLE 3 Two-way ANOVA analysis of difference in difference: interaction of year and gender variables in selected measures

Question	F	Partial η^2	Difference in difference	p
'I consider environmental impacts caused by single-use plastic food packaging to be important'	6.365	0.003	-0.18 (95% CI, -0.32 to -0.04)	.012
'I am personally motivated to reduce the amount of single-use plastic food packaging because of its environmental impacts'	6.933	0.003	-0.208 (95%CI, -0.363 to -0.053)	.009
'Regulations to reduce consumption of single-use plastic packaging for food should be strengthened in Canada'	7.593	0.004	-0.0234 (95% CI, -0.401 to -0.068)	.006

Decline in environmental motivation is significantly greater among men than it is among women. Also, decline in support for tighter regulations is significantly greater among men than among women. Interestingly, in 2019, there was no statistical difference between men and women in either the environmental motivation measures or in attitudes towards regulations and bans. The divergence of opinion between genders, over the 2019–2020 period, has led to a significant gender difference that did not exist previously; men are now significantly less motivated to decrease plastics pollution, and also significantly less supportive of regulations and bans.

5 | DISCUSSION

Previous crises, such as outbreaks of BSE or the Fukushima meltdown, have led to measurable shifts in consumer behaviour away from affected goods (Aruga, 2017; Burton & Young, 1996; Ujiie, 2012; Wakamatsu & Miyata, 2017). In these examples, there is an identifiable product for consumers to avoid (i.e. Canadian beef, Fukushima seafood). The COVID-19 pandemic poses a different situation for consumers. Concern about the virus is pervasive but uncertain; it is not obvious what steps consumers should or will take in order to protect themselves. It is not even obvious whether there is a food safety crisis underway. Objectively there appears not to be a crisis, but these results suggest that there is a subjective crisis of food safety concern.

5.1 | Food safety motivation

Our survey data shows that 55% of respondents have been more concerned about food safety since the start of the COVID-19 pandemic (34% somewhat agree/22% strongly agree). This increase is as hypothesized. What was unknown was how this food safety concern would impact consumer attitudes towards plastics. We hypothesized that a possible reaction to food safety concerns might be an increase in purchases of plastic-packaged food, if consumers perceived plastic packaging as a potential barrier against the risk of infection.

Previous research has shown that trust in the food system is an important factor in mitigating the effects of a food safety scare (Charlebois et al., 2015; de Jonge et al., 2008; Verbeke, 2005). Even in the face of new food safety concerns, Canadian consumers have

demonstrated that they will maintain their habits if there is sufficient trust (Charlebois & Labrecque, 2007; Ding et al., 2013). This study finds that, for the majority of Canadians (65%), trust in the food system is unchanged by the COVID-19 pandemic. What's more, for those experiencing change, respondents were more likely to report an increase in trust than a decrease. This is an important finding in its own right, reflecting the considerable successes of both industry and government in maintaining confidence in the food system during a major crisis. Beyond that – and for the purposes of this study – it is an important mitigating factor in the impact of the pandemic on consumer attitudes and behaviour.

While trust in the food system remained strong, respondents were divided on the importance of COVID-19 concerns in their decisions of whether or not to purchase single-use plastic packaged foods. Asked to rate the importance of these new safety concerns, as a factor in the purchase decision, on a scale of 1–5 (Not at all Important, Slightly Important, Moderately Important, Very Important, Extremely Important), responses were polarized. As shown below, the least popular options were slightly or moderately important. One quarter of respondents felt that COVID-19 was not at all important to the plastics buying decision, but 40% of respondents felt that it was very or extremely important. Beyond these aggregate findings, there is significant variability between groups. Gender is an important factor (Mann–Whitney U Test: $Z = 158,646$, $p < .001$) with 47% of Females considering new safety concerns to be very or extremely important, compared to only 34% of men. There are also clear trends across number of children, income, and age, with few children, lower income, and older age all associated with a higher perceived importance of new safety concerns. This greater concern among older respondents would seem to reflect the greater danger from COVID-19 faced by these demographics.

