

PEER-REVIEWED ARTICLE

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“I Walk around Like My Hands are Covered in Mud”: Food Safety and Hand Hygiene Behaviors of Canadians during the COVID-19 Pandemic

ABSTRACT

The coronavirus disease 2019 (COVID-19) pandemic has affected consumers' food handling behaviors. We conducted a qualitative research study to investigate how and why Canadians engaged in different food handling and hand hygiene behaviors at the onset of the COVID-19 pandemic. Online, text-based focus groups were conducted following a semistructured question guide in May and June 2020. A thematic analysis was conducted using the Theoretical Domains Framework as a coding guide. A total of 42 consumers participated across seven focus groups. The most notable changes in behaviors were seen in participants' hand washing, sanitation, and grocery shopping practices. Participants tended to perceive grocery store employees, shoppers, and foodservice staff as having inadequate sanitation precautions and therefore as a source of COVID-19 transmission risk. They heavily relied on public health, medical, and government officials as sources of information. Feelings of stress and anxiety appeared to be linked to certain sanitation behaviors. Many participants displayed a general apathy toward

routine food safety practices, such as safe food storage at home. This research supports the need for clear and concise messaging for safe food handling during the COVID-19 pandemic and in future times of crisis.

INTRODUCTION

Foodborne illness has a significant burden on morbidity and mortality in Canada. It is estimated that 4 million Canadians become ill because of foodborne illness annually, leading to more than 11,000 hospitalizations and more than 200 deaths (34). Furthermore, most cases of foodborne illness go undetected and are underreported (20). Foodborne illness results in a multitude of economic impacts leading to significant costs to the health care system (i.e., physician time and lab tests) and society because of lost productivity (22). The burden of foodborne illness on the health care system can be intensified during times of crisis when the system is already at or approaching capacity, such as during the coronavirus disease 2019 (COVID-19) pandemic (5). For example, some symptoms of common foodborne illnesses can overlap with those associated with COVID-19 (12). Previous Canadian

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studies have shown that consumers often do not engage in recommended safe food handling practices and behaviors at home, which can increase their risk of foodborne illness (23, 26). This is particularly noteworthy during the COVID-19 pandemic, because many restaurants were closed during its early stages, resulting in more cooking at home. As such, additional efforts are needed by consumers during pandemic situations to prevent foodborne illness and its severe consequences to help relieve stress on the health care system.

At the onset of the COVID-19 pandemic, media reports noted a trend among consumers of panic buying or stockpiling various household supplies and foods, including perishable items such as meat and poultry (36). This trend was also noted during prior emergencies, such as a 2015 snowstorm in New York City (38). This practice raises food safety concerns because of the need for adequate storage and refrigeration of these foods; for example, most perishable foods must be either frozen or consumed within 3 to 4 days to prevent potentially hazardous microbial growth (14). In addition, hand sanitizer shortages led to online promotion of homemade hand sanitizer recipes, which have limitations compared with traditional hand washing (7) and may not be effective if not prepared properly or if unvalidated recipes are used. Other potentially unsafe practices, including washing produce with soap, were also promoted online (10).

The COVID-19 pandemic presents an opportunity to investigate these issues among Canadians. Thus, we conducted an investigation using qualitative descriptive methods (25). The purpose of this study was to investigate how and why Canadians engaged in different food handling and hand hygiene behaviors during the current COVID-19 pandemic. Furthermore, the results of the study can help to identify future public health and food safety education, communication, and outreach needs in future times of crisis or emergency. The standards for reporting qualitative research guideline was followed during the preparation and reporting of this article (29).

MATERIALS AND METHODS

Study participants

Online, text-based focus groups were conducted with Canadian consumers meeting the following eligibility criteria: were living in Canada, were aged 18 or older, prepared meals at home at least once per week, and were able to participate in a text-based chat in English. The focus groups were conducted in May and June 2020. Participants were recruited via online postings on the Facebook “Focus Groups” group, the Reddit community *r/SampleSize*, *Kijiji.ca* (targeting the Canadian cities of Vancouver, Regina, Halifax, Toronto, and Edmonton), and through personal referrals. The recruitment notice directed participants to an online screening form. They were then required to complete this form to ensure they fulfilled eligibility criteria for study inclusion and to provide consent. We contacted eligible

participants via a follow-up email to provide details (i.e., date, time, and web-conferencing link) of the focus group. At the end of each focus group, participants were directed to a factsheet detailing best practices for shopping and handling groceries during the pandemic (28). Each participant was emailed a \$25 (CAD) e-gift card to an online retailer as a participation incentive. This study was approved by Ryerson University’s Research Ethics Board (REB 2020-152).

Data collection

Participants attended focus groups via the web-conferencing service Zoom (Zoom Video Communications, Inc., San Jose, CA). We used the waiting room and lock-meeting features to ensure meetings were secure. In addition, a unique meeting password was required to join each session. Focus groups were conducted using the chat function only, with audio and video functions turned off for moderators and participants. Focus groups followed a semistructured, flexible question guide that was adapted according to the answers provided. The questions were open ended and inquired about food preparation habits at home; food safety concerns (during and before COVID-19); food purchasing, handling, and storage behaviors; hand hygiene and sanitation practices; and information sources about food safety in relation to the COVID-19 pandemic. A copy of the screening form and question guide are provided as supplemental material.