5.2 | Economic motivation

Past research indicates that, during an economic crisis, consumers tend to become more price conscious (Hampson & McGoldrick, 2013, 2017; Steenkamp & Maydeu-Olivares, 2015). This shift is motivated both by financial necessity and also shifts in social norms (Hampson & McGoldrick, 2017). Our research supports this hypothesis, with 55% of Canadians reporting that they have become more price conscious shopping for groceries during the COVID-19 pandemic.

Support for this statement is notably higher among lower income groups, with 65% agreement among households earning less than \$40,000/year, compared to only 37% agreement among households earning over \$150,000/year. During the pandemic, the Government of Canada provided a benefit package (known as CERB) to those Canadians who had lost their jobs or were unable to work. We asked respondents whether they had received CERB, as a proxy measure to indicate those most economically affected by the pandemic (i.e. those receiving CERB are those who have lost their jobs and/or incomes). There is a clear correlation between receiving CERB and being more price conscious, with 59% of those who are or have received CERB indicating more price consciousness, versus 48% of those who did not receive CERB.

It was hypothesized that this increase in price consciousness would lead to a decrease in willingness to pay for biodegradable alternative packaging. This would be in keeping with prior findings that show a decreased willingness to pay for Fair Trade items during the 2008 Financial Crisis (Bondy & Talwar, 2011). In contrast, however, our findings show a notably increased willingness to pay for biodegradable alternatives in 2020 compared to 2019. Those who have received CERB are no less likely to be willing to pay more for biodegradable alternatives. This is in spite of a dramatic economic downturn and widespread unemployment.

Several possible explanations exist for this trend. First, it should be noted that there is a weak correlation, where increased price consciousness is associated with lower willingness to pay for alternative packaging (a Spearman's rank-order correlation to assess the relationship of these variables found a weak, negative relationship: $r_s(1,045) = -0.147, p < .0005$). It is, therefore, possible to say that the pandemic, and the related economic downturn, have tended to increase consumer price consciousness, and that this increased price consciousness is associated with a lower willingness to pay for biodegradable alternative packaging. However, this trend is not strong enough to produce an actual drop in the willingness to pay measure. Clearly, there are other factors that are having a stronger impact.

It is a limitation of this study, that the design does not support a claim of causation. It is possible to compare responses between 2019 and 2020, but it is not possible to say how much of those changes are directly attributable to the pandemic. Given the magnitude of the COVID-19 pandemic's impact, and the centrality of the pandemic to many Canadian's experiences of Winter 2020, it seems plausible to suggest COVID-19 is a likely explanation for a large change in opinion between Summer 2019 and Summer 2020. However, without the ability to reference a counter-factual, it is not possible to be definitive in ascribing causation. We remain open to the possibility that the increase in willingness to pay for biodegradable packaging is related to some other cause; for instance, an increase in awareness of plastics issues in 2019, or a longer-term trend in sentiment towards biodegradables (Walker et al., 2021).

Therefore, what is proposed is not a definitive model, but rather a potential explanation that incorporates Canadians' experiences with the pandemic. This explanation depends on another key finding from this study: while Canadians are more willing to pay

for biodegradable packaging, they are also less likely to support legislative bans or tighter regulations on single-use plastics packaging. This suggests another influence on willingness to pay, beyond the purely economic considerations. It may be that the decline in support for plastics bans is an indication of consumers' increased recognition of the value of packaging. If consumers perceive packaging as valuable, but remain mostly committed to reducing plastics use, it is reasonable that they would be increasingly interested in alternative packaging options. Packaging has always played a role in guaranteeing food safety, but Canadians may have a new appreciation of this role during the pandemic; coupled with this appreciation is the recognition that packaging may be something worth paying for.

5.3 | Shifts in attitudes

While a survey cannot directly measure behaviour, several questions measured respondents' perceptions of their purchasing habits. Between years there was no statistical change in the percentage of consumers who reported actively shopping for alternatives to plastic packaged goods. Furthermore, 54% of consumers reported no change in the amount of plastic-packaged foods that they were purchasing. That said, there were 29% of respondents reporting an increase in the amount of plastic-packaged foods that they purchase versus only 16% reporting a decrease. This suggests that there may be an overall increase in purchases of plastic-packaged goods, but it is confined to a fairly small portion of the market. Interestingly, in spite of the fact that older adults indicate more concern about COVID-19 safety, it is younger adults who are more likely to be purchasing greater amounts of plastic-packaged goods. This suggests a different mechanism than food safety concerns; potentially, this trend may be based on an increase in food delivery and take-out orders among younger demographics. In contrast, the trend for women to be buying more plastic-packaged goods is in line with increased food safety concern amongst women.

Recent studies have reported that the global COVID-19 pandemic has created an increased use of single-use plastic used for take-out and fast food and even reversal of some policies to ban plastic bags due to safety concerns (Prata et al., 2020; Silva, Prata, Walker, Campos, et al., 2020; Silva, Prata, Walker, Duarte, et al., 2020). For example, concerns over cross-contamination caused by reusable containers and bags have been raised, which led to withdrawals or postponements of single-use plastic bans and fees (Silva, Prata, Walker, Duarte, et al., 2020). Silva, Prata, Walker, Duarte, et al., (2020) reported that some governments have delayed SUP bans amid COVID-19 concerns (e.g. the province of Newfoundland and Labrador in Canada delayed implementing a ban for a short time, states of New York, Delaware, Maine and Oregon in the U.S., and Portugal), while others reintroduced single-use plastics and even banned the use of reusable alternatives (e.g. New Hampshire in the U.S.). Many of the recent changes in behaviour and reversal of government policies of increased single-use plastic use caused by

COVID-19 pandemic will need to be revisited by government policy makers, consumers and food retailers, post-COVID-19.

5.4 | Gender difference

An unexpected finding of this study is the divergence in opinion between genders, over the study's time span. Past studies have shown that women respond more strongly to food safety events (Nardi et al., 2020; Zingg et al., 2013). So it was not surprising to see women indicate higher levels of concern with food safety during COVID-19. Consistent with this trend, women were also more likely to indicate that they were purchasing more single-use plastics packaged food since the onset of the pandemic. Based on this, one would expect that it would be women who would reject tighter regulations or plastics bans, since they are the ones buying more plastic. But instead, it is men who are abandoning their support for more stringent regulations, while women's opinions are significantly less changed. The change in male opinion may be explained to some extent by the decline in environmental motivation among men (motivation to decrease plastics pollution is declined significantly more among men than among women from 2019 to 2020). But this begs the question of what can explain such a decline in males' environmental motivation. This study has proposed two mechanisms that might alter consumers' attitudes towards plastic packaging: food safety concerns, and price consciousness. Results show no difference between genders in price consciousness, and higher levels of food safety concern among women. Therefore, neither mechanism is capable of explaining why it is men who are rejecting a plastics ban.

This is an area worthy of further study, particularly given that the gender divide on this issue appears to be a new development; measures of environmental motivation were not significantly different in 2019, and neither was willingness to pay for biodegradable alternatives (Walker et al., 2021). Now in 2020, women were significantly more motivated by environmental concerns, and significantly more likely to be willing to pay for green packaging. Ketelsen et al., (2020) in their systematic review of consumer responses to green packaging, find ambiguous results regarding the role of gender: some studies show women more willing to pay for green packaging, others show men more willing to pay, and finally several studies show no gender effect. Our study sheds new light on this issue by showing a dynamic relationship between gender and attitudes towards plastic packaging. This result suggests that gender effects may not be generalisable across time periods, but are instead specific to a given time and place.