Focus groups were scheduled to include five to eight participants each, lasting 1 to 2 h in duration (17). To identify possible age-based differences or trends in participants’ behaviors, we stratified focus group participation by age group, conducting separate groups for those aged 18 to 39 and those aged 40 or older. The sessions were recorded to ensure that transcripts of the text were available upon completion. The names used in this article are pseudonyms that have been randomly assigned to participants to maintain their confidentiality.

Data analysis

Thematic analysis was conducted on the focus group transcripts using the Theoretical Domains Framework as a coding guide (2). Each person who participated in a focus group was considered a separate unit of analysis. Once collected, the data were coded by two investigators (R. Haas and I. Young). Both investigators reviewed and coded the first transcript independently, and results were discussed and merged. Minor revisions were also made to the coding form. The remaining six transcripts were then independently coded by both investigators, and results were subsequently merged. The coding process entailed numerous readthroughs of the transcripts, identifying trends and patterns and inferring nuances such as emotion in the data.

The analysis was conducted using NVivo 12 qualitative analysis software (QSR International, Doncaster, Australia). Themes were developed, revised, refined, and named in an iterative process by grouping and evaluating the coded

segments and themes among participants with different categories of these characteristics (e.g., male versus female and aged 18 to 39 versus 40 or older). We also examined possible differences in discussion trends at the focus-group level between the sessions conducted with younger and those conducted with older participants. Two triangulation methods were used to enhance the credibility of the findings. The use of two data analysts during the coding process provided multiple perspectives on interpretation of the data (4). Member checking was also conducted, which included sending a summary of the results to each participant and asking for their feedback on our interpretation of the overall discussion themes (29).

RESULTS

Descriptive summary

Seven focus groups were conducted, ranging in size from two to eight participants ($n = 42$ participants total). Participant ages ranged from 19 to 76 years (mean = 35.5 years, standard deviation [SD] = 12.7 years). Their characteristics are shown in *Table 1*. Four of the focus groups consisted of participants aged 18 to 39 ($n = 27$), and three of the focus groups consisted of participants aged 40 or older ($n = 15$). Participants resided in the provinces of Ontario ($n = 33$), British Columbia ($n = 5$), Saskatchewan ($n = 3$), and Nova Scotia ($n = 1$). More participants identified as female ($n = 31$) than male ($n = 11$). Although results showed some age-related differences in behaviors discussed in the sanitation subtheme section below, we did identify not notable gender differences in participant discussion of the issues and themes. Member checking yielded feedback from one participant, who felt the results were accurately presented.

Four themes were generated from the coding framework: (1) hand hygiene, grocery shopping, and sanitation practices influenced by the COVID-19 pandemic; (2) the influence of others on one's pandemic experience; (3) emotion and awareness in connection to the pandemic; and (4) routine food safety practices not influenced by the COVID-19 pandemic. The first theme also consists of three subthemes: hand hygiene, grocery shopping, and sanitation and washing of produce. Illustrative quotes are used to substantiate the main findings within each theme and subtheme.

Hand hygiene, grocery shopping, and sanitation practices influenced by the COVID-19 pandemic

For hand hygiene, nearly all participants noted improvements in both their frequency and their rigor of hand washing. Changes in practices were most pronounced upon returning from outside the home:

Ella: Definitely hand washing more, and very conscious of "dirty" hands. Just feel odd touching anything in the house after going out without purel [sic] or washing with soap and water.

Austin: Wash my hands more than usual. I'm much more aware of it now.

Hand washing with soap and water was preferred to using hand sanitizer. Hand sanitizer was primarily used when outside the home (i.e., in the car):

Lana: I only use hand sanitizer when I'm outside the house. When I'm inside I wash if I can. It's an availability thing as Adrienne said—I prefer washing with soap and water if I can, and would rather avoid public washrooms.

TABLE 1. Descriptive characteristics of 42 focus group participants, May to June 2020, Canada

Characteristic	<i>n</i> (%)
Age (years)	
18–24	8 (19.0)
25–29	9 (21.4)
30–39	10 (23.8)
40–49	10 (23.8)
50+	5 (11.9)
Gender	
Female	31 (73.8)
Male	11 (26.2)
Province of Residence	
Ontario	33 (78.6)
British Columbia	5 (11.9)
Saskatchewan	3 (7.1)
Nova Scotia	1 (2.4)

Most people owned hand sanitizer before the onset of the pandemic. Several participants noted that quantities were scarce or that the cost had increased, but few reported attempting to make their own:

Ahmed: *Had some extra hand sanitizer at home before [the] pandemic. Finally finding a use for them.*

Austin: *Hard to find!*

Jayden: *The price is too high now.*

For grocery shopping, most participants reported reducing the frequency of trips to the grocery store. Consequently, they preferred buying higher quantities of foods during these shops to ensure there was enough to last until the next one:

Ahmed: *Also didn't want to go grocery shopping as much as it became a hassle and took much longer. Can't easily make a quick trip to the grocery store anymore. So bought extras for this reason.*

The types of food people purchased have also changed. Overall, participants purchased more frozen and canned food items, dry goods such as pasta, and, in some cases, prepackaged produce as participants believed that it would have been handled by fewer people and was therefore safer to eat:

Hannah: *I bought more canned goods (e.g., beans, corn, etc.), meat to freeze, pasta, frozen foods.*

Lana: *Not more food in general, but definitely buy more frozen food than before. It's nice to have stuff that won't go bad in case you can't make it to the grocery store, etc.*

There were various stockpiling behaviors among participants, ranging from next-to-no stockpiling to families that purchased several months' worth of food supplies. Often, the extent of stockpiling was influenced by available storage space at home:

Grayson: *Space in the fridge is of a concern for me and limits how much I can stockpile.*

Meera: *No as I do not have much space in my fridge/freezer.*

There have been notable changes in shopping behaviors within the grocery store. Participants reported exercising a greater degree of caution (e.g., less face touching and phone use); using gloves, masks, sanitary wipes, and/or disposable bags; physical distancing; and browsing more selectively:

Adrienne: *When I'm at the grocery store, I feel like everything around me is contaminated and I try to touch as little as I possibly can. I walk around like my hands are covered in mud until I get out of the store and can clean my hands properly (don't touch my face, don't touch my phone, etc.).*

Sanitation has been more frequent during the COVID-19 pandemic, with the intensity of people's rituals varying a great deal. Most participants reported making changes that included sanitizing food packaging and high-touch surfaces with disinfectant wipes. Some established more thorough routines that included step-by-step surface and item sanitation, as well as showering and changing clothes upon entering the house. Changes in practices were most pronounced upon returning from outside the home:

Aaliyah: *Nonperishables I keep in the car for a couple of days and perishables I bring inside as normal and put away as normal. No washing containers, etc.*

Danielle: *We use gloves and antiseptic towels.*

Angela: *At first I would wash my hands first then put on my kitchen gloves before putting groceries away. Didn't do anything special for the groceries put into the fridge except the mushrooms I would remove from the packaging and put into a paper bag. Then disinfect the handles on the fridge doors and other surfaces I touched. Disinfect the packaging for my dried beans before putting them away. Then disinfect the cupboard door handles and kitchen faucet, sink.*

For several participants, sanitation practices implemented early in the pandemic had become less strict as the pandemic progressed:

Ella: *At first we wiped down all packages with Lysol wipes before they entered the house, and a sink full of soapy water to wash all produce before we put it in the fridge. We did this for about a month, and now we don't do anything.*

There was a significant amount of misinformation reported in terms of washing produce. Participants reported washing their produce with liquid and dish soap, vinegar, and baking soda. Washing with soap was more commonly discussed among participants aged 40 and older. Many other participants only washed their produce in water. Some participants already routinely washed produce with substances in addition to the water before the COVID-19 pandemic:

Lucy: *I wash everything down before I put it away. I fill the sink with water and a small dab of liquid soap and wash all fruits and veggies, etc. and then wipe them dry.*

The influence of others on one's pandemic experience

Concerns over others' food handling practices were consistently expressed. This included worries about both grocery store staff and shoppers. Participants were also concerned that grocery store staff might not be taking proper sanitation precautions:

Sarah: *I wipe all my items down at the grocery store, and do self check out (because cashiers wear the same gloves for every customer) and wash produce before consumption.*

Austin: *Mostly [worried about] the packaging and who handles it (including the supplier, the grocery store worker, and whoever else might touch it at the store).*

The reported frequency of purchasing food delivery or takeout has either stayed the same or decreased during the pandemic. For delivery and takeout foods, participants were concerned about the risk of virus transmission from couriers and restaurant staff to food and packaging. These concerns centered around catching COVID-19, not foodborne illness:

Zoe: *I know it might sound a bit much but even when I order grocery or takeout delivery, I think about the person delivering my order and the possibility that they could have it and come into contact with my items.*

Julia: Maybe the foods packaging would also concern me. But the courier is the primary.

Nearly all participants indicated that they sought information from public health and government officials for COVID-19-related information, primarily through news on television, news outlet websites, and government websites. They also believed that public health and government officials were the most trustworthy sources for such information. However, in some instances, medical professionals who were known to the participants had provided inaccurate information or advice that the participant then followed:

Andre: Prime Minister, Premier largely because they are being advised by top medical health professionals.

Noah: I wash [produce] with soap. [Heard this recommendation] through a friend who is [a] Doctor.

Penelope: I like watching the news as it's interactive; but I also like reading information as I can reread things over.

There was some discussion over frustration with conflicting or unclear information and how this made participants unsure of what to believe or fostered a sense of distrust:

Ahmed: I don't think anyone is an expert at this situation. We may rely on health experts, but clearly they don't know what's going on either.

To some extent, there was an expression of wanting to support others and help keep them safe. This was articulated through desires to support local businesses, forgoing reusable bag use despite their preferences, limiting stockpiling behaviors, and reducing contact with food in grocery stores out of respect for staff and shoppers:

Zoe: I did buy way too much when it was first hitting the news that it was in Ontario.... But after that one grocery run, I bought everything in regular amounts (not overdoing it to give others a chance to get what they need).

Emotion and awareness in connection to the pandemic

Several participants indicated a lack of interest or concern over food safety before the pandemic but noted that the onset of COVID-19 had alerted them to such concerns:

April: For me, personally, I've never really thought twice about hygiene and my foods. COVID-19 has really changed that for me, I've always kind of been a "what doesn't kill me makes me stronger" type in regard to germs and now I [empty] boxes as soon as I get home.