5.5 | Limitations

This study adds to a growing number of works that looks at the problem of plastic consumerism. Self-reported survey data is understood to have its limitations. The issue of social desirability bias is well documented, and several studies discuss the likelihood of

aspirational perceptions of self-behaviours (Hartley et al., 2015; Pahl & Wyles, 2017; Wyles et al., 2019). It is expected that the anonymous design of the survey and relatively non-sensitive nature of the questions will mitigate this issue. It is also understood that the study design is limited in its ability to ascribe causation. In addition, as we collected categorical and nominal data, we were unable to perform higher-level statistics on the data such as regression. With only two points of measurement (May 2019 and June 2020) and no possibility of a counter-factual, it is possible to measure changes but not possible to ascertain how much (if any) of those changes are directly resulting from the COVID-19 pandemic. Nevertheless, given the centrality of the COVID-19 pandemic to Canadian's experiences of Spring 2020, we feel that it is reasonable to interpret changes over the study's timespan as generally likely to be related to the pandemic.

6 | CONCLUSION

These results are notable both for what has changed between 2019 and 2020, and also for what has not changed. Measures of environmental motivation show that Canadian respondents remain strongly motivated to reduce single-use plastic use. COVID-19 has undermined this sentiment somewhat, but not overwhelmingly. In contrast, attitudes towards policy show more dramatic shifts. Major declines in support for tighter regulations and legislative bans, coupled with a growing willingness to pay for biodegradable alternatives, suggest that Canadians are changing their approach to the problem of single-use plastics. Where before, bans and regulations had represented near-consensus options, these policy instruments appear increasingly controversial. Given the increases in food safety concern, it may be that a significant portion of Canadians are increasingly recognising the value of packaging. While this shift is manifested in a hesitancy to ban plastics, it is also visible in the increased willingness to pay for biodegradable alternatives: recognising the value of packaging, but maintaining concern over the environmental impacts of plastics, consumers seek alternatives to achieve both safety and sustainability. One major practical implication from this study is for industry and to governments to proceed with extreme caution. Even though changes are seen as necessary by many, risk perceptions do change during a crisis which would merit some sensitivity. This is a finding with direct, real-world implications, implying increased room for market-based responses that aim to capitalize on the increased willingness to pay.

CONFLICT OF INTEREST

No authors have any conflicts of interest to report.

DATA AVAILABILITY STATEMENT

Data available on request from the authors.

ORCID

Robert Kitz  <https://orcid.org/0000-0003-4222-9244>

Sylvain Charlebois  <https://orcid.org/0000-0002-9400-0153>

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APPENDIX A1.

Kruskal–Wallis H Test, Groupwise Comparisons by Demographic Groups, 2020 Survey Questions

Z	Gender	p	Age	x2(4), Age	p, Age	Region	x2(5), Region	p, Region	Income	x2(3), Income	p, Income	Education	x2(4), Education	p, Education	Rural	x2(2), Rural	p, Rural	CERB	x2(3), CERB	p, CERB	Children	x2(3), Children	p, Children
Q: premium cost...																							
153,069		<.001		8.231	.083	5.516	5.516	.356	2.603	2.603	.457	9.582	9.582	.048	9.651	9.651	.008	1.662	1.662	.011	1.662	1.662	.645
New safety concerns																							
158,646		<.001		36.816	<.001	10.972	10.972	.052	14.593	14.593	.002	8.942	8.942	.063	10.762	10.762	.005	6.471	6.471	.091	15.018	15.018	.002
More concerned about food safety																							
122,455		.003		9.377	.052	19.14	19.14	.002	4.056	4.056	.255	9.446	9.446	.051	13.633	13.633	.001	5.034	5.034	.169	5.002	5.002	.172
Price conscious																							
128,130		.077		7.61	.107	12.14	12.14	.033	62.47	62.47	<.001	38.815	38.815	<.001	1.412	1.412	.494	14.59	14.59	.002	8.1	8.1	.044
I have purchased more foods packaged in SUP																							
23,259.5		.003		15.501	.004	7.193	7.193	.207	13.859	13.859	.003	20.934	20.934	<.001	7.034	7.034	.03	6.911	6.911	.075	3.002	3.002	.391
Regulations should wait																							
137,902		.768		24.27	<.001	8.222	8.222	.144	2.052	2.052	.562	18.938	18.938	.001	2.263	2.263	.323	3.9	3.9	.272	6.82	6.82	.078