There were a few instances in which shame or embarrassment were expressed in connection to some pandemic-related behaviors:

Hannah: I also (embarrassingly) stockpiled at the beginning of the pandemic.

Similarly, there was a sense of unease among some participants when they did not partake in certain behaviors, like cleaning food packaging:

Lyla: I think there's also a sense of panic and guilt if you're unable to Lysol everything?

Violet: Had concerns about food safety but read somewhere that restaurants practice good hygiene as a rule, so trying to

believe that. But handling all the containers is a little anxiety-inducing, to be honest.

Some participants noted that they were not seeking information related to food safety during the pandemic. In addition, some participants noted that they were not seeking pandemic-related information because of concerns over mental health:

Sophie: Haven't been watching or reading news for that.

Oliver: No reading of that, try to be happy all the time.

Some participants expressed a desire to continue some hygiene and sanitation practices they have developed since the onset of the COVID-19 pandemic, whereas others have indicated that they intend to return to their normal routines, because the heightened vigilance and caution causes stress:

Telisha: It definitely has made this concern stronger as in the future, even when restaurants do open up, I think I will be hesitant to dine out before preparing something at home.

Evelyn: I will likely keep up some of the COVID-19 lessons. Living with Sjogren's [syndrome] makes the common cold a pain. I feel more educated to keep myself healthy from this experience.

Penelope: Once COVID [sic] is over and there is a vaccine I will return to my old ways. This is way to[o] intense to keep up.

Isabelle: I am not a germaphobe either, I think if I overdo things it will end up being more stressful.

Routine food safety practices not influenced by the COVID-19 pandemic

There appears to be relatively little concern over food safety under regular circumstances. Many participants listed vague or nonspecific food concerns such as cross-contamination or food poisoning, and others reported no food safety concerns:

Lyla: I don't think I had many food safety and security concerns prior to the pandemic.

Sarah: I am not sure that I have one.

Nia: I would have to say cross-contamination.

Almost all participants mentioned using best-before dates as a means for ensuring their foods were still safe to eat. Participants also heavily relied on their own senses and intuition about the safety of their foods, citing smell, look, texture, and sometimes even taste for ways of determining whether food was safe to eat:

Julia: I determine its safe to eat by checking the expiration date if it has one. if its fresh produce I look for signs of ripeness versus rotting.

Madison: I smell the product and check the expiry date.

Ella: We're vegetarian so not often concerned about foods making us sick, unless they have gone mouldy.

Keisha: Sniff test.

There was a notable range in the length of time that fresh and/or preprepared meat and poultry, and leftovers, were kept in the fridge:

Andre: Fresh and ready to eat meat maybe like 3 to 4 days tops. Leftovers sometimes 1 week at most.

Theodora: [I] never keep raw meat in fridge.

Isaac: We don't keep leftovers overnight.

There was little concern over food storage practices beyond having sufficient space. Most participants did not use refrigerator or freezer thermometers and did not feel they were useful. Again, they relied on their capabilities and senses to determine whether the appliances were cold enough:

Fatima: Usually, you feel that the fridge/freezer is a certain temp. Obviously, if your fridge stops working you will feel it, so I don't think it's necessary to check temp every day. If my food is going bad I will know it's because of the fridge.

DISCUSSION

There have been both positive and negative new behaviors adopted by participants since the onset of the COVID-19 pandemic. The most notable positive change has been the increased frequency and rigor of hand washing. This behavior change suggests that public health messaging encouraging frequent hand washing has been communicated and understood by Canadians. Continued efforts are needed to promote the importance of regular hand washing in the future, because proper hand washing is effective in preventing the spread of many communicable diseases, in addition to COVID-19 and foodborne illness (1). Similarly, the additional caution exercised by participants when grocery shopping was a positive change. They appear to be diligent in heeding guidelines related to physical distancing and nonmedical mask use.

Conversely, excessive sanitation practices and washing produce in substances other than water alone are two of the recently adopted practices that may result in adverse health consequences. Sanitation practices such as disinfecting grocery packaging, doorknobs, keys, and changing clothes upon returning from outside are likely influenced by results from some early studies and related media attention, suggesting that virus particles can be recovered from fomites after several days (32, 35). However, more recent reports suggest that these studies are not reflective of real-life scenarios and that transmission risk from fomites has been exaggerated (11). Furthermore, of the viral particles recovered in these studies, it is likely that not all are infectious, which may mean that transmission risk is even less pronounced (18). As such, the extreme effort and caution that many participants reported exercising are unlikely to reciprocate benefits of a similar magnitude. Canadians who engage in such extreme sanitation behaviors may then be inadvertently and unnecessarily increasing their risk of other health issues such as stress and anxiety, as well as accidental poisonings. For example, Canadian poison control centers reported increases in calls associated with various household cleaners and disinfectants in 2020 compared with 2019, with peak year-over-year increases of 235% ($n = 258$ versus 77) for disinfectants and 138% ($n = 483$ versus 203) for bleach in April (37). Similar

spikes in such exposures were also reported to poison control centers across the United States, where during January to March 2020, there was a 20.4% increase in calls compared with January to March 2019 (6).

Similarly, the practice of washing produce with soap, vinegar, and/or other substances in addition to water may result in illness because of the ingestion of harmful chemicals or chemical residues (8). Some participants reported that they decided to wash their produce in soap by applying the principles of hand washing to produce washing (i.e., soap breaks down the virus). Others reported that they had heard this suggestion from health professionals. Receiving this type of information from health professionals appears to be common, as seen in an instance early in the pandemic in which a family doctor made this recommendation among others, such as suggesting the importance of extreme sanitation practices for groceries, in a widely viewed online viral video (10). It is evident that the lack of explicit information and guidelines surrounding the transmission of the virus from food and packaging, as well as how to handle these items, has played a role in these potentially harmful behaviors. Furthermore, because they are often viewed as reputable sources, it is crucial that health and medical professionals are equipped with accurate knowledge to help prevent the spread of potentially harmful misinformation. Some participants reported washing their produce with various chemicals before the onset of the COVID-19 pandemic, indicating additional communication may be needed on this issue in regular food safety messaging.

The apparent lack of understanding and apathy surrounding food safety and associated routine practices not related to the COVID-19 pandemic among participants is cause for concern. For example, our results indicated a heavy reliance on best-before dates and rules of thumb for determining whether frozen and refrigerated foods were safe to eat. However, both results from this study and previous surveys suggest that consumers often do not have a sufficient understanding of best-before dates, which apply only to unopened foods (16, 27). This lack of understanding may therefore result in increased instances of foodborne illness. Furthermore, the reported lack of concern and infrequent use of refrigerator and freezer thermometers is a concern, because *Listeria monocytogenes* can grow at refrigeration temperatures (3, 9). This is particularly worrying for older adults, who face an elevated risk of infection, and pregnant women, because listeriosis can result in fetal loss, preterm labor, neonatal sepsis, meningitis, and death (13, 33). Participants in the study also expressed a great deal of apprehension over catching COVID-19 and took precautions against this, yet they had few concerns over foodborne illness and the potential for infection within the home. These results indicate a need for enhanced education and messaging campaigns about domestic food safety, especially for high-risk population groups. In addition, one participant indicated that a lack of

concern about food safety due to being a vegetarian. Additional research should explore the food safety perceptions and behaviors of consumers following plant-based diets (e.g., vegetarians and vegans).

In pandemics or times of crisis, it is essential to have a clear and consistent source to provide information surrounding food safety and sanitation practices, including sanitation of food packaging, as well as washing of produce. A trusted, reliable source can help to reduce mixed messages and the resulting food safety behaviors linked to adverse health outcomes (19, 30). Effective risk communication about food safety in emergencies and times of crisis could help to limit the risk of illnesses, as well as reduce unnecessary behaviors (e.g., excessive cleaning) that can result in anxiety, mental fatigue, or accidental poisonings. For example, in the United States, information about COVID-19 and food safety risks and implications was communicated rapidly by university extension offices (21). In Canada, the role of food safety extension and outreach with consumers is primarily the responsibility of local, provincial, and federal government agencies. Our results suggest that public health officials such as local or provincial medical officers of health or the chief public health officer of Canada would be best positioned to conduct risk communication about food safety related to COVID-19 and in future times of crisis or emergencies. Possible platforms through which to communicate this information to a wide audience include television, government websites, and social media.

There are some limitations to this study. We used an online recruitment approach and the study had a small sample size; therefore, participants and their behaviors identified in this study may not reflect those of the broader Canadian population. Instead, the study highlights a range of insights and experiences of Canadians during the early stages of the COVID-19 pandemic. Only four Canadian provinces were represented among participants, with most residing in Ontario, and most participants were under the age of 40. It would be beneficial to examine these behaviors among Canadians in other provinces (e.g., with differing levels of pandemic impacts and control measures) and in more older adults to better compare food handling and hand hygiene behaviors by these factors. For example, we identified that older adults tended to discuss washing of produce in substances other than water more than younger adults, which may warrant investigation in a larger survey study. The small sample size may have limited our ability to identify other age- or gender-related differences or behavioral trends. We only captured information on participants' age, gender, and

location of residence; future studies could explore other sociodemographic factors (e.g., income and education) related to consumer safe food handling behaviors (31). It is likely that the online, text-based nature of the focus groups resulted in a shorter duration of each focus group. However, the content amassed in online, text-based focus group discussions has been found to result in comparable quality of data as in-person focus groups (15, 24). Finally, only one participant responded during the member checking process, and we were not able to confirm agreement of the other participants with our results interpretation.

Overall, participants have made several notable changes to their hand hygiene and food handling behaviors during the COVID-19 pandemic. The altered behaviors identified as being the most ubiquitous among participants were hand washing and sanitation practices, including washing of produce using substances other than water alone, as well as exercising greater caution when grocery shopping. However, other behaviors, such as the stockpiling of perishable foods and the creation of homemade hand sanitizers, were not found to be pervasive. In general, there is a need for better risk communication regarding food safety behaviors during the COVID-19 pandemic and future times of crisis, because concerns around mixed messaging were noted by participants and identified through the reported behaviors. This need for improved communication extends to routine food safety practices not influenced by the COVID-19 pandemic, because results have highlighted common behaviors that are cause for concern (e.g., sensory checks to determine the safety of perishable foods). It is vital to ensure that Canadians have access to trusted and reliable sources of information to inform their food safety and hand hygiene behaviors. Clear, consistent messaging and regular reminders are necessary to reinforce recommended behaviors. Findings from this study can be used to inform future research concerning the effectiveness of food safety and hand hygiene messaging both during and outside times of crisis.

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REFERENCES

1. Aiello, A. E., R. M. Coulborn, V. Perez, and E. L. Larson. 2008. Effect of hand hygiene on infectious disease risk in the community setting: a meta-analysis. *Am. J. Public Health* 98:1372–1381.
2. Atkins, L., J. Francis, R. Islam, D. O'Connor, A. Patey, N. Ivers, R. Foy, E. M. Duncan, H. Colquhoun, J. M. Grimshaw, R. Lawton, and S. Michie. 2017. A guide to using the Theoretical Domains Framework of behaviour change to investigate implementation problems. *Implement. Sci.* 12:77.
3. Borrusso, P. A. and J. J. Quinlan. 2017. Prevalence of pathogens and indicator organisms in home kitchens and correlation with unsafe food handling practices and conditions. *J. Food Prot.* 80:590–597.

4. Carter, N., D. Bryant-Lukosius, A. DiCenso, J. Blythe, and A. J. Neville. 2014. The use of triangulation in qualitative research. *Oncol. Nurs. Forum* 41:545–547.
5. Centers for Disease Control and Prevention COVID-19 Response Team. Severe outcomes among patients with coronavirus disease 2019 (COVID-19)—United States, February 12–March 16, 2020. *Morb. Mort. Wkly. Rep.* 69:343–346.
6. Chang, A., A. H. Schnall, R. Law, A. C. Bronstein, J. M. Marraffa, H. A. Spiller, H. L. Hays, A. R. Funk, M. Mercurio-Zappala, D. P. Calello, A. Aleguas, D. J. Borys, T. Boehmer, and E. Svendsen. 2020. Cleaning and disinfectant chemical exposures and temporal associations with COVID-19—National Poison Data System, United States, January 1, 2020–March 31, 2020. *Morb. Mort. Wkly. Rep.* 69:496–498.
7. de Aceituno, A. F., F. E. Bartz, D. W. Hodge, D. J. Shumaker, J. E. Grubb, J. W. Arbogast, J. Dávila-Aviña, F. Venegas, N. Heredia, S. García, and J. S. Leon. 2015. Ability of hand hygiene interventions using alcohol-based hand sanitizers and soap to reduce microbial load on farmworker hands soiled during harvest. *J. Food Prot.* 78:2024–2032.
8. De Pralormo, S., M. Brunet, A. Marquis, C. Bruneau, G. Le Roux, M. Deguigne, C. Bruneau, and E. Le Roux. 2019. Ingestion of bar soap may produce serious injury: clinical effects and risk factors. *Clin. Toxicol.* 57:356–361.
9. Dumitraşcu, L., A. I. Nicolau, C. Neagu, P. Didier, I. Măitre, C. Nguyen-The, S. E. Skuland, T. Mørsetrø, S. Langsrud, M. Truninger, P. Teixeira, V. Ferreira, L. Martens, and D. Borda. 2020. Time-temperature profiles and *Listeria monocytogenes* presence in refrigerators from households with vulnerable consumers. *Food Control* 111:107078.
10. Geggel, L. 2020. Viral video advises washing fruit and vegetables with soap. Here's why that's a bad idea. Available at: <https://www.livescience.com/do-not-wash-fruits-vegetables-with-soap.html>. Accessed 5 November 2020.
11. Goldman, E. 2020. Exaggerated risk of transmission of COVID-19 by fomites. *Lancet Infect. Dis.* 20:892–893.
12. Grant, M. C., L. Geoghegan, M. Arbyn, Z. Mohammed, L. McGuinness, E. L. Clarke, and R. G. Wade. 2020. The prevalence of symptoms in 24,410 adults infected by the novel coronavirus (SARS-CoV-2; COVID-19): a systematic review and meta-analysis of 148 studies from 9 countries. *PLoS One* 15:e0234765.
13. Health Canada. 2016. Risks of listeriosis (*Listeria*). Available at: <https://www.canada.ca/en/public-health/services/diseases/listeriosis/risk-listeriosis.html>. Accessed 5 November 2020.
14. Health Canada. 2019. Safe food handling tips. Available at: <https://www.canada.ca/en/health-canada/services/food-nutrition/food-safety/safe-food-handling-tips.html>. Accessed 5 November 2020.
15. Kite, J., and P. Phongsavan. 2017. Insights for conducting real-time focus groups online using a web conferencing service. *F1000Res.* 6:122.
16. Kosa, K. M., S. C. Cates, S. Karns, S. L. Godwin, and D. Chambers. 2007. Consumer knowledge and use of open dates: results of a web-based survey. *J. Food Prot.* 70:1213–1219.
17. Krueger, R. A., and M. A. Casey. 2015. Focus groups: a practical guide for applied research. Fifth Edition. SAGE Publications, New Delhi, India.
18. Lindsley, W. G., F. M. Blachere, R. E. Thewlis, A. Vishnu, K. A. Davis, G. Cao, J. E. Palmer, K. E. Clark, M. A. Fisher, R. Khakoo, and D. H. Beezhold. 2010. Measurements of airborne influenza virus in aerosol particles from human coughs. *PLoS One* 5:e15100.
19. Ma, J., B. Almanza, R. Ghiselli, M. Vorvoreanu, and S. Sydnor. 2017. Food safety information on the internet: consumer media preferences. *Food Prot. Trends* 37:247–255.
20. MacDougall, L., S. Majowicz, K. Doré, J. Flint, K. Thomas, S. Kovacs, and P. Sockett. 2008. Under-reporting of infectious gastrointestinal illness in British Columbia, Canada: who is counted in provincial communicable disease statistics? *Epidemiol. Infect.* 136:248–256.
21. Mahmoud, B. 2020. COVID-19 & food safety: the importance of research and extension in mitigating the negative impacts of COVID-19. Available at: <https://www.foodsafetymagazine.com/enewsletter/covid-19-food-safety-the-importance-of-research-and-extension-in-mitigating-the-negative-impacts-of-covid-19/>. Accessed 5 November 2020.
22. McLinden, T., J. M. Sargeant, M. K. Thomas, A. Papadopoulos, and A. Fazil. 2014. Component costs of foodborne illness: a scoping review. *BMC Public Health* 14:509.
23. Murray, R., S. Glass-Kaasta, C. Gardhouse, B. Marshall, N. Ciampa, K. Franklin, M. Hurst, M. K. Thomas, and A. Nesbitt. 2017. Canadian consumer food safety practices and knowledge: foodbook study. *J. Food Prot.* 80:1711–1718.
24. Namey, E., G. Guest, A. O'Regan, C. L. Godwin, J. Taylor, and A. Martinez. 2020. How does mode of qualitative data collection affect data and cost? Findings from a quasi-experimental study. *Field Methods* 32:58–74.
25. Neergaard, M. A., F. Olesen, R. S. Andersen, and J. Sondergaard. 2009. Qualitative description—the poor cousin of health research? *BMC Med. Res. Methodol.* 9:52.
26. Nesbitt, A., M. K. Thomas, B. Marshall, K. Snedeker, K. Meleta, B. Watson, and M. Bienefeld. 2014. Baseline for consumer food safety knowledge and behaviour in Canada. *Food Control* 38:157–173.
27. Newsome, R., C. G. Balestrini, M. D. Baum, J. Corby, W. Fisher, K. Goodburn, T. P. Labuza, G. Prince, H. S. Thesmar, and F. Yiannas. 2014. Applications and perceptions of date labeling of food. *Compr. Rev. Food Sci.* 13:745–769.
28. North Carolina State University. 2020. COVID-19 and food safety FAQ: shopping and handling groceries. Available at: https://foodsafety.ces.ncsu.edu/wp-content/uploads/2020/03/Handling-Groceries_COVID-19_Flyer.pdf. Accessed 5 November 2020.
29. O'Brien, B. C., I. B. Harris, T. J. Beckman, D. A. Reed, and D. A. Cook. 2014. Standards for reporting qualitative research: a synthesis of recommendations. *Acad. Med.* 89:1245–1251.
30. Overbey, K. N., L.-A. Jaykus, and B. J. Chapman. 2017. A systematic review of the use of social media for food safety risk communication. *J. Food Prot.* 80:1537–1549.
31. Patil, S. R., S. Cates, and R. Morales. 2005. Consumer food safety knowledge, practices, and demographic differences: findings from a meta-analysis. *J. Food Prot.* 68:1884–1894.
32. Rabenau, H. F., J. Cinatl, B. Morgenstern, G. Bauer, W. Preiser, and H. W. Doerr. 2005. Stability and inactivation of SARS coronavirus. *Med. Microbiol. Immunol.* 194:1–6.
33. Silk, B. J., B. E. Mahon, P. M. Griffin, L. Hannah Gould, R. V. Tauxe, S. M. Crim, K. A. Jackson, P. Gerner-Smidt, K. M. Herman, and O. L. Henao. 2013. Vital signs: *Listeria* illnesses, deaths, and outbreaks—United States, 2009–2011. *Morb. Mort. Wkly. Rep.* 62:448–452.
34. Thomas, M. K., R. Murray, L. Flockhart, K. Pintar, A. Fazil, A. Nesbitt, B. Marshall, J. Tataryn, and F. Pollari. 2015. Estimates of foodborne illness-related hospitalizations and deaths in Canada for 30 specified pathogens and unspecified agents. *Foodborne Pathog. Dis.* 12:820–827.
35. Van Doremalen, N., T. Bushmaker, D. H. Morris, M. G. Holbrook, A. Gamble, B. N. Williamson, A. Tamin, J. L. Harcourt, N. J. Thornburg, S. I. Gerber, J. O. Lloyd-Smith, E. De Wit, and V. J. Munster. 2020. Aerosol and surface stability of SARS-CoV-2 as compared with SARS-CoV-1. *N. Engl. J. Med.* 382:1564–1567.
36. Wiener-Bronner, D. 2020. Panic buying: how grocery stores restock shelves in the age of coronavirus. Available at: <https://www.cnn.com/2020/03/20/business/panic-buying-how-stores-restock-coronavirus/index.html>. Accessed 5 November 2020.
37. Yasseen III, A., D. Weiss, S. Remer, N. Dobbin, M. MacNeill, B. Bogeljic, D. Leong, V. Wan, L. Mosher, G. Bélair, M. Thompson, B. Button, J. Hardy, S. Perwaiz, A. Smith, and R. Wootton. 2021. Increases in exposure calls related to selected cleaners and disinfectants at the onset of the COVID-19 pandemic: data from Canadian poison centres. *Heal. Promot. Chronic Dis. Prev. Canada.* 41:25–29. <https://doi.org/10.24095/hpcdp.41.1.03>.
38. Zheng, R., B. Shou, and J. Yang. 2020. Supply disruption management under consumer panic buying and social learning effects. *Omega* 101:102238.

SUPPLEMENT

Focus Group Screening Form:

We are hosting a series of online, chat-based focus groups to investigate the food purchasing, handling, and hand hygiene behaviors of Canadians during the COVID-19 pandemic. To participate you need to be at least 18 years old, currently live in Canada, and prepare meals at home at least once a week. In addition, you should be able to respond to the chat in English and have a working internet connection.

Focus groups are scheduled for the following dates and times:

[insert dates/times]

If interested in participating in one of these focus groups, please fill out the form below.

The focus groups will be chat based (no video or audio), lasting 1 to 2 h. Participants will receive a \$25 gift card to your choice of Tim Horton's, Amazon.ca, or Chapters-Indigo. The study has been reviewed and approved by the Ryerson University Research Ethics Board (REB 2020-152). If you are interested in more information or have any questions, please contact us directly (see below).

Thank you for your time,

Drs. Ian Young, Richard Meldrum, and Fatih Sekercioglu

School of Occupational and Public Health, Ryerson University, Toronto, Canada

Contact information: email (iyoung@ryerson.ca) or phone (+1-416-979-5000 ext. 557614).

Form

Enter first name _____ Enter last name _____

Enter email address _____

Please enter your age _____

Please enter your gender _____

Do you prepare meals at home at least once per week: yes/no

Do you currently live in Canada: yes/no

Please enter your city/town of residence _____

Please select the focus group dates and times that you are available to attend: [checkbox option of available dates/times]

Submit—we will follow-up with you via email to confirm a focus group date and time.

Focus group guide

The purpose of this focus group is to determine the food purchasing, handling, and hygiene behaviors of Canadians during the COVID-19 pandemic. The questions are open ended, and there are no right or wrong answers. We will ask how and why you engaged in different food handling and hand hygiene behaviors. Insights and results from this study will help public health and food safety authorities to develop more effective education and communication strategies in future times of crisis or emergency. Does anyone have any questions before we begin?

Warm-up/introduction

1. What is your favorite type of meal to make at home?
2. How did your meal preparation and eating habits change during the COVID-19 pandemic?
3. What is your biggest food safety concern in Canada
 - a. How did this concern change, if at all, during the COVID-19 pandemic?

Part 1: food purchasing and handling behaviors

4. To what extent did you stockpile food from the grocery store during the COVID-19 pandemic?
 - a. What types of foods did you stockpile or purchase more of than usual?
 - b. What about meat, poultry, or other perishable products (e.g., dairy and eggs)?
5. During the COVID-19 pandemic, how did you handle and store food upon return from the grocery store?
 - a. If meat, poultry, or other perishables were stockpiled, how did you accommodate this food? Was there sufficient space in your refrigerator and freezer?
6. How do you determine that refrigerated and frozen foods in your home are still safe to eat?
 - a. How many days on average did you keep fresh or ready-to-eat meat and poultry in your refrigerator prior to cooking? How about leftovers?
 - b. Do you own or use refrigerator or freezer thermometers? Do you think they are useful or necessary?

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7. During the COVID-19 pandemic, how did you ensure that fruits and vegetables you purchased were safe to eat?
 - a. Did you wash or rinse your fruits and vegetables with water?
 - b. How about with soap? If so, where did you hear about this recommendation?

Part 2: hand hygiene and sanitation practices

8. How did your hand washing practices change during the COVID-19 pandemic?
 - a. How about specifically after returning from the grocery store?
 - b. How about specifically before and after preparing food?
9. How often did you use hand sanitizer during the COVID-19 pandemic? In what circumstances did you use hand sanitizer instead of hand washing?
 - a. How about specifically after returning from the grocery store?
 - b. How about specifically before and after preparing food?
10. Did you ever prepare or consider preparing your own hand sanitizer using homemade recipes?
 - a. If so, please explain where you obtained the recipe and your preparation process.
11. How did your household sanitation practices change during the COVID-19 pandemic?
 - a. How about specifically when shopping in the grocery store (e.g., when handling shopping carts or selecting food for purchase)?
 - b. How about specifically after returning from the grocery store (e.g., washing and sanitation of reusable grocery bags)?
 - c. How about specifically before and after preparing food (e.g., washing and sanitation of kitchen countertops and surfaces)?

Part 3: information sources

12. What was your primary source of information about safe food handling during the COVID-19 pandemic?
 - a. How did you verify the reliability of this or other sources of information?
13. What is your preferred way to receive future information about food safety during a pandemic such as COVID-19 or in another emergency situation?

Closing

14. Is there anything else you would like to tell us about your food handling or hand hygiene practices during the COVID-19 pandemic?
15. In your opinion, what is the most important point or issue that we discussed today